



# LICENCE CONDITIONS FOR WIND GENERATORS FINAL DECISION

**May 2010**



## **Licence Conditions for Wind Generators – Final Decision**

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### **Public Information about Commission activities**

Information about the role and activities of the Commission, including copies of latest reports and submissions, can be found on the Commission website at [www.escosa.sa.gov.au](http://www.escosa.sa.gov.au).

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## GLOSSARY OF TERMS

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AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
COMMISSION	The Essential Services Commission of SA, established under the ESC Act
ELECTRICITY ACT	<i>Electricity Act 1996 (SA)</i>
E-RET	Expanded Renewable Energy Target
ESC ACT	<i>Essential Services Commission Act 2002 (SA)</i>
ESIPC	Electricity Supply Industry Planning Council
MW	Mega Watt
NEM	National Electricity Market
NEMMCO	National Electricity Market Management Company
NER	National Electricity Rules

# 1 INTRODUCTION

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Operators of electricity generating plant in South Australia are required to be licensed in accordance with the *Electricity Act 1996*. The Essential Services Commission of SA (Commission) is the entity responsible for the issuing of electricity generation licences.

The Commission's decisions as to whether or not to issue an electricity generation licence to an applicant for such a licence, as well as the conditions attached to such a licence, are guided by criteria specified in the *Electricity Act*, as well as the general objectives for the Commission specified in the *Essential Services Commission Act 2002* (ESC Act). In particular, section 6 of the ESC Act specifies that, in performing its functions, the Commission must have as its principal objective the protection of the long term interests of South Australian consumers of essential services with respect to the price, quality and reliability of such services. The ESC Act defines essential services to include electricity services.

The Commission is reviewing the special conditions attached to the licences of wind-powered electricity generators (wind generators). These conditions are special in the sense that they are additional to licence conditions applied to other types of electricity generators.<sup>1</sup>

The special conditions have applied to wind generation licences issued by the Commission since finalisation of the Commission's Wind Generation Licensing Statement of Principles in September 2005.<sup>2</sup> This paper sets out the Commission's final decision for the current review of those special licence conditions.

The review has taken place against a background of increasing national and state focus on climate change policies promoting the role of renewable energy in a sustainable, low carbon energy future.<sup>3</sup> These policies have already resulted in South Australia developing Australian and world leading wind generation capacity in just eight years since the Commission issued the first wind generation licence in this State. South Australia presently has the highest installed capacity of wind generation in Australia, and the highest contribution by wind energy to State electricity demand in Australia; the penetration of wind generation in this State is amongst the highest in the world.

The Commission's objective in undertaking this review of the special licence conditions for wind generators is the same objective which it applied in the development of the 2005 Statement of Principles; namely, that at all times the Commission must fulfil its statutory

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<sup>1</sup> The *Electricity Act* specifies (sections 21, 22) a set of mandatory licence conditions that must be included by the Commission in the licences of all electricity generators; the Commission's discretionary power to include additional licence conditions is provided for through the concurrent operation of sections 21(3) and 22(2) of the *Electricity Act*.

<sup>2</sup> The 2005 Statement of Principles and associated documents are available at <http://www.escosa.sa.gov.au/projects/17/2005-wind-generation-licensing.aspx>

<sup>3</sup> Climate Change policies include the Australian Government's proposed Carbon Pollution Reduction Scheme, and the 20% national Renewable Energy Target, and the South Australian Government's Tackling Climate Change – Greenhouse Strategy.



mandate in relation to protection of the long term interests of South Australian consumers with respect to the price, quality and reliability of electricity supply. The imperative of protecting the long term interests of consumers necessarily implies assessing and responding to current issues and conditions but also taking into account, insofar as is possible, likely future issues and conditions.

The Commission's focus, consistent with its primary statutory objective, is to apply a measured and cautious approach to the licensing of wind generators to ensure that the overall network is not adversely affected by the introduction of large volumes of wind generation and that during contingency events, security of the system is maintained and quality of supply is not impinged.

## **1.1 Statement of Principles 2005**

By late 2004, the Commission had licensed about 400 MW of wind generation and had before it eleven licence applications from wind farm proponents amounting to an additional 1,260 MW. In response to what was then considered to be an unprecedented interest in the development and operation of large scale wind generators across wide areas of South Australia the Commission undertook a lengthy review process which resulted in the development of the 2005 Wind Generation Licensing Statement of Principles.

The Statement of Principles was developed taking into account advice from the then Electricity Supply Industry Planning Council (ESIPC), as outlined in a detailed report<sup>4</sup>, that there was a significant risk to the ongoing security and reliability of the SA power system if the level of wind generation capacity connected to the power system were to increase beyond the then 450 MW which had been licensed. The ESIPC report to the Commission suggested that the maximum level of wind generation likely to eventuate in South Australia was 800 - 1,000 MW. In fact, the extensive studies and modelling undertaken by ESIPC at that time assumed a maximum level of 800 MW. The ESIPC report proposed means of managing those risks through the establishment of a regulatory environment in which the further expansion of wind generation could safely occur. The Commission sought stakeholder comment on the ESIPC report as part of its review.

In the Statement of Principles, the Commission concluded that, based on consideration of the impact of additional wind generation in South Australia on the achievement of the general objectives specified at section 6 of the ESC Act and the findings of the ESIPC report, the reliability and security of the South Australian power system was at significant risk in the absence of upgraded conditions for network connections, high quality wind forecasting, and proper market arrangements to integrate wind generators more fully into the National Electricity Market (NEM).

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<sup>4</sup> Available at <http://www.escosa.sa.gov.au/projects/17/2005-wind-generation-licensing.aspx>

The Commission formulated its final view in the 2005 Statement of Principles in the following terms:

***The view of the Commission, based on consideration of the impact of additional wind generation in South Australia on the achievement of the objectives specified in section 6(1) of the Essential Services Commission Act and the findings of the ESIPC Report is that:***

- ▲ the long term interests of South Australian consumers would be adversely affected in relation to reliability of electricity services by such a development, and that any off-setting benefits (eg those associated with enhanced competition in the generation sector) are minor; and***
- ▲ accordingly there are grounds for the Commission to reject each of the wind generation licence applications***

***unless***

- ▲ the main findings of the ESIPC Report are given effect in such a way as to bind the proponents of additional wind generation capacity in South Australia.***

Wind Generation Licensing Statement of Principles, Essential Services Commission of SA, September 2005

The Statement of Principles then set out the particular measures and licence conditions by which the Commission proposed, consistent with the ESIPC advice, to manage the reliability and system security risks posed by significant volumes of wind generation; thereby allowing wind generators to continue to be licensed in South Australia while still enabling the Commission to meet its legislative objectives.

In developing and finalising the Statement of Principles, the Commission expressed the view that it was preferable to address issues associated with the connection and operation of large volumes of intermittent electricity generation into the NEM through national, market-wide solutions rather than individual state based responses. The Commission undertook to review the licence conditions set out in the Statement of Principles when changes to the national arrangements and the National Electricity Rules (NER) to better integrate wind generation into the NEM had occurred.

## **1.2 Current Review**

The Commission acknowledges that, since the release of the Commission's Statement of Principles in September 2005, significant changes to the NER and to relevant arrangements under the NEM have been implemented which have the effect of better integrating wind generation into the NEM. These changes, discussed in sections 3 and 4 of this paper, are as follows:



- ▲ In 2007, the Australian Energy Market Commission (AEMC) amended the NER in the area of technical standards for wind generator and other generator connections;
- ▲ In 2008, the AEMC amended the NER, to establish a new “semi-scheduled” category of generation which provides for the participation of wind generators in the central dispatch processes of the NEM;
- ▲ An advanced wind forecasting system has been developed and implemented by the Australian Energy Market Operator (AEMO); and
- ▲ AEMO has amended the arrangements for recovering the cost of ancillary services in the market.

The Commission therefore determined in 2008 that it was appropriate to initiate a review of the special licence conditions introduced by the Commission in 2005. Consistent with the approach that the Commission took in the conduct of the review that led to the 2005 Statement of Principles, the key issue for the Commission in the current review is as follows:

***Are the NER amendments made since 2007, to better incorporate the peculiarities of intermittent generation such as to adequately address the risks to the South Australian power system identified in 2005, so that the Commission could conclude that achievement of its primary objective would not be endangered if the special licence conditions were no longer to apply to new licences issued to wind generators.***

The Commission’s current review of the wind generator licence conditions was initiated with the release of a Draft Proposals paper in December 2008. Having considered submissions received in response to the Draft Proposals paper, the Commission released a Draft Decision in June 2009. In July 2009 the Commission issued a Statement of Clarification concerning the proposed new licence condition relating to the ability of a wind farm to ride through disturbances following contingency events.

### **Role of Australian Energy Market Operator**

From its establishment in 2000 until 30 June 2009, ESIPC provided the Commission with technical advice and assistance in relation to wind generation and a wide range of other matters.

Prior to release of the Draft Proposals paper, the Commission sought the advice of ESIPC on the question of the adequacy of the NER amendments in addressing the risks to the South Australian power system associated with large amounts of wind generation. Similarly, the Commission sought the advice of ESIPC on the submissions made in response to the Draft Proposals paper.



In each of these cases, ESIPC concluded that the NER amendments would enable the licence conditions concerning central dispatch, wind forecasting and ancillary services to be removed. However, ESIPC concluded that NER amendments concerning technical standards associated with generator connection (fault ride-through and reactive power) were insufficient for South Australia; it therefore recommended that the Commission retain the special licence conditions in those areas (albeit that they should be re-expressed in terms that are more consistent with the NER).

From 1 July 2009, following amendments to the NER and associated gas market rules, ESIPC merged with the National Electricity Market Management Company (NEMMCO) and various other entities to form AEMO.

Pursuant to a requirement under the National Electricity Law,<sup>5</sup> AEMO provides technical advice and support on various aspects of the South Australian declared power system, on both an ongoing and as-needs basis, to the Commission and the South Australian Government. In completing this review the Commission has been informed by technical advice from AEMO.

### **This Paper**

The release of this Final Decision paper completes the Commission's second review of Wind Generation Licence Conditions in South Australia. In finalising its decision, the Commission has sought to respond to submissions received on the Draft Decision of June 2009 as clarified in July 2009.

Written submissions on the Draft Decision were received from:<sup>6</sup>

- ▲ ABB Australia Pty Ltd (ABB);
- ▲ AGL Energy Ltd (AGL);
- ▲ Babcock and Brown Power Ltd (BBP);
- ▲ Clean Energy Council (CEC);
- ▲ Infigen Energy Limited (Infigen);
- ▲ International Power Pty Ltd (IP);
- ▲ N.P. Power Pty Ltd (NP);
- ▲ Pacific Hydro Pty Ltd;
- ▲ TrustPower Australia Holdings Pty Ltd (TP); and

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<sup>5</sup> Refer section 50B of the National Electricity Law, which is a Schedule to the *National Electricity (South Australia) Act 1996*.

<sup>6</sup> The Draft Decision, Statement of Clarification, and Submissions received in response to the Draft Decision are available at <http://www.escosa.sa.gov.au/projects/15/2008-wind-generation-licensing.aspx>



- ▲ Vestas Australian Wind Technology Pty Ltd & Siemens Ltd & Suzlon Energy Australia Pty Ltd & Repower Australia Pty Ltd (VSSR) - joint submission.

The Commission requested AEMO, pursuant to its additional advisory functions for the South Australian declared power system, to review the submissions and to provide advice on the matters raised. AEMO's advice on this matter is attached to this Final Decision paper as Appendix 1.

Several submissions raised concerns with aspects of the Commission's Draft Decision concerning the technical standards licence conditions. These matters are dealt with in section 3 of this paper. The submissions expressed no disagreement with the Commission's Draft Decision on licence conditions relating to wind forecasting, optimized dispatch and ancillary services. These matters are dealt with in section 4 of this paper.

The paper stresses that the national arrangements in relation to wind generation in the NEM have been amended in some major respects since 2005. For example, the implementation of a new semi-scheduled classification for dispatch of intermittent generation in the NEM, with attendant wind forecasting and ancillary services requirements, is a substantial step to establishing a robust national framework for intermittent generation.

In relation to technical standards, however, while the AEMC reviewed and amended the technical standards for generator connection in 2007, the work was regarded as incomplete and, as outlined in section 3 of this paper, further reviews are planned.

As a result, the Commission remains of the view that it is necessary and prudent at this stage for it to continue to apply a measured and cautious approach to wind generation licensing in South Australia in order to meet the long term interests of South Australian consumers with respect to the quality and reliability of electricity supply.

## 2 WIND GENERATION IN SOUTH AUSTRALIA

### 2.1 Development of Wind Generation

At June 2009, South Australia had 3,641 MW of installed conventional electricity generation (fueled by coal, natural gas, and distillate)<sup>7</sup> and, at April 2010, licensed wind generation (refer Table 1) with total capacity of 1,155 MW, of which approximately 910 MW<sup>8</sup> is installed and operational.

*Table 1: Licensed wind generators (as at April 2010)*

Licensee	Wind Farm Name	Capacity (MW)	Date of Issue
AGL Hydro Partnership & Hallett Hill Pty Ltd	Hallett Hill	71	Mar 2008
AGL Hydro Partnership & Brown Hill North Pty Ltd	North Brown Hill	133	Dec 2009
Brown Hill Pty Ltd	Brown Hill	95	Mar 2006
Canunda Power Pty Ltd	Canunda	46	Oct 2004
Cathedral Rocks Wind Farm Pty Ltd	Cathedral Rocks	66	Oct 2004
Lake Bonney Windpower Pty Ltd	Lake Bonney Stage 1	80	July 2002
	Stage 2	160	Mar 2006
	Stage 3	40	Dec 2009
Mt Millar Wind Farm Pty Ltd	Mt Millar	70	Sept 2004
Pacific Hydro Clements Gap Pty Ltd	Clements Gap	58	June 2005
Snowtown Wind Farm Pty Ltd	Snowtown	99	Nov 2007
Starfish Hill Wind Farm Pty Ltd	Starfish Hill	35	Jan 2002
Waterloo Wind Farm Pty Ltd	Waterloo	111	Oct 2009
Wattle Point Wind Farm Pty Ltd & AGL Hydro Partnership	Wattle Point	91	Apr 2004
<b>TOTAL</b>		<b>1,155</b>	

It is noteworthy that prior to the issue of the Commission's Statement of Licensing Principles in September 2005, the Commission had issued six electricity generation licences to wind generators, with a total installed capacity of 445 MW; since that time, the Commission has issued a further six such licences, and twice varied (by adding capacity) the Lake Bonney Windpower licence, to add a further 710 MW to the installed capacity of licensed wind generators.

South Australia has the highest installed capacity of wind generation in Australia, together with the highest proportional contribution by wind energy to State electricity demand in Australia. The Commission presently has before it one wind generation licence

<sup>7</sup> Details of all South Australian electricity generation plant and capacities can be found in Electricity Supply Industry Planning Council – Annual Planning Report June 2009 <http://www.aemo.com.au/planning/e400-0003.pdf>

<sup>8</sup> The North Brown Hill and Waterloo wind farms are both under construction and are anticipated to become operational during 2010/11.

application for plant with capacity of 130 MW,<sup>9</sup> which brings the potential licensed capacity in South Australia by end 2010 to almost 1300 MW. The Commission is also aware (refer Table 2 below) of additional proposals which may lead to wind generation licence applications in the near future.

It is relevant to note that the peak demand in South Australia was 3,413 MW in 2008/09, while the minimum load is approximately 1,100 MW.<sup>10</sup> The licensed capacity of wind generation in South Australia (1,155 MW) thus now exceeds the State's minimum load, and the installed and operational wind generation (910MW) is nearing the State's minimum load.

In its 2009 Annual Planning Review ESIPC made the following observations about the outlook for renewable energy in South Australia:<sup>11</sup>

- ▲ *The share of total as generated energy supplied by wind farms is projected to rise from 14% in 2008-09 to 15.7% in 2009-10 and reach 34.1% by 2018-19.*
- ▲ *Generation supplied by conventional scheduled thermal generators, including imports, is projected to fall from 85.5% in 2008-09 to 63.2% by 2018-19.*

Table 2 provides details of South Australian wind generation proposals classified by AEMO at June 2009 as being advanced or publicly announced (i.e. not yet committed).<sup>12</sup>

**Table 2: Proposed Semi-Scheduled Projects - classified as advanced proposals or publicly announced projects**

Proponent	Generation Plant	Capacity (MW)	Commissioning date
Acciona Energy	Allendale East	71	June 2015
AGL Energy	Hallett III (Mt Bryan)	90	Oct 2011
AGL Energy	Hallett V (The Bluff)	52	unknown
International Power	Willogoleche	50	unknown
NP Power	Lincoln Gap	118	June 2011
Pacific Hydro Pty Ltd	Carmodies Hill	140	unknown
Transfield	Kulpara Wind Farm	109	2018
Transfield	Mt Hill	80	Dec 2019
Trust Power	Snowtown Stage 2	206	2011
<b>TOTAL</b>		<b>916</b>	

<sup>9</sup> Application from Barn Hill Wind Farm Pty Ltd for generation plant in the Barunga Ranges with capacity 130 MW; if licensed, this wind farm is expected to be operational by end-2011.

<sup>10</sup> Details of South Australian electricity demand can be found in Electricity Supply Industry Planning Council – Annual Planning Report June 2009 <http://www.aemo.com.au/planning/e400-0003.pdf>

<sup>11</sup> Electricity Supply Industry Planning Council – Annual Planning Report June 2009 <http://www.aemo.com.au/planning/e400-0003.pdf> at page 32.

<sup>12</sup> Refer AEMO Electricity Statement of Opportunities 2009 Chapter 4 <http://www.aemo.com.au/planning/0410-0007.pdf>. Updated information is also available at [http://www.aemo.com.au/data/gendata\\_prop.shtml](http://www.aemo.com.au/data/gendata_prop.shtml).

The box below summarises key statistics regarding the current status of wind generation development in South Australia as well as projected developments in the period to 2020.

**April 2010**

***South Australia has 1,155 MW of licensed wind generation, with a further licence application (130 MW) pending.***

***South Australia has the highest installed capacity of wind generation in Australia.***

***South Australia has the highest contribution by wind energy to State electricity demand in Australia – 910 MW relative to a minimum demand of 1,100 MW and a peak demand of 3,413 MW.***

***South Australia currently has one of the highest penetrations of wind generation with respect to installed capacity world wide – 910 MW of operating wind generation and 3,641 MW conventional generation.***

**Anticipated: 2010-2020**

***By end 2010 - it is expected that there will almost 1,300 MW operating wind generation. At this point, South Australia could have the highest relative contribution from wind generation to customer sales in the world.***

***By 2020 – based on current information and projections it is expected that South Australia will have at least 2,200 MW of wind generation.***

## **2.2 Current Licence Requirements**

As noted previously, the licensing principles for wind generators established in the Commission's Statement of Principles in 2005 and presently applied by the Commission are special in the sense that they are additional to the general licence requirements for conventional generators and other electricity entities. In summary form, the principles are as follows:

### **Quality of electricity supply**

A wind generator licence applicant must provide evidence to the Commission that a connection agreement between the proposed wind generator and the relevant network service provider has been executed or fully negotiated. This will satisfy the Commission that the proposed generating plant is capable of generating electricity of appropriate quality for the relevant network.<sup>13</sup>

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<sup>13</sup> Refer Electricity Act, section 17(2)(b).

## **Special licence conditions**

Licence conditions imposed on wind generators, in addition to the standard generator licence conditions, relate to the following matters:

### **Technical Standards**

- ▲ Wind generators with nameplate rating  $\geq 5$  MW are subject to more onerous technical standards than those prescribed by the NER in the areas of fault ride through capability and reactive power capability (refer section 3 of this paper for more detail regarding these licence conditions).
- ▲ Wind generators with nameplate rating  $\geq 5$  MW must meet NEMMCO requirements regarding data on active and reactive power and be capable of remote control by NEMMCO; the generating plant must meet such requirements for at least 3 hours following loss of supply.

### **Optimized Dispatch**

- ▲ Wind generators with nameplate rating  $\geq 30$  MW are required to be classified as scheduled generators in the NEM and to provide forecasts of expected generation output to AEMO.<sup>14</sup>

### **Wind Forecasting**

- ▲ Wind generators with a nameplate rating  $\geq 5$  MW must provide wind forecasting data and models and cooperate with the development and implementation of national wind forecasting systems.

### **Ancillary services**

- ▲ Wind generators with a nameplate rating  $\geq 5$  MW must register as market generators,<sup>15</sup> install appropriate metering and pay for ancillary services on the same “causer pays” basis as other generators.

## **Compliance with special licence conditions**

A wind generator licence applicant must certify in writing to the Commission that the generation plant and associated equipment that is the subject of the licence application will be operated to comply in all respects with applicable licence conditions as enunciated in the Statement of Principles. Necessary details and evidence must be provided where relevant as to the manner in which the proposed

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<sup>14</sup> The licence condition in fact imposed an obligation on the licensee not to seek to be classified by NEMMCO as a non-scheduled generator.

<sup>15</sup> A market generating unit is one for which the generation output is not purchased in its entirety by the “local retailer” as defined in the NER (the local retailer for SA is AGL SA Pty Ltd) or by a market customer located at the same connection point. A market generator is required to sell its generation output through the wholesale market operated by AEMO under the provisions of the NER, Chapter 3. Importantly, as a market generator is part of market settlements, it is part of the recovery for ancillary services.

generation plant and associated equipment at the connection point will be able to comply with the licence conditions (usually this involves the provision of technical studies to the Commission which are evaluated by AEMO).

**Condition precedent to issue of any licence type**

In accordance with the Electricity Act, a licence of any type cannot be issued until the relevant licence fee is paid.<sup>16</sup> The Commission gives all licence applicants 60 days from the date on which the issue of a licence is approved to pay the fee.

If the fee is not paid within 60 days of the Commission's decision, approval for the issue of the licence lapses. If the approval lapses, the applicant must re-submit the application and the Commission reserves the right to undertake a further round of public consultation and to request further advice from AEMO. Further advice is especially important if other generators have also been licensed to operate in the same general area of the network as the licence applicant.

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<sup>16</sup> Refer Electricity Act, section 20(1).

## 3 TECHNICAL STANDARDS

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This section contains the Commission's final decision concerning its review of each of the current special licence conditions for wind generators dealing with technical standards.

### 3.1 *Current Arrangements*

A key aspect of the Commission's special licence conditions has been the requirement that wind generators meet specified technical standards in order to connect to the South Australian transmission or distribution network.

In its 2005 Statement of Principles, the Commission concluded that, in order to fulfil its statutory mandate to protect the long term interests of South Australian consumers with respect to the reliability of electricity supply and in view of the anticipated high levels of wind generation in South Australia, it would be unable to issue any further licences to wind generators unless special technical standards were imposed on future wind generators.

In particular, the Commission determined that wind generators should have the ability to ride through a prescriptive and more severe low voltage event than is usually negotiated in connection agreements; to smooth short term fluctuations in output; to generate and absorb reactive power and control voltage; and to be remotely controlled and be able to curtail output where necessary.

#### **Fault Ride Through**

In order to sustain the anticipated high levels of wind generation on the South Australian network, a robust approach to fault ride through capability was considered necessary. The ability of generators to remain connected to the system through a fault was regarded as essential to prevent cascading failures. Cascading failures may occur where a system fault or the loss of one generator leads to further generators tripping off and making the situation worse.

The Commission's view was that a standard higher than the minimum which could otherwise be negotiated by the wind generator proponent and the network service provider under the NER was required to ensure appropriate reliability and system security of the South Australian power system.

#### **Reactive Power**

As the minimum reactive power that a generator must offer to the power system under the NER (as at 2005) was very limited, the Commission determined that wind generators should be required to have reactive power capabilities greater than the minimum standard, so that:

- ▲ a contribution could be made to local voltage control during and immediately after a fault; and



- ▲ the impact of further wind generators on the power system would be minimised, thereby deferring the time at which voltage control might become an issue.

The requirements imposed by the licence conditions were less onerous than the automatic access standard under the NER, but were considered by the Commission to be appropriate to ensure voltages on the network could be managed and voltage stability maintained.

The box below lists the principles underlying the current special licence conditions (which have applied to all new wind generation licences issued by the Commission since September 2005) concerning the technical standards relating to fault ride through and reactive power capability.<sup>17</sup> To supplement these licence conditions, the Commission also specified that it would be necessary for the generating plant to have the necessary capability to provide real time data regarding active and reactive power to NEMMCO and to be controllable by NEMMCO, and that such capabilities should be maintained even in the event of loss of supply to the connection point.

Principles Underlying the Technical Standards Licence Conditions included in Wind Generation Licences issued since September 2005

**FAULT RIDE THROUGH CAPABILITY**

**1. Each generating unit of the electricity generating plant operated by the licensee must be capable of continuous uninterrupted operation during the occurrence of a normal voltage fluctuation caused by a transmission network fault involving a single phase or two phase to ground condition with a loading level after the fault is cleared that is at, or reasonably about, the loading level immediately prior to the fault.**

**2. For the purposes of clause 1, normal voltage fluctuation means voltage remaining within a band for 3 minutes, 10 seconds and 175 milliseconds following a fault, with the band having:**

- **an upper boundary of 110% of nominal voltage at all times; and**
- **a lower boundary of 0% of nominal voltage for the first 175 milliseconds during the fault, 80% of nominal voltage for the first 10 seconds after the fault is cleared and 90% of nominal voltage for the next 3 minutes.**

**REACTIVE POWER CAPABILITY**

**1. At full rated power output the electricity generating plant operated by the licensee must be capable of:**

<sup>17</sup> Actual licence conditions are available from the Commission's website at <http://www.escosa.sa.gov.au/electricity-overview/licensing/generation-wind-generation-licences.aspx#T36>.

- *absorbing reactive power of 0.395 times that power output; and*
- *delivering reactive power of 0.395 times that power output.*
- 2. *At generation levels below full rated output the electricity generating plant operated by the licensee must be capable of:*
  - *absorbing reactive power at a level at least pro-rata to that of full output; and*
  - *delivering reactive power at a level at least pro-rata to that of full output.*
- 3. *The electricity generating plant operated by the licensee must at all times be capable of providing:*
  - *at least 50 percent of the reactive power capabilities referred to in clause 1 and clause 2 on a dynamically variable basis; and*
  - *the balance of any reactive power capability referred to in clause 1 and clause 2 not supplied dynamically on a static basis.*
- 4. *The reactive power capability of the electricity generating plant operated by the licensee must be capable of control by a fast-acting, continuously variable, voltage control system which is able to receive a voltage set point.*
- 5. *The electricity generating plant operated by the licensee must be capable of operating to a power factor set by the network service provider from time to time.*

### **3.2 Changes to the NER since 2005**

In February 2006, NEMMCO proposed changes to generator technical standards in the NER to the AEMC. The AEMC completed its consideration of these proposed changes in March 2007.<sup>18</sup> The NER changes adopted by the AEMC implemented various changes to the technical standards applying to connecting generators and particularly to the application of those standards to wind generators, including adoption of a tighter definition of the term “continuous uninterrupted operation”, and the introduction of the consideration of impacts on reliability of the system as a result of connection.

This work was, however, recognised as incomplete and following the AEMC’s review and amendment of the technical standards for generator connection in 2007, in February 2008, the AEMC requested the Reliability Panel to review the technical standards and to identify:

- ▲ the principles that should be applied in revising the technical standards; and

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<sup>18</sup> Refer <http://www.aemc.gov.au/electricity.php?r=20060324.143345>.

- ▲ processes for implementing the recommended changes to the technical standards, including Rule changes.

The Reliability Panel Final Report was completed in April 2009.<sup>19</sup> A subsequent review (the “Comprehensive Review of Technical Standards”) is to review the individual technical standards, including the levels of each individual technical standard and clause drafting, based on the Principles developed in the April 2009 review. That further review is yet to commence.

### **3.3 Draft Decision**

The Commission’s Draft Decision in the current review of wind generator licence conditions, released in June 2009, was informed by up-dated advice from ESIPC (attached to the Draft Decision), which took account of the changes in the NER since 2005 and the submissions received on the Proposals Paper.

The Commission observed that it is very difficult to develop appropriate national rules for the connection of wind generation across the NEM, given that such rules must apply across Australia and each jurisdiction has vastly differing amounts of wind generation relative to total generation. South Australia has a high penetration of wind generation, while in Queensland and New South Wales the relative contributions of wind generation to total electricity generation output is at a comparatively small level.

ESIPC’s advice to the Commission was that, despite changes to the NER since 2005, the NER do not yet deal adequately both in the manner of treatment of reactive power, and in provisions relevant to generator access arrangements as they affect network congestion, at least for the South Australian network.

Each of these issues remains important in the context of South Australia’s growth in wind generation capacity and in the number of applicants seeking connection. ESIPC recommended that the Commission continue to impose South Australian specific technical standards in licence conditions.

The Draft Decision noted that the primary issue for the Commission remains that the NER allow applicants seeking to connect to the system to negotiate technical standards within a range. The lower limit, below which connection must not be allowed, is referred to as the *minimum access standard* and the upper limit at which connection is allowed without negotiation is the *automatic access standard*. In several cases, the criteria for any *negotiated access standard* between these levels are also outlined. The outcome of any negotiation can be to the bottom of the range.

While the majority of the technical standards set out in the NER are satisfactory for wind and other generators seeking to connect in South Australia, the Commission in formulating the Draft Decision took the view that those technical standards in the NER

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<sup>19</sup> Refer <http://www.aemc.gov.au/Media/docs/Reliability%20Panel%20Technical%20Standards%20Review%20-%20Final%20Report-2bed0aa1-39fa-4b85-85c3-9c7f67c35412-0.pdf>.

which apply to wind generators and which are necessary for network and system reliability were insufficient for the South Australian network.

For these standards, the Commission's Draft Decision was to continue to impose (by licence condition) specific standards which are higher than the minimum access standard. Under that approach, while proponents remain able to negotiate with the relevant network service provider for a standard which is lower than that imposed by licence (for example, at the minimum access standard), to operate at that standard rather than the Commission's licensing standard would result in a breach of licence condition, with associated penalties (which may extend to suspension or cancellation of licence). It is therefore incumbent on the prudent generator to be mindful of the South Australian specific licensing requirements when undertaking the connection negotiation process under the NER.

In the Draft Decision, the Commission concluded that, given the large volume of wind generation in operation, in development and in planning in South Australia, higher technical standards for fault ride through and reactive power capability should continue to be applied by the Commission through licence conditions, and this need remains despite changes to the NER.

The Draft Decision of the Commission was that the intent of the current requirements in relation to fault ride-through should remain but should be restated and updated to incorporate the national changes and to improve clarity.

The box below lists the principles underlying the amended licence conditions as proposed in the Draft Decision concerning the technical standards relating to fault ride through and reactive power capability. The proposed licence conditions were framed to achieve greater consistency with the NER.

Principles Underlying the Technical Standards Licence Conditions proposed for inclusion in Wind Generation Licences (Commission Draft Decision, June 2009)

***FAULT RIDE-THROUGH CAPABILITY***

***Each electricity generating unit of the electricity generating plant operated by the licensee must comply with:***

- ***NER S5.2.5.5 Generating system response to disturbances following contingency events -automatic access standard; and***
- ***NER S5.2.5.4 Generating system response to voltage disturbances – Automatic access standard except that generators may seek to negotiate compliance with clause S5.2.5.4 (a)(1) (the ability to ride through voltages in excess of 110 %) provided the Network Service Provider agrees that there would be no material adverse impact on the quality of supply to other Network Users or power system security.***

**REACTIVE POWER CAPABILITY**

*The generating plant operated by the licensee must at all times be capable of continuous operation at a power factor of between 0.93 leading and 0.93 lagging at the connection point at real power outputs exceeding 5MW.*

*At least 50% of the reactive power required to meet the above power factors must be dynamically variable, with the balance able to be provided by non dynamic plant. For the purposes of this requirement, dynamically variable means continuous modulation of the reactive power output over its range, with an initial response time of less than 200 msecs and a speed of response such that 95% of the steady state reactive power response is achieved within 1 second. The two second short term overload capability of dynamic plant may be used to fulfil the 50% dynamically variable requirement provided compliance to the other technical requirements can be achieved with the use of that short term capability.*

*The reactive power capability of the generation system operated by the licensee must be controlled by a fast-acting, continuously variable, voltage control system which is able to receive a local and remote voltage set point.*

*The licensee must be able to operate its generating system to a set power factor that is able to be set locally or remotely if that is the preferred mode of control at any time. The power factor control mode must be capable of automatically switching to voltage control mode during power system voltage disturbances, and automatically reverting to power factor mode when the disturbance has ceased.*

Shortly after the release of the Draft Decision, a matter was brought to the Commission's attention concerning the proposed new licence condition relating to the ability of a wind farm to ride through disturbances following contingency events (NER S5.2.5.5). This requirement was clarified in a separate statement issued in July 2009.<sup>20</sup>

Specifically, the Commission indicated in the Statement of Clarification that a wind farm should, as a minimum, be capable of riding through faults described in the automatic access standard in NER S5.2.5.5 clause (b)(1). The intention was that the behaviour of the wind farm during and immediately after clearance of the fault would not necessarily need to meet the conditions in NER clause S5.2.5.5(b)(2); rather the performance during and immediately following a fault should be negotiated as set out in the NER, meeting the minimum requirements set out in S5.2.5.5(c)(2) and the negotiation requirements set out in S5.2.5.5(d), (e) and (f). The Commission's Statement indicated that the Commission would reflect this position in the Final Decision.

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<sup>20</sup> Refer <http://www.escosa.sa.gov.au/Publications/DownloadPublication.aspx?id=23&versionId=20>.

### **3.4 Final Decision**

The Commission has considered the submissions received in response to the Draft Decision, further advice from AEMO (attached to this Final Decision paper as Appendix 1), and various other matters in coming to its final decision on technical standards licence conditions for wind generators. In response to issues raised in submissions to the Draft Decision, as well as to reflect the statement of clarification issued by the Commission in July 2009, AEMO has proposed various amendments to the technical standards conditions proposed in the Draft Decision (refer Appendix 1).

The Commission's objective has always been to fulfil its statutory mandate in relation to protection of the long term interests of South Australian consumers with respect to the quality and reliability of electricity supply. The Commission recognises that in order to do so, it is necessary to not only assess and respond to current issues and conditions but also to take into account, insofar as is possible, likely future issues and conditions.

While it would be possible for the Commission to restrict the number, location or volume of wind generators which can be licensed and operated in South Australia; these are not approaches preferred by the Commission at this time. Rather, the Commission's focus has always been on ensuring that the overall network is not adversely affected by the introduction of large volumes of wind generation and that during contingency events, security of the system is maintained and quality of supply is not impinged.

That approach is consistent with the Commission's primary statutory objective. The special technical standards licence conditions which have been in place since September 2005 now apply to about 710 MW of wind generation capacity (refer Table 1).

#### **3.4.1 Key Issues for the Commission**

The Commission's decision on the technical standards licence conditions has taken into account the matters discussed below:

##### **Level of Wind Generation in South Australia**

In 2005, the ESIPC report to the Commission suggested that the maximum level of wind generation likely to eventuate in South Australia was 800 - 1,000 MW. In fact, the extensive studies and modelling undertaken by ESIPC at that time assumed a maximum level of 800 MW.

In early 2010, with 1,155 MW of wind generation capacity already licensed and a further 1,000 MW now considered likely (refer section 2 of this paper), the scale of wind generation in South Australia is likely to reach levels that are quite unprecedented (relative to conventional generation) and which go well beyond levels contemplated in the Commission's 2005 Statement of Principles. Such a level of wind generation warrants caution to ensure there are no adverse effects on the reliability of electricity supply to South Australian consumers.

As demonstrated in the 2005 ESIPC report, and reaffirmed by ESIPC and AEMO in subsequent advice, large amounts of wind generation connected to the South Australian power system represent a significant risk to reliability of the power system in the absence of specific actions to address such risks.

### **Potential Impact of Climate Change Response Measures**

The climate change and renewable energy policies of the Commonwealth Government are expected to fundamentally change the generation portfolio in the NEM over the next decade. For example, the expanded Renewable Energy Target scheme (e-RET), which commenced in January 2010, establishes a target of 20% of Australia's electricity production in 2020 to be met from renewable energy sources. A further enhancement to this scheme was announced in February 2010, providing a specific 2020 Renewable Energy Target for large-scale renewable energy systems such as wind farms.

The promotion of significant changes in the generation mix under climate change response policies has the potential to increase the risk of reliability issues for the South Australian power system, as such policies are designed to bring forward the retirement of coal fired generation plant and encourage the building of significant amounts of renewable electricity generation plant.

The 20% e-RET and complementary subsidy schemes are expected to drive significant additional investment, particularly in the first five years of the scheme. Wind generation is forecast to be the most likely source of the majority of the additional renewable energy under the e-RET scheme, especially in the next 5 years while wind has a significant cost advantage over most other sources of renewable energy.

In 2009 the AEMC, at the request of the Ministerial Council on Energy, undertook a review of energy market arrangements in light of climate change policies then being proposed.<sup>21</sup> A supporting paper to this review, entitled *Survey of the Evidence of Implications of Climate Change Policies for Energy Markets*, suggested that the e-RET subsidy was likely to result in a large increase in renewable generation, with potentially 8,000 MW of new renewable capacity to be built by 2020. The paper further suggested that the largest share of this additional capacity would be intermittent wind generation and that in early years a high share of that wind generation would be located in South Australia and Victoria.

Significant wind resources remain available for exploitation in South Australia. Having regard to the likely impact of climate change response policies and in view of the ongoing interest expressed by wind generation proponents in South

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<sup>21</sup> Papers for this review are available from <http://www.aemc.gov.au/Market-Reviews/Completed/Review-of-Energy-Market-Frameworks-in-light-of-Climate-Change-Policies.html>

Australia, the Commission expects that there will continue to be a concentration of investment in wind generation in this State.

Given that South Australia has already exceeded the 2005 predicted maximum level of wind generation, and that climate change response measures are likely to have the effect of changing the generation portfolio over time by bringing forward significantly higher levels of wind generation, it is important to ensure that NEM connection arrangements do not present a risk to the South Australian network.

### **Changes to NER Technical Standards**

The Commission's Draft Decision outlined the amendments to the NER made by the AEMC to better integrate intermittent generation into the NEM. These include amendments to integrate wind generators into the optimized dispatch processes of the NEM (refer section 4 of this paper).

In relation to technical standards, however, the NER technical standards allow negotiation of connection requirements within a range between the minimum access standard and the automatic access standard. The outcome of any negotiation can be to the bottom of the range. This minimum standard remains lower than the standards presently required in South Australia for fault ride through and reactive power. Furthermore, as noted in section 3.2, the AEMC review of the NER technical standards is an ongoing process.

The situation for South Australia is fundamentally different to other NEM regions given the high proportion of wind generation both currently operational and forecast to be operational within a few years.

The unique characteristics of wind generation (particularly its intermittency), the already unprecedented levels of wind generation relative to demand in South Australia, the concentration of wind generation in particular regions of the transmission network within the State, and the continued strong interest in building new wind generation plant, all suggest that specific approaches to technical standards for wind generators need to be developed for South Australia.

### **Sufficiency of the NER for South Australian Circumstances**

While some submissions on the Draft Decision argued that the amended NER contain sufficiently flexibility to enable the specific requirements of South Australia to be addressed, the Commission notes that there have been no changes to the NER in relation to fault ride through. Furthermore, as outlined elsewhere in this paper, the changes to the reactive power requirements still permit negotiation to the bottom of a range which the Commission has previously concluded is too low to adequately address the South Australian reliability concerns.



### **Nature of the NER Negotiating Framework**

The negotiating framework in the NEM between the network service provider and a connecting generator is focused on negotiating the minimum acceptable technical standard for a proposed new connection point.

This negotiation is only permitted to take into account the existing power system and any committed generators and network projects.

This approach does not permit the network service provider, when negotiating technical standards for connection for a particular wind generator, to take into account the fact that other wind generators may also be undertaking studies at the same time and be engaged with the network service provider in concurrent connection negotiations.

The Commission's licence conditions are therefore designed to ensure the maximum amount of wind generation can be connected without causing power system reliability or security issues.

### **Consistency with Other Generation Types**

Several submissions raised the matter of wind generation being subject to different standards than apply to other generation types. The Commission discussed this issue at length with AEMO, and the AEMO response to the Commission (refer Appendix 1 and section 3.4.2) provides some views on this issue.

The Commission notes that intermittent generation is a relatively new addition to the generation portfolio in South Australia and it is appropriate to take a cautious and measured approach to its technical and market integration. Market integration has now been achieved by the inclusion of the new semi-scheduled category, but international experience suggests that it is particularly important to pay attention to the addition of large volumes of intermittent generation from a technical perspective.

There is an emerging high correlation of the output of wind generators in South Australia. In general, these generators generate in harmony and fluctuate in harmony, with the effect that when wind generators are all generating they will be displacing large amounts of conventional generation. This makes the technical capabilities of the wind generation plant even more important as it is possible that at the time of a fault there may not be much conventional generation plant in operation.

In addition, wind generators use varying generation and support technology and are often located on remote sections of the transmission or distribution network. Given that the penetration of wind generation in South Australia is now at a world-leading level, the maintenance of secure and reliable supply is paramount when considering appropriate licence conditions.

### 3.4.2 Review of Submissions and Commentary

The Commission requested AEMO to review the submissions made in response to the Draft Decision and to comment on the issues raised. The AEMO response to the Commission’s request (refer Appendix 1) focused on the key matters of fault ride through and reactive power capability.

#### **Fault Ride Through**

Table 3 reproduces from Appendix 1 a summary of major issues raised in submissions concerning fault ride through requirements and the AEMO response to those issues.

**Table 3: Fault Ride Through – Submissions and AEMO Response**

Submission	Summary	AEMO response
Infigen	Infigen argues that the NER now covers this aspect adequately and that loss of a block of any type of generation eg steam, gas turbine or wind has the same impact on the power system and therefore questions why wind generation is treated more harshly than other generation types.	AEMO considers that because of the remote locations and clustering of wind generation, the maximum penetration of wind will be achieved with stronger standards applied to fault ride through. Also see discussion on consistency issue (Appendix 1)
ABB	ABB agrees that the most critical item to secure a reliable transmission system in South Australia is to have a strong fault ride through capability.	Agreed
VSSR	VSSR argue that for NER S5.2.5.5 it is too onerous to require the wind generator to ride through a distribution fault cleared with breaker fail protection if it is longer than 430 milliseconds. On the other hand they argue that for NER S5.2.5.4 the Network Service Provider should have to demonstrate that there is a need, in practice, for the generator to withstand a particular voltage profile e.g. voltage within the range 80% to 90% of nominal voltage for 10 seconds.	In the interests of a reliable power system, the proposed standards aim to achieve maximum penetration of wind without compromising power system performance. The issue of having to ride through slow distribution fault clearances could be resolved through the upgrade of protection systems. It is not acceptable for generation to trip during these types of faults as it will lead to cascade failures.
CEC	CEC argues that the technical standards are too stringent and not applied equally to all types of generators.	The reasons for the increased technical standards have been stated previously. Also see discussion on consistency of treatment of generation types (Appendix 1).
AGL	AGL argues that the NER should be adequate and the specific technical standards should be withdrawn. AGL has specifically asked for AEMO to comment on the licensing principles.	It is AEMO’s view that applying a standard close to the automatic access standard will allow a higher level of penetration of wind generation in South Australia.
PH	PH agrees with VSSR on the issue of a 10 second capability at reduced voltage. They also have issue with meeting S5.2.5.5 (b) (iii) and (iv) because of the long protection times in some parts of the South Australian distribution system.	As stated above, the issue of ride through for long clearance times may be resolved by the Network Service Provider replacing protection on the distribution system.
TP	TP supports the changes.	

NP	NP considers that the NER has been improved to the point where there is no need for the ESCOSA licence conditions relating to technical standards. They also consider that there is an inconsistency between the treatment of wind and other forms of generation.	See discussion on consistency issue (Appendix 1).
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The Commission notes that the fault ride through provisions of the NER remain the same in 2010 as they were in 2005.

The issue which is of particular concern to the Commission is the risk of cascading failure of multiple generators which may lead to partial or complete shut-down of the South Australian power system.

As both ESIPC (in 2005, 2008 and 2009) and AEMO (in 2009) have advised, it is of paramount importance that, for the most severe type of fault (a three-phase fault to ground cleared by all primary protection systems), generators will continue to operate without interruption.

In 2005, the Commission noted that the NER only requires the assessment of network faults in respect to fault ride through capability to encompass other projects which are classified as “committed”. This makes the assessment of the full impact of a significant and rapid increase in the installed capacity of wind generation problematic since it can only, by definition, include other projects that already exist or that are considered “committed”.

In a situation such as that which existed in South Australia in 2005 and still exists in 2010, where there are a large number of new proponents all seeking connection concurrently, there is little or no scope for either AEMO or the Network Service Provider to make an effective assessment of the impact of all of the new projects together in a national market setting.

The risk identified by the Commission in 2005 remains, therefore, that without appropriate measures in place, significant degradation in the overall network and power system performance may result. If problems do occur or inefficiencies develop over time, there is the risk that consumers bear the costs.

As outlined above, the NER does not specifically require the fault ride through capability to be confirmed against actual protection performance, all pre-fault power system configurations and all contingencies or with future configurations including future wind generation investment. The NER requires an assessment of the proposed generator performance against network faults cleared in target primary protection time.

In 2005, advice from ESIPC highlighted that work commissioned by NEMMCO to assess potential security risks arising from high levels of wind generation on the South Australian system, identified several cases where close-in credible faults will

cause certain wind farms to trip and other cases where more distant faults causing more modest but longer low voltage faults could lead to wind farms tripping.

In view of the potentially large concentrations of wind energy in the South Australian region, the Commission required wind generators to have a more robust ride through capability – both the ride through of a more severe fault close to the wind generator and a distant fault which could cause a more modest but longer voltage depression at the wind generator’s connection point.

The ability of wind farms to ride through voltage depressions is internationally recognised and provided for in newer Codes and standards. Various codes which apply in overseas jurisdictions require generators to ride through a longer fault than is required by the Commission’s licence condition.

### **Reactive Power Capability**

Table 4 reproduces from Appendix 1 a summary of major issues raised in submissions concerning reactive power capability requirements and the AEMO response to those issues.

**Table 4: Reactive Power Capability – Submissions and AEMO Response**

Submission	Summary	AEMO response
Infigen	Infigen argues that the NER now covers this aspect adequately and that the reactive requirements of the licence create a situation where in some cases the reactive will never be used and in other cases there is not enough reactive. They consider that in some cases there is an unnecessary cost imposed on the wind farms.	The existing NER allows for a minimum access standard with regard to reactive power of no capability to supply or absorb reactive power. This is unchanged from earlier versions of the NER. The widespread application of this minimum standard would be detrimental to the continued installation of wind farms. The licence standard allows for not only the present needs of the network for each incremental wind farm but attempts to resolve the future needs of the network given a very significant penetration level of wind farms.
ABB	ABB consider that the initial response time requirement of 200msecs is too long and that 50msecs would be easily achievable. They also consider that the speed of response such that 95% is achieved in 1 second is too onerous as it is measured in reactive power output which is very voltage dependent. ABB also consider that the 2 second short term overload capability defines a particular technology and is not driven by system requirements.	It is recognised that the response time requirement does not require leading edge technology but is considered adequate for the widespread installation of wind farms. The 2 second overload capability is reworded in the recommended revised licence drafting (Appendix 1).
VSSR	VSSR argue that the 50% requirement for dynamic reactive is too restrictive. The response time is too fast and there should be the option of negotiating to have reactive plant installed at other locations in the grid.	The issues of response time and the 50% requirement for dynamic reactive have been considered in the suggested word changes to the licence (refer Appendix 1). A fast response time also provides for reactive support to the system during fault conditions; a specific technical requirement in a number of international markets with high wind penetration. Until such time as there is a mechanism to allow the trading of reactive power between the networks and generators it is our recommendation that the current requirements of each plant providing reactive

		capacity are maintained.
CEC	CEC does not see the need for the automatic standard for reactive power to be applied regardless of the location of the generation and is concerned about the requirement for control modes to go beyond the automatic standards of the NER.	The licence requirement for reactive power is not as onerous as the automatic standard as it allows reduced reactive power with reduced power output whereas the automatic access standard requires the full reactive to be provided over the whole range of active power output. As stated above we have reviewed the wording on control modes (refer Appendix 1).
AGL	AGL argues that the requirement to install large amounts of reactive support irrespective of network location is illogical and uneconomic. They also have some issues with the wording on the control mode requirements.	Until such time as there is a mechanism to allow the trading of reactive power between the networks and generators it is our recommendation that the current requirements of each plant providing reactive capacity are maintained. Once again this is in the interests of the network present and future needs. The wording on the control mode requirements has been modified given the submission (Appendix 1).
PH	PH provides a very detailed response to the reactive power requirements. They have questioned much of the wording of the proposed licence. Their concerns are around the response characteristics of the reactive control and voltage control of a wind farm.	Four sets of wording changes proposed in the redraft (Appendix 1) are in response to the PH submission. Firstly the "initial response time" wording has been replaced with a term that is already defined in the NER, rise time. Secondly, the words "following a voltage disturbance on the network" have been added to make it clear that it is response to a system change rather than a voltage setpoint change that is required. Thirdly, the words "automatically switching to" has been changed to "overridden by" to better describe the logic used by most manufacturers. Fourthly, the option of a reactive power control mode has been added.
NP	NP raises the issue of the reactive requirements being significant regardless of where the plant is located.	Until such time as there is a mechanism to allow the trading of reactive power between the networks and generators it is our recommendation that the current requirements of each plant providing reactive capacity are maintained. Once again this is in the interests of the network present and future needs.

In 2005, and as highlighted in the Commission's Statement of Principles, network analysis undertaken by ESIPC and by consultants BRW and digSilent for NEMMCO all highlighted real risks of problems with voltage control and voltage stability if a relatively large number of wind farms are connected in South Australia with minimal reactive capability.

In 2010, the current NER arrangements still allow the reactive capability of connecting generators to be negotiated down to zero, which was the primary issue that the Commission sought to address in its 2005 decision.

The wind resource in South Australia can be quite remote from the main transmission network and large amounts of wind generation is being concentrated in particular areas – both of these matters can result in network voltage and stability control issues. International experience suggests that particular attention needs to be paid to the reactive power requirements imposed on wind generators.

Work commissioned by NEMMCO in 2005 demonstrated that the addition of considerably more capacity to the system which has minimum, or no, reactive power capability will lead to serious voltage control problems. This work and

advice to the Commission from ESIPC led to the Commission developing the requirement that wind generators have reactive power capabilities greater than the current minimum standard, so that:

- ▲ contribution could be made to local voltage control during and immediately after a fault; and
- ▲ the impact of further wind generators on the power system would be minimised, thereby deferring the time at which voltage control might become an issue.

The AEMC Review of Energy Market Frameworks in light of Climate Change Policies observed that over time there may be expected to be a more stringent application of the current generator connection standards, noting that network service providers can negotiate proposals for new generator connections to meet a standard for the provision of reactive power up to the automatic level, where power system security is at risk.<sup>22</sup> It further noted that if a more stringent application of the current standard does not prove to be adequate, standards could be changed. The Reliability Panel's further review of technical standards will potentially address the matter of the minimum standard for generator connection, but this review has yet to commence.

The focus of the licence condition is to ensure reactive support to the network during and immediately following disturbances.

### 3.4.3 Summary and Conclusions

Taking into account the above matters, the Commission's conclusion is that, notwithstanding the recent amendments to the NER Technical Standards, there remains a significant risk to the long term interests of South Australian consumers in relation to reliability of electricity supply if specific licence conditions relating to technical standards for wind generators in this State are not maintained, i.e. if reliance is placed entirely on the NER Technical Standards. The Commission remains convinced that the particular circumstances in South Australia require a specific regulatory response.

The Commission considers that it should retain the two technical standards relating to fault ride through and reactive power while remaining as consistent as possible with the NER; but that the technical standards applying to wind generators in South Australia should continue to lie at the high end of the prescribed NER negotiating range rather than the minimum.

AEMO advises that the NER fault ride through requirements remain as they were in 2005. Furthermore, the current national arrangements allow the reactive

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<sup>22</sup> Refer <http://www.aemc.gov.au/Market-Reviews/Completed/Review-of-Energy-Market-Frameworks-in-light-of-Climate-Change-Policies.html>

capability of connecting generators to be negotiated down to zero. This situation represents an unacceptable risk to the security and reliability of the South Australian electricity system, given the already high penetration of wind generation.

The wording of the particular licence requirements in relation to fault ride through and reactive power have been reviewed taking into account submissions received, and there has been extensive discussion with AEMO concerning the specific detail of the licence conditions.

It remains the Commission's position that such State-specific conditions should be withdrawn when the Commission can be satisfied that the NER Technical Standards adequately address the risks to the South Australian power system associated with large amounts of wind generation. The Commission notes that the forthcoming comprehensive review of the NER Technical Standards by the AEMC Reliability will provide a further opportunity to consider this matter.

The Commission's final decision for the principles underlying the special licence conditions concerning technical standards for wind generators is detailed in the box below. The principles have been amended from those proposed in the Draft Decision to provide greater consistency with the NER, to reflect the Commission's views on fault ride through as expressed in the statement of clarification issued in July 2009, and to incorporate the advice from AEMO regarding response to the submissions (refer Appendix 1).

The Commission has determined that it will also be necessary to retain the supplementary condition requiring the generating plant to have the necessary capability to provide real time data regarding active and reactive power to AEMO and to be controllable by AEMO.

These conditions will apply to any new licences for wind generators with nameplate rating  $\geq 5$  MW issued by the Commission from the date of release of this Final Decision; they will also apply in a situation where an existing licensee seeks to add new capacity to an existing wind farm.

Commission Final Decision

Principles Underlying the Technical Standards Licence Conditions to be included in Wind Generation Licences

**FAULT RIDE-THROUGH CAPABILITY**

- 1. Each generating unit which the licensee is authorized to operate under this licence must comply with:***

- (a) the automatic access standards for generating system response to disturbances following contingency events specified in clause S5.2.5.5(b)(1) of the NER; and*
- (b) subject to clause 2, the automatic access standards for generating system response to disturbances following contingency events specified in clause S5.2.5.5(b)(2) of the NER; and*
- (c) subject to clause 3, the automatic access standards for generating system response to voltage disturbances specified in clause S5.2.5.4 of the NER.*

*2. The licensee is not required to comply with clause 1(b) in respect of a generating unit which the Licensee is authorized to operate under this licence where:*

- (a) the minimum access standard requirements specified in clause S5.2.5.5(c)(2) of the NER in relation to generating system response to disturbances following contingency events; and*
- (b) the requirements of clauses S5.2.5.5(d), (e) and (f) of the NER*

*are satisfied in respect of that generating unit.*

*3. The licensee is not required to comply with clause 1(c) in respect of a generating unit which the licensee is authorized to operate under this licence where:*

- (a) AEMO and the relevant network service provider have agreed, pursuant to clause 5.2.5.4(c)(3) of the NER, that there would be no material adverse impact on the quality of supply to other network users or of power system security as a result of that non-compliance; and*
- (b) The requirements of clauses S5.2.5.4(c), (d), (e) and (f) of the NER are otherwise satisfied in respect of that generating unit.*

#### **REACTIVE POWER CAPABILITY**

*1. The electricity generating plant operated by the licensee must at all times be capable of continuous operation at a power factor of between 0.93 leading and 0.93 lagging at real power outputs exceeding 5 MW at the connection point.*

*2. The electricity generating plant operated by the licensee must at all times be capable of providing:*

- (a) subject to clause 4(b), at least 50% of the reactive power required to meet the power factor referred to in clause 1 on a dynamically variable basis; and*
- (b) the balance of the reactive power required to meet the power factor referred to in clause 1 on a non-dynamic basis.*



**3. At generation levels below full rated output the electricity generating plant operated by the licensee must be capable of:**

- (a) absorbing reactive power at a level at least pro-rata to that of full output; and**
- (b) delivering reactive power at a level at least pro-rata to that of full output.**

**4. For the purposes of clause 2(a):**

- (a) dynamically variable means continuous modulation of the reactive power output over its range, with an initial response time or dead time < 200 milliseconds and a rise time (as defined in clause S5.2.5.13 of the NER) < 1 second following a voltage disturbance on the network; and**
- (b) for a period of  $\leq 2$  seconds on any single occasion, a short-term overload capability may be used to meet the 50% requirement, provided that use of that short-term overload does not cause a breach of any other licence condition.**

**5. The reactive power capability of the electricity generating plant operated by the licensee must be capable of control by a fast-acting, continuously variable, voltage control system which is able to receive a local and remote voltage set point.**

**6. The electricity generating plant operated by the licensee must be able to operate at either a set reactive power, or a set power factor, which is able to be set locally or remotely at any time.**

**7. The power factor or reactive power control mode of the electricity generating plant operated by the licensee must be capable of:**

- (a) being overridden by voltage support mode during power system voltage disturbances; and**
- (b) automatically reverting to power factor or reactive power mode when the disturbance has ceased.**

## 4 MARKET INTEGRATION

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### 4.1 Central Dispatch

In the 2005 Statement of Principles, the Commission determined that, until appropriate arrangements (such as formalised semi-dispatch rules) were made in the NEM, it was appropriate to require wind generators to operate as scheduled generators under the NER. This was achieved through a licence condition which specified that the generator must not apply to be registered in the NEM as a non-scheduled generator.

On 1 May 2008, the AEMC gave notice of its final Rule Determination for National Electricity Amendment (Central Dispatch and Integration of Wind and Other Generation) Rule 2008.<sup>23</sup> As a result of these changes, the NER now include a “semi-scheduled” generator plant category, which became operational from 31 March 2009. Those amendments, together with those which increased the accuracy of wind energy forecasts (refer section 4.2), improve the ability of AEMO to manage the power system with large increases in intermittent generation capacity and changes in dispatch patterns.

The semi-scheduled category requires generators with intermittent output to participate in the NEM central dispatch and Projected Assessment of System Adequacy processes through submitting dispatch offers (as for scheduled units), and limit their output at times when that output would otherwise violate secure network limits. This allows AEMO to more efficiently manage network constraints when they arise by being able to constrain the maximum output of semi-scheduled generating units in the same way as scheduled generating units at those times

The Commission’s Draft Decision on the continued relevance of the licence condition introduced in September 2005 was that the operational arrangements for wind generators classified as *semi-scheduled* meet the objectives of maintaining efficient market operation and system security, and that the NER amendments to introduce a suitable form of central dispatch of wind farms removed the need for the Commission’s requirement that wind generators be classified as scheduled plant.

The wording of the current licence condition, which prohibits a generator from being classified as non-scheduled, has the effect that, since March 2009, it has been possible for licensees to either avail themselves of the new semi-scheduled category or to remain as scheduled plant.

#### 4.1.1 Commission Final Decision

No submission received in response to the Draft Decision expressed concern regarding the Commission’s proposals in this area.

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<sup>23</sup> Refer <http://www.aemc.gov.au/electricity.php?r=20070430.162452>.

The Commission is satisfied that developments in NER operational arrangements since 2005 in relation to the new classification of semi-scheduled meets the Commission's requirements for South Australian system safety and security, and the Commission accepts that South Australian wind generators should be able to avail themselves of this new category.

It is noted that clause 2.2.7 of the NER requires that a generating unit with nameplate rating  $\geq 30$  MW and with intermittent output (as defined in the NER) must be classified as semi-scheduled unless AEMO approves either a scheduled or non-scheduled classification. As a consequence, the final decision of the Commission is that it will retain the special licence condition specifying that a wind generator cannot be classified as non-scheduled; this has the effect that the licensed generating plant must be classified as semi-scheduled unless AEMO approves a scheduled classification in accordance with the NER.

The Commission notes that an existing licensee wishing to transfer to the new semi-scheduled category may do so within the terms of the licensee's existing licence.

## **4.2 Wind Forecasting**

In the 2005 Statement of Principles, the Commission determined that wind generators should be required to have the capability to provide accurate and verifiable wind forecasting data, wind energy conversion models, and other relevant information regarding the operation of the licensed generating plant to NEMMCO and ESIPC as required.

As noted previously, an advanced wind energy forecasting system (the Australian Wind Energy Forecasting System) has been developed and is now being implemented by AEMO.<sup>24</sup>

In the Draft Decision the Commission proposed that, for all new wind generators classified as semi-scheduled under the NER, there would be no need to retain the specific licence condition relating to the provision of such information, since such generators are required to participate in the operation of the Australian Wind Energy Forecasting System and are obliged to provide AEMO with wind forecasting data in a specified form.

The Commission concluded that the standard mandatory licence condition (incorporated in all licences issued by the Commission) requiring licensees to provide any information requested by the Commission from time to time, was sufficient to enable the Commission to gather any information it requires in relation to the operations of a licensed wind generator.

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<sup>24</sup> Refer <http://www.aemo.com.au/electricityops/awefs.html>.

## 4.2.1 Commission Final Decision

No submission received in response to the Draft Decision expressed concern regarding the Commission's proposals in this area.

It is clear that the specific and detailed licence condition concerning wind forecasting, models and information is no longer necessary for a semi-scheduled generator. The Commission can instead rely on the mandatory licence condition in relation to the provision of information to the Commission to gain any models and operational information it requires from a licensee once a licence has been issued. Under this condition, the Commission has very broad powers to obtain information that is relevant to the performance of its functions.

However, as noted in section 4.1.1 above, clause 2.2.7 of the NER provides the possibility that a wind generator may be classified as scheduled by AEMO, and the Commission understands that in those circumstances participation in the operation of the Australian Wind Energy Forecasting System is not obligatory. Thus, the Commission will retain the special licence condition but will express the condition in terms such that it does not apply to a wind generator classified as semi-scheduled.

## 4.3 Ancillary Services

In the 2005 Statement of Principles, the Commission noted the importance of ensuring that wind generators participated in the NEM causer pays arrangements for regulation frequency control ancillary services. This could be achieved if wind generators were required to register as market generators and hence be part of the NEM settlement processes; it would also be necessary for generators to install metering relevant to this purpose. Thus a licence condition sufficient to achieve this outcome was introduced.

On 30 July 2008, NEMMCO published its final determination with respect to the calculation of causer pays factors for the allocation of the costs of obtaining regulation Frequency Control Ancillary Services in the market.<sup>25</sup> This determination extends the calculation of such factors in an explicit manner to cover semi-scheduled generators from March 2009.

The Commission's Draft Decision was that, as all generators registered as market generators and classified as semi-scheduled are now included in the national processes to recover the costs of ancillary services, there was no need for the Commission to impose licence conditions concerning ancillary services and metering for such generators.

### 4.3.1 Commission Final Decision

No submission received in response to the Draft Decision expressed concern regarding the Commission's proposals in this area.

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<sup>25</sup> Refer <http://www.aemo.com.au/electricityops/168-0100.pdf>.

The Commission notes that a wind generator is not prevented by the NER from seeking registration as a non-market generator. Since the causer pays arrangements for regulation frequency control ancillary services do not apply to non-market generators, the Commission will retain the requirement that a wind generator be registered as a market generator.

The calculation of causer pays factors in an explicit manner now covers both scheduled and semi-scheduled generators following the NEMMCO determination of July 2008. The Commission will therefore delete the special licence condition relating to cost allocation of ancillary services, including the requirement to install relevant operational metering

## 5 OTHER MATTERS

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### 5.1 *Small Wind Generators*

The Commission's Draft Decision considered whether or not small wind generators (nameplate rating 5 - 30 MW) should be required to be classified as semi-scheduled (thereby bringing such generators within the AEMO wind forecasting, control and payment for ancillary services arrangements). Currently such generators are not required by the NER to be classified as semi-scheduled.

The Commission noted that small wind farms are likely to be located in similar areas to other (larger) wind farms and therefore are likely to generate at much the same time. For the purposes of forecasting and managing the security of the power system an aggregation of small wind farms could cause the same problems as a larger wind generator.

The Commission also noted that the operator of the network to which a small generator connects would require installation of a control system to allow the generation output to be controlled by the network operator; therefore, a requirement for such generators to be semi-scheduled (and thereby controlled by AEMO) might not be a significant additional requirement.<sup>26</sup>

The Commission's Draft Decision was that wind generators with nameplate rating 5 – 30 MW would not be required to be classified as semi-scheduled. However, the Commission indicated that it would review the status of each such generator in relation to this matter on a regular basis (3 years), and that it would undertake an immediate review in the event that a small wind generator, or a group of small wind generators, was considered to be contributing to system reliability and stability issues.

Several submissions to the Draft Decision addressed this matter. Both Infigen and NP supported the Commission's decision, while the joint submission of turbine manufacturers (VSSR) suggested that the Commission's Draft Decision to periodically review the status of such wind generators could create difficulties in formulating a business case for smaller projects.

#### 5.1.1 Commission Final Decision

The Commission remains of the view that there is the potential for a single small wind generator or (as is more likely) a cluster of small wind generators to cause system security and reliability problems in the same way as a larger wind generator. It also notes that small generators, embedded in the distribution

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<sup>26</sup> In the case of a small generator less than 30 MW, the most likely connection would be to the distribution network operated by ETSA Utilities rather than the transmission network operated by ElectraNet

network, may be located in closer proximity to large numbers of customers than is the case for larger generators.

Nevertheless, the Commission is not aware of any current proposals to develop smaller wind farms in South Australia. That being the case, the Commission does not believe that the protection of the long term interests of South Australian electricity consumers requires the imposition of a licence condition that such generators be semi-scheduled. The Commission notes in any case that its decision in relation to technical standards (section 3) does extend to wind generators with nameplate rating of 5 – 30 MW.

The Commission's final decision is that the need or otherwise for wind generators of 5 – 30 MW nameplate rating to be classified as semi-scheduled will be assessed on a case by case basis.

This will enable the Commission to take into account the particulars of each proposed wind generator of this capacity - such as geographical location, proximity to customers, and proposed size.

The Commission notes that the conditions relating to registration as a market generator, wind forecasting and ancillary services as enunciated in the 2005 Statement of Principles were expressed as applying to wind generators with nameplate rating  $\geq 5$  MW. The Commission's judgement is that, in future, the application of such requirements to wind generators with nameplate rating  $< 30$  MW will (as for the semi-scheduled classification issue) be assessed on a case-by-case basis.

The Commission's decision underlines the importance of proponents of small wind generators discussing their proposals with the Commission at an early stage in order that licensing requirements can be appropriately considered and incorporated into the design requirements for the particular development.

## **5.2 Pre-September 2005 Licensees**

In both the Proposals Paper and the Draft Decision, the Commission expressed the view that there would be some efficiency benefits from *all* wind generators in South Australia being classified as semi-scheduled (i.e. including those licensed prior to the Statement of Principles issued by the Commission in September 2005<sup>27</sup>). It was also noted that this could impose significant costs on some existing wind generators to implement such arrangements and the benefits could be small.

The Commission noted that some wind generators licensed prior to September 2005 have clauses in their connection agreements that require generation dispatch control by

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<sup>27</sup> At 30 June 2005, the Commission had issued seven electricity generation licences to wind generators, with a total installed capacity of 446 MW (refer Table 1 of this paper).

ElectraNet, the transmission network operator. Where generators are required to meet such requirements, they would already have the tools to permit remote generator control by AEMO. Control of some wind generators by ElectraNet and some (which contribute to the same network limitations) through central dispatch by AEMO, could lead to inefficient outcomes.

It was also noted that some very early wind generators do not have any control systems and a requirement to become semi-scheduled would impose costs on these existing wind generators.

The focus of this issue is particularly on those wind generators which have pre-September 2005 licences and whose output is already controlled under arrangements in connection agreement with ElectraNet. This leaves these generators controlled by ElectraNet while other generators, perhaps in the same area, are to have their output controlled by AEMO. The joint management does not appear to fit with the usual roles and responsibilities in the NEM and may not lead to efficient and secure outcomes.

The Commission's Draft Decision noted the views put in some submissions about the "sovereign risk" to wind generators should the Commission seek to apply "new" rules to existing generators. The Commission notes that the Electricity Act explicitly confers on it the power to vary the terms and conditions of existing licences. Before doing so it must give the licensed entity reasonable notice of the proposed variation and allow the entity a reasonable opportunity to make representations about the proposed variation. The Electricity Act also provides a review and appeal process.

The Commission also noted that in some European jurisdictions new and up-dated technical standards and other requirements are applied to existing wind generators.

BBP, in its submission on the Draft Decision, specifically addressed this aspect of the Commission's Draft Decision, suggesting that

*the consequences of grandfathering these [pre-2005] licences has created a regulatory environment whereby power system management, particularly at times of contingency events, is being fragmented between ElectraNet and AEMO.*

BBP referred to a particular incident in June 2009 in which a constraint was applied to Playford Power Station by AEMO to maintain power system security, while ElectraNet was responsible for imposing limits on both Mt Millar and Cathedral Rocks wind farms which are non-scheduled.

BBP argued that:

*...such an arrangement represents a potential risk to the effectiveness of market operator as it effectively fragments AEMO's powers to coordinate the central dispatch process with regard to power system security and reliability.*



BBP expressed the view that wind farms with the technical capability of being semi-scheduled should be required by the Commission to move to this category.

### 5.2.1 Commission Final Decision

While noting the BBP view, the Commission is not presently convinced that it is necessary to vary pre-2005 licences for wind generators whose output is controlled by ElectraNet. It has not been demonstrated to the Commission that the protection of the long term interests of South Australian electricity consumers is sufficiently at risk as to require the variation of the current licence conditions for pre-September 2005 licensees.

The Commission will continue to be guided in this matter by advice from AEMO and ElectraNet together with the assessment of the Commission's primary and subsidiary objectives.

In the event of receiving particular advice that net benefits of reclassification of some wind generation plant to semi-scheduled are substantial, the Commission may vary those pre-2005 licences, but would consult with affected wind generators before doing so, in accordance with the legislative requirements.

## 6 SUMMARY

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National developments to better incorporate wind generation into the NEM, together with the scale of further wind generation currently considering connecting in South Australia, and the high level of wind generation already operating, under construction or committed, have led the Commission to reassess whether the licensing approach outlined in the Statement of Principles for Wind Generation Licensing developed by the Commission in September 2005, remains appropriate or requires modification.

Having assessed the national changes, considered submissions from interested stakeholders and further advice from AEMO, the Commission has concluded that, while some special licence conditions can be substantially removed for plant which is classified in the new category of “semi-scheduled”, it is appropriate to retain the special licence conditions relating to technical standards for reactive power and fault ride through that were introduced in September 2005. These conditions have, however, been amended to provide greater consistency with the NER, and to reflect the advice from AEMO.

The Commission has reached these conclusions taking into account its primary objective which, in the context of its electricity regulatory obligations, is to protect the long term interests of South Australian consumers of electricity services with respect to the price, quality and reliability of those services.

In particular, the Commission remains concerned to ensure the long term security and reliability of the electricity system in South Australia, with 1,155 MW of wind generation licensed and either operating, under construction or considered committed and a further 130 MW of wind generation currently at the licence application stage. If this plant is constructed as planned, it is expected South Australia will have almost 1,300 MW of operational wind generation by the end of 2010 and it is possible that South Australia will have at least 2,200 MW of wind generation by 2020.

Given that South Australia has the highest installed capacity of wind generation in Australia; the highest contribution by wind energy to State electricity demand in Australia; and has amongst the highest relative contributions from wind generation to customer sales in the world, the Commission considers that a measured and cautious approach to licensing wind generators is appropriate.

The Commission remains of the view that provided wind generator proponents can satisfy the Commission that the plant and equipment to be connected at the connection point will satisfy the Commission’s special licence conditions relating to technical standards, together with meeting the other licensing criteria, the Commission will be discharging its legislative functions in an appropriate manner.

The final decision concerning special licence conditions for wind generators, as outlined in this paper, will be applied to the Commission’s future consideration of licence applications in this area.

The following is a restatement of the licensing principles for wind generators, using the September 2005 principles (refer section 2.2 of this paper) as a reference point and incorporating amendments arising from the Final Decision of the current review of wind generator special licence conditions as outlined in this paper.

**Statement of Licensing Principles for Wind Generators – May 2010**

**1. Quality of Supply**

***A wind generator licence applicant must provide evidence to the Commission that a connection agreement between the proposed wind generator and the relevant network service provider has been executed or fully negotiated.***

**2. Special Licence Conditions for wind generator with nameplate rating  $\geq$  30 MW**

**▲ *Technical Standards***

***(a) Fault Ride Through Capability: refer condition specified in section 3.4.3.***

***(b) Reactive Power Capability: refer condition specified in section 3.4.3***

***(c) Retain condition that the generating plant be capable of meeting requirements of AEMO for data on active and reactive power, and to be controllable by AEMO***

**▲ *Optimised Dispatch***

***Retain existing condition that the licensee must not apply to have the generating plant classified as non-scheduled under the NER***

**▲ *Wind Forecasting***

***Express existing condition to apply only to generating plant classified other than as semi-scheduled***

**▲ *Cost Allocation of Ancillary Services***

***Retain existing condition that the generating unit must be registered as a market generator; remainder of the condition to be deleted***

**3. Special licence conditions for wind generator with nameplate rating 5 -30 MW**

***Technical standards licence conditions as expressed above to apply; applicability of remaining special licence conditions to be considered on a case-by-case basis.***

**4. Compliance with special licence conditions**

***A wind generator licence applicant must certify in writing to the Commission that the generation plant and associated equipment that is the subject of the licence application will be operated to comply in all respects with applicable licence conditions as enunciated in this Statement of Principles.***

**5. Pre- April Wind Generation Licensees**

***Generation licences issued to wind generators prior to May 2010 will not be amended to reflect the outcomes of this review unless a clear case for doing so emerges.***

An amended electricity generation licence for a wind generator with capacity  $\geq 30$  MW, incorporating the amended special licence conditions, is being released with this final decision. Intending licence applicants should use this amended licence for the purposes of reviewing compliance requirements.

The Commission emphasises that it continues to view the principles underlying the special licence conditions for wind generators in South Australia, as outlined above, as being transitional in nature. As noted in the 2005 Statement of Principles, the Commission believes that a national market-wide solution to the issues associated with large amounts of wind generation capacity is the most appropriate outcome. The Commission will continue to work with all stakeholders towards that end.

## APPENDIX: AEMO ADVICE

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17th September 2009



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Ms Margaret Cross  
Executive Director, Regulatory Development and Implementation  
Essential Services Commission of South Australia  
Level 8, 50 Pirie Street  
ADELAIDE SA 5000

Dear Margaret

### Re | ESCOSA Licence Conditions for Wind Generators

AEMO under its additional advisory functions for the South Australian declared power system as set out in Division 2, Subdivision 2, Section 50B of the National Electricity Law provide the following comments on the consultation responses for ESCOSA Licence Conditions for Wind Generators – Draft Decision paper.

AEMO has reviewed the ten responses received during the consultation period from (the abbreviation in [ ] will be used to refer to the submission in this document):

- International Power Australia (IPRA) Pty Ltd [IPRA]
- Babcock & Brown Power Ltd [B&BP]
- Infigen Energy Ltd [Infigen]
- ABB Australia Pty Ltd [ABB]
- Vestas Australian Wind Technology Pty Ltd / Siemens Ltd / Suzlon Energy Australia Pty Ltd / REpower Australia Pty Ltd [VSSR]
- Clean Energy Council [CEC]
- AGL Energy Ltd [AGL]
- Pacific Hydro Pty Ltd [PH]
- TrustPower Australia Holdings Pty Ltd [TP]
- NP Power Pty Ltd [NPP]

AEMO considers that three of the submissions IPRA, B&BP and TP are supportive of the draft decision to amend the technical requirements of the SA wind generator licences however they raise other issues of process and application which AEMO does not intend to comment on in this document. AEMO is solely concerned with providing ESCOSA with



advice on the technical requirements that are considered justified in the South Australian situation. The SA wind generator licence conditions are not intended to act as a barrier to entry for wind generators; rather these standards should support the connection of a higher level of wind generation compared with the minimum technical standards that apply in the National Electricity Rules (NER).

As has been stated previously by ESCOSA and ESIPC, the level of penetration of wind generation in South Australia is unprecedented in Australia and is second only to Denmark on a world scale. The wind resource in South Australia can be quite remote from the main transmission network and therefore large amounts of wind generation can create network voltage and stability control issues. The negotiating framework in the NEM between the Network Service Provider and the connecting generator is about negotiating the minimum acceptable technical standard for each new connection taking into account only the existing power system and any committed generators and network projects. This approach is adopted despite knowing that many other wind generators are seeking to connect and expecting that a number of these will proceed. The licence conditions for wind are about ensuring that, for the existing network and into the future, the maximum amount of wind generation can be connected without causing power system security or reliability issues. In the interests of achieving this in South Australia it is therefore considered necessary to raise the minimum technical standard in two areas: namely fault ride through and reactive power capability.

### ***Fault Ride Through Capability***

On the issue of fault ride through capability (covered under NER S5.2.5.4 and S5.2.5.5) AEMO and ESCOSA are particularly concerned about the risk of cascade failure of multiple generators in a particular area which may lead to partial or complete shutdown of the power system within South Australia. It is of paramount importance that for the most severe type of fault (a three phase fault to ground cleared by all primary protection systems) the generators will continue to operate without interruption. This is why the standard is being set at the automatic level rather than any negotiated level below this standard.

The following table summarises the submission and provides AEMO's response:

<b>Submission</b>	<b>Summary</b>	<b>AEMO Response</b>
Infigen	Infigen argues that the NER now covers this aspect adequately and that loss of a block of any type of generation eg steam, gas turbine or wind has the same impact on the power system and therefore questions why wind generation is treated more harshly than other	AEMO considers that because of the remote locations and clustering of wind generation, the maximum penetration of wind will be achieved with stronger standards applied to fault ride through. Also see consistency issue below.

	generation types.	
ABB	ABB agrees that the most critical item to secure a reliable transmission system in South Australia is to have a strong fault ride through capability.	Agreed
VSSR	VSSR argue that for NER S5.2.5.5 it is too onerous to require the wind generator to ride through a distribution fault cleared with breaker fail protection if it is longer than 430 milliseconds. On the other hand they argue that for NER S5.2.5.4 the Network Service Provider should have to demonstrate that there is a need, in practice, for the generator to withstand a particular voltage profile e.g. voltage within the range 80% to 90% of nominal voltage for 10 seconds.	In the interests of a reliable power system, the proposed standards aim to achieve maximum penetration of wind without compromising power system performance. The issue of having to ride through slow distribution fault clearances could be resolved through the upgrade of protection systems. It is not acceptable for generation to trip during these types of faults as it will lead to cascade failures.
CEC	CEC argues that the technical standards are too stringent and not applied equally to all types of generators.	The reasons for the increased technical standards have been stated previously. Also see consistency issue below.
AGL	AGL argues that the NER should be adequate and the specific technical standards should be withdrawn. AGL has specifically asked for AEMO to comment on the licencing principles.	It is AEMO's view that applying a standard close to the automatic access standard will allow a higher level of penetration of wind generation in South Australia.
PH	PH agrees with VSSR on the issue of a 10 second capability at reduced voltage. They also have issue with meeting S5.2.5.5 (b) (iii) and (iv) because of the long protection times in some parts of the South Australian distribution system.	As stated above, the issue of ride through for long clearance times may be resolved by the Network Service Provider replacing protection on the distribution system.
TP	TP supports the changes.	

NPP	NPP consider that the NER has been improved to the point where there is no need for the ESCOSA licence conditions relating to technical standards. They also consider that there is an inconsistency between the treatment of wind and other forms of generation.	See consistency issue below.
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### **Consistency with other generation types**

A number of the submissions argue that the standard being applied to wind farms is different to the standard applied to other generation types. Intermittent generation is a relatively new addition to the generation portfolio of any power system and there are special provisions made both in terms of their interaction with markets and their technical standards of connection in all power systems where they have been introduced. Many countries in Europe have had to develop standards in response to problems that have occurred following the introduction of a significant proportion of intermittent generation. Not only is the power source intermittent but the initial generation technology was not consistent with the actual location of this generation which is generally remote and on weak sections of the distribution and transmission system. The penetration of wind generation in South Australia has exceeded all but one European country and the maintenance of secure and reliable supply of power in South Australia is paramount to the considerations of generation licence conditions.

While the existing and proposed licencing conditions do apply particularly to wind generation, they are not outside the standards within the Rules. The NER requires negotiation between the minimum and automatic standard. In many cases the outcome may be similar to the requirements of the licence condition in any event, that is, the automatic standard would be required. However, the analysis would not be undertaken on the basis of the ultimate system configuration and there is a risk that some generators would be assessed as not being required to have the automatic standard. That decision cannot be reversed in the future should problems emerge and the connection of future wind generators may become difficult. Therefore it is considered prudent to apply the automatic standard as a policy decision to maintain system security with the amount of wind generation expected in South Australia.

### **Conclusion**

It is considered prudent in the interests of maximising the amount of allowable wind generation in South Australia and ensuring the same standard is applied to all wind generation that the existing automatic standard in the NER be applied.

The statement of clarification issued by ESCOSA on the 7 July 2009 needs to amend the draft decision words as follows:



**FAULT RIDE THROUGH CAPABILITY**

*Each electricity generating unit of the electricity generating plant operated by the licensee must comply with:*

**NER S5.2.5.5 Generating system response to disturbances following contingency events – Automatic access standard except that the behaviour of the wind farm during and immediately after clearance of the fault would not necessarily need to meet the conditions in NER clause S5.2.5.5 (b) (2); rather the performance during and immediately following a fault should be negotiated as set out in the Rules, meeting the minimum requirements set out in S5.2.5.5 (c) (2) and the negotiation requirements set out in S5.2.5.5 (d) (e) and (f); and**

**NER S5.2.5.4 Generating system response to voltage disturbances – Automatic access standard except that generators may seek to negotiate compliance with clause S5.2.5.4 (a) (1) (the ability to ride through voltages in excess of 110%) provided the Network Service Provider agrees that there would be no material adverse impact on the quality of supply to other Network Users or power system security.**

**Reactive Power Capability**

The following table summarises the submission and provides AEMO’s response:

Submission	Summary	AEMO Response
Infigen	Infigen argues that the NER now covers this aspect adequately and that the reactive requirements of the licence create a situation where in some cases the reactive will never be used and in other cases there is not enough reactive. They consider that in some cases there is an unnecessary cost imposed on the wind farms.	The existing NER allows for a minimum access standard with regard to reactive power of no capability to supply or absorb reactive power. This is unchanged from earlier versions of the NER. The widespread application of this minimum standard would be detrimental to the continued installation of wind farms. The licence standard allows for not only the present needs of the network for each incremental wind farm but attempts to resolve the future needs of the network given a very significant penetration level of wind farms.

<p>ABB</p>	<p>ABB consider that the initial response time requirement of 200msecs is too long and that 50msecs would be easily achievable. They also consider that the speed of response such that 95% is achieved in 1 second is too onerous as it is measured in reactive power output which is very voltage dependent. ABB also consider that the 2 second short term overload capability defines a particular technology and is not driven by system requirements.</p>	<p>It is recognised that the response time requirement does not require leading edge technology but is considered adequate for the widespread installation of wind farms. The 2 second overload capability is reworded in the recommended revised licence drafting.</p>
<p>VSSR</p>	<p>VSSR argue that the 50% requirement for dynamic reactive is too restrictive. The response time is too fast and there should be the option of negotiating to have reactive plant installed at other locations in the grid.</p>	<p>The issues of response time and the 50% requirement for dynamic reactive have been considered in the suggested word changes to the licence. A fast response time also provides for reactive support to the system during fault conditions; a specific technical requirement in a number of International markets with high wind penetration.</p> <p>Until such time as there is a mechanism to allow the trading of reactive power between the networks and generators it is our recommendation that the current requirements of each plant providing reactive capacity are maintained.</p>
<p>CEC</p>	<p>CEC does not see the need for the automatic standard for reactive power to be applied regardless of the location of the generation and is concerned about the requirement for control modes to go beyond the automatic standards of the NER.</p>	<p>The licence requirement for reactive power is not as onerous as the automatic standard as it allows reduced reactive power with reduced power output whereas the automatic access standard requires the full reactive to be provided over the whole range of active power</p>

		<p>output.</p> <p>As stated above we have reviewed the wording on control modes.</p>
AGL	<p>AGL argues that the requirement to install large amounts of reactive support irrespective of network location is illogical and uneconomic. They also have some issues with the wording on the control mode requirements.</p>	<p>Until such time as there is a mechanism to allow the trading of reactive power between the networks and generators it is our recommendation that the current requirements of each plant providing reactive capacity are maintained. Once again this is in the interests of the network present and future needs.</p> <p>The wording on the control mode requirements has been modified given the submission.</p>
PH	<p>PH provides a very detailed response to the reactive power requirements. They have questioned much of the wording of the proposed licence. Their concerns are around the response characteristics of the reactive control and voltage control of a wind farm.</p>	<p>Four sets of wording changes proposed in the redraft are in response to the PH submission. Firstly the “initial response time” wording has been replaced with a term that is already defined in the NER, rise time. Secondly, the words “following a voltage disturbance on the network” have been added to make it clear that it is response to a system change rather than a voltage setpoint change that is required. Thirdly, the words “automatically switching to” has been changed to “overridden by” to better describe the logic used by most manufacturers. Fourthly, the option of a reactive power control mode has been added.</p>
NPP	<p>NPP raise the issue of the reactive requirements being significant regardless of where the plant is located.</p>	<p>Until such time as there is a mechanism to allow the trading of reactive power between the networks and generators it is our recommendation that the current</p>



		requirements of each plant providing reactive capacity are maintained. Once again this is in the interests of the network present and future needs.
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As stated in the previous ESIPC report, the issue of location is problematic in the NEM and has not been adequately resolved. Until such time as there is a mechanism to allow the trading of reactive power between the networks and generators it is our recommendation that the current requirements are maintained.

The South Australian licence conditions currently require half of the reactive power capability to be “dynamically variable”. The new licence conditions aim to clarify what is meant by this general term, following experience in the application of the original licence conditions. The objective of this provision is not for the steady state control of voltage as some comments appear to address. Rather the objective is to ensure reactive support to the network during and immediately following disturbances. An alternative which was considered is to actually specify the reactive output in these circumstances. Some European Grid Codes require that with a voltage drop of more than 50%, the wind generator must be capable of producing active power in proportion to the voltage and reactive current equal to the active current. It was considered that the alternative of modifying existing technical standards was preferable to adding different standards and that the proposed arrangements provide the level of performance considered warranted in the South Australian situation.

The wording of the licence requirements has been reviewed following the submissions and we now recommend some changes as shown below to better define the requirements. The intent has not changed but hopefully the revised wording will be clearer to all parties.

**REACTIVE POWER CAPABILITY**

***The generating plant operated by the licensee must at all times be capable of continuous operation at a power factor of between 0.93 leading and 0.93 lagging at the connection point at real power outputs exceeding 5MW.***

***At least 50% of the reactive power required to meet the above power factors must be dynamically variable, with the balance able to be provided by non dynamic plant. For the purposes of this requirement, dynamically variable means continuous modulation of the reactive power output over its range, with an initial response time or dead time of less than 200 msecs and a rise time (as defined in clause S5.2.5.13)~~speed of response such that 95% of the steady state reactive power~~***

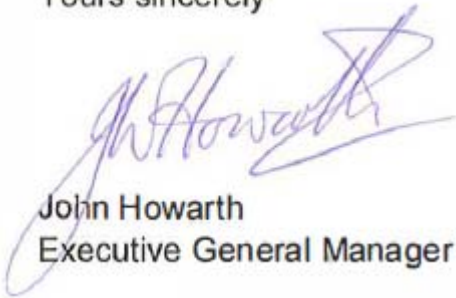
**response is achieved within of less than 1 second following a voltage disturbance on the network. The two secondA short term overload capability of dynamic plant of not less than 2 seconds may be used to fulfil the 50% dynamically variable requirement provided compliance to the other technical requirements can be achieved with the use of that short term capability.**

**The reactive power capability of the generation system operated by the licensee must be controlled by a fast-acting, continuously variable, voltage control system which is able to receive a local and remote voltage set point.**

**The licensee must be able to operate its generating system to either a set reactive power or a set power factor that is able to be set locally or remotely if that is the preferred mode of control at any time. The power factor or reactive power control mode must be capable of being overridden by automatically switching to voltage support mode during power system voltage disturbances, and automatically reverting to power factor or reactive power mode when the disturbance has ceased.**

If you have any further queries or points of clarification please do not hesitate to contact me on 03 8664 6565.

Yours sincerely



John Howarth  
Executive General Manager Transmission Services