



Electricity

Inquiry into the licensing arrangements for generators in South Australia

DRAFT REPORT

May 2017

Request for submissions

The Essential Services Commission (**Commission**) invites written submissions on this paper by **Friday, 9 June 2017**.

It is the Commission's policy to make all submissions publicly available via its website (www.escosa.sa.gov.au), except where a submission either wholly or partly contains confidential or commercially sensitive information provided on a confidential basis and appropriate prior notice has been given.

The Commission may also exercise its discretion not to publish any submission based on length or content (for example containing material that is defamatory, offensive or in breach of any law).

Responses to this paper should be directed to: **Inquiry into the licensing arrangements for generators in South Australia**.

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Glossary of terms

AEC	Australian Energy Council
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AGC	Automatic generation control
AGL	AGL Energy
ARENA	Australian Renewable Energy Agency
Black System event	South Australian Black System event of 28 September 2016
CEC	Clean Energy Council
CoAG Energy Council	Council of Australian Governments Energy Council
Commission	Essential Services Commission, established under the Essential Services Commission Act 2002
DSD	Department of State Development of the Government of South Australia
ElectraNet	ElectraNet Pty Ltd – the South Australian transmission network service provider
ESIPC	Electricity Supply Industry Planning Council
ESC Act	Essential Services Commission Act 2002
Electricity Act	Electricity Act 1996
ENA	Energy Networks Association
EWOSA	Energy and Water Ombudsman SA
FCAS	Frequency control ancillary services
FFR	Fast frequency response
Final Advice	Recommended Technical Standards For Generator Licensing In South Australia: Advice to ESCOSA – prepared by AEMO
Finkel Review	Review of the power system by the Chief Scientist for Australia, Dr Alan Finkel
FPSS	Future Power System Security program
GPS	Generator performance standards

GWh	Gigawatt hour
Issues Paper	Issues Paper on the Inquiry into licensing arrangements under the Electricity Act 1996 for inverter-connected generators
kVA	Kilovolt ampere
MW	Megawatt
NEM	National Electricity Market
NER	National Electricity Rules
NERC	North American Electric Reliability Corporation
NSP	Network service provider
PV	Photovoltaic
RET	Renewable Energy Target
Rules	National Electricity Rules
SRAS	System restart ancillary services

Executive Summary

The Essential Services Commission (**Commission**) is proposing changes to licence conditions applying to electricity generators in South Australia. The proposals are based on the technical advice provided by the Australian Energy Market Operator (**AEMO**) and the Commission will consult on these proposals before making a final decision in July 2017.

The proposed technical recommendations for electricity generators are aimed at promoting the resilience and security of the South Australian power system. AEMO has proposed to the Commission that careful consideration must be given to ensuring a secure, resilient, and reliable power system for the State in the context of a greater, and variable, proportion of non-synchronous generation. Among other things, AEMO's recommendations seek to ensure that generators are better able to ride through power system disturbances and, with active power controls, will have the ability to both better control their energy output during a dispatch period as well as being able to assist with the control of voltage and frequency if required. In particular, AEMO's recommendations encompass the following matters:

- ▶ static and dynamic reactive power requirements
- ▶ voltage control capability
- ▶ performance during, and subsequent to, contingency events
- ▶ active power control facilities
- ▶ the ability to assist with system restart
- ▶ the provision of simulation models, and
- ▶ regular updates to the Commission's framework.

AEMO has not recommended that generator licence conditions include the requirement to provide electrical inertia or system strength (or fast frequency response). AEMO considers that prescriptive requirements on new or existing South Australian plant, alone, would be inefficient and, instead, is considering alternative means to procuring these services which are being considered as part of other concurrent broader technical reviews.

Background and purpose of the Inquiry

In June 2016, the Commission commenced an Inquiry under Part 7 of the Essential Services Commission Act 2002 (**ESC Act**) into the licence conditions to apply to electricity generators connected to the South Australian power system which it licenses under the Electricity Act 1996 (**Electricity Act**). This is the third such review that the Commission has undertaken following similar reviews of wind-powered generators in 2005 and 2010.

In those first two reviews, the focus on wind-powered electricity generators reflected the large numbers of such proposals emerging at the time and the need to integrate them into the South Australian power system in a way that promotes ongoing system stability.

Since 2010, the underlying generation mix in South Australia has changed markedly. There has been a shift from large-scale, synchronous, centrally-dispatched generation towards distributed and intermittent (or variable) non-synchronous generation, connected to the power system through solid state inverters. These include wind-powered electricity generators, as well as a growing proportion of non-dispatched solar photovoltaic (**PV**) systems throughout the distribution grid.

The existing national regulatory frameworks have not had, and do not appear to have, the flexibility and speed to change to meet the new challenges presented by the rapid emergence of these new technologies. The Commission has been driving change in this area since 2005, when it first introduced special licence conditions to cater for the differing electrical and physical characteristics of wind-powered generators compared to existing conventional generators. These special conditions required new wind-powered generators to meet higher performance standards than were specified under the National Electricity Rules (**NER**) at the time.

The South Australian power system is undergoing a fundamental transformation and the technical and system impacts of that transformation are not adequately dealt with under the existing national framework. The Commission, therefore, feels it is necessary to continue to require additional generation licence conditions until such time as the national framework adequately addresses those impacts. The Commission has stated consistently that were such a national framework in place for existing inverter-connected (non-synchronous) electricity generators and other emerging generation and storage technologies, specific licence conditions in South Australia may be unnecessary.

The purpose of this Inquiry is to determine whether or not there should be any changes to the technical licensing requirements for electricity generators in South Australia. In particular, the Commission is inquiring into:

- ▶ whether the current licence conditions for the grid connection of wind-powered electricity generators should be removed, retained or varied, and
- ▶ whether any additional or amended technical requirements should be imposed on other grid-scale inverter-connected electricity generators (such as solar generation) or other generation technologies and sources (including conventional synchronous generation).

Advice from the Australian Energy Market Operator

To assist with its Inquiry, the Commission sought advice from AEMO on the appropriate technical standards to apply to electricity generators seeking to connect to the South Australian power system. AEMO's advice to the Commission has been informed by its investigations into the South Australian Black System event of 28 September 2016 (**Black System event**) and a number of other concurrent reviews into similar matters.

From its analysis into these investigations and these other reviews, AEMO has highlighted that the power system in South Australia is likely to experience the following situations more frequently:

- ▶ the increasing possibility of long periods where the ratio of non-synchronous to synchronous generation is very high
- ▶ periods where the South Australian power system is separated (or islanded) from the national electricity network or that islanding was a credible contingency, and
- ▶ periods of low or zero demand due to increasing volumes of generation within the distribution network.¹

AEMO also advises that for the South Australian power system to be resilient and to operate securely under the above situations, it is no longer appropriate to rely on synchronous generators alone to provide the power system with the essential system services necessary for its proper functioning. AEMO has recommended that these essential system services will need to be obtained from non-synchronous generators or as network services. The transition to a power system dominated by

¹ This low or zero demand can result from the substantial volume of small scale rooftop solar systems embedded throughout the distribution network which effectively serves consumers demand first thereby offsetting the need for large scale generation (at the wholesale market level).

non-synchronous generation technologies, like wind, solar and batteries, will require these generators to provide some of the services previously offered by synchronous plant.

AEMO has proposed to the Commission that careful consideration must be given to ensuring a secure, resilient, and reliable power system for the State in the context of a greater, and variable, proportion of non-synchronous generation. Among others, AEMO's key recommendations are that new generators should provide the following capabilities:

- ▶ power system voltage and frequency disturbance ride-through, and
- ▶ active power control.

AEMO does not recommend relaxation of the existing power system disturbance (or fault) ride-through and reactive power licence conditions, although changes have been recommended to how these conditions are expressed.

Furthermore, AEMO has advised the Commission to apply these recommendations on all new generators (regardless of technology) such that the South Australian generation fleet is armed with the capabilities to provide a secure and resilient power system.

Importantly, AEMO has not recommended that generator licence conditions include the requirement to provide electrical inertia or system strength. AEMO considers that prescriptive requirements on new or existing South Australian plant, alone, would be inefficient and, instead, is considering alternative means to procuring these services.

A broad outline of AEMO's recommendations follow:

Voltage and frequency disturbance ride-through recommendations

From its analysis of the Black System event, AEMO has recommended more detailed standards for the fault ride-through capability of both synchronous and non-synchronous plant including:

- ▶ Greater clarity on performance requirements under low and high voltage conditions – that is, how long generation must stay connected if voltage is higher or lower than nominal during a fault. This will include provisions that more clearly specify how plant should operate while it is riding through to support secure operation of the power system.
- ▶ Requirements for generators to ride through multiple faults, regardless of number up to a cumulative time limit consistent with best practice international standards.
- ▶ Requirements to withstand frequency changes over and above what is in the current Rules.

Active power control recommendations

Frequency control ancillary services (**FCAS**) are used to maintain the power system in a nominal band that supports the ongoing secure operation of the power system. Currently, FCAS is provided by precisely increasing or decreasing the active power output from generators. To date, no wind or solar plant has provided these active power services.

AEMO has recommended that all new entrant plant, whether synchronous or non-synchronous, have active power control capability to:

- ▶ provide regulation and contingency FCAS services
- ▶ be controlled by AEMO via Automatic Generation Controls (AGC)
- ▶ limit changes in active power output in each five minute dispatch period, and
- ▶ communicate the status of its active power controls in real time.

Furthermore, AEMO has recommended that all new entrant generators register for FCAS, which will allow for these frequency capabilities to be used if required.

Other matters

As well as the above recommendations, AEMO has also proposed recommendations to generator licences to:

- ▶ provide the ability to assist with the process of power system restoration, and
- ▶ ensure that plant is designed to maintain certain standards, taking into account the prevailing network conditions to address the underlying drivers of reductions in system strength.

In addition to making recommendations relating to the technical standards for incorporation in generator licences, AEMO has also recommended that the Commission consider making changes in relation to the following associated matters:

- ▶ the provision of simulation models, and
- ▶ regular updates to the Commission's framework.

Although, AEMO has not recommended additional generator licence condition requirements specifically for system inertia (nor fast frequency response (FFR)), it has made recommendations in relation to the provision of system inertia from network service providers.

AEMO's intention to submit a Rule change

Finally, AEMO has advised the Commission that it considers that the technical standards in the NER require updating as soon as is practicable. To that end, AEMO has indicated that it intends to submit a Rule change to the Australian Energy Market Commission (by July 2017) requesting appropriate revisions in accordance with the recommendations made in its advice to the Commission.

Should AEMO's recommendations apply to existing generators?

AEMO has suggested that the Commission may wish to consider how some or all of the recommendations could be applied to existing generators in South Australia, with due regard to:

- ▶ the physical limitations of some existing generating units
- ▶ the likely cost of enabling the capability for each generating unit, and
- ▶ the incremental benefit that would be gained.

If the proposed technical requirements were applied only to new generation licensees, the benefits of AEMO's proposals would not be realised for a number of years. The Commission's preliminary position is that there may be a need for current licensed generators to provide additional capabilities and services to the power system to improve system security and resilience. However, the Commission also recognises that there may be some current licensed generators that are unable to meet those additional requirements and the costs to upgrade plant to meet such capabilities would be inefficient.

The Commission is proposing to work with existing licensees and AEMO through the consultation period for this Draft Report to assess any barriers and costs involved for existing licensees to meet any proposed new licence conditions. This will include seeking information on the current capability of the generator to provide the proposed services as required by any new proposed conditions, the nature and type of generation equipment and associated plant, any costs involved to upgrade the generator's capabilities including to plant and communication systems, and any benefits that may arise from providing these additional services.

Next steps

The Commission supports the general intent of AEMO's recommendations. However, it recognises that further consultation is required with industry participants regarding the details of these recommendations and their likely impacts.

In addition, the broadening of the scope of the Commission's Inquiry to include all generation technologies and the potential for the application of any proposed licence conditions to existing licensees warrants further consultation.

As part of its consultation, the Commission will hold a workshop in Adelaide on Tuesday, 16 May 2017, and all stakeholders and other interested industry participants are invited attend. This workshop will provide stakeholders with the opportunity to discuss the Commission's Draft Report and AEMO's recommendations. In addition to this workshop, the Commission invites stakeholders to make written submissions on the matters covered in this Draft Report, AEMO's advice and the discussions arising from the stakeholder workshop. Stakeholders have the opportunity to provide any additional information, raise matters, and provide any other research and analysis to inform the Commission's decision-making process.

With the conclusion of stakeholder consultation, the Commission will prepare a Final Report for release in July 2017.

1 Introduction

The Essential Services Commission (**Commission**) is a statutory authority established as an independent economic regulator and advisory body under the Essential Services Commission Act 2002 (**ESC Act**).

The Commission has economic regulatory responsibility in the water, sewerage, electricity, gas, rail and maritime services, and a general advisory function on regulatory and economic matters. The ESC Act and various industry Acts together provide the Commission with those regulatory and advisory powers and functions.

Under the ESC Act the Commission has the primary objective of:

... protection of the long term interests of South Australian consumers with respect to the price, quality and reliability of essential services.

In June 2016, the Commission commenced an Inquiry under Part 7 of the ESC Act into the licence conditions which the Commission should apply to the electricity generators which it licenses under the Electricity Act 1996 (**Electricity Act**). This is the third review that the Commission has conducted into similar matters – following earlier reviews of licence conditions for wind-powered generators in 2005 and 2010.

Since the 2005 review, the Commission has placed additional conditions on wind-powered generators, requiring them to meet the highest performance standards under the National Electricity Rules (**NER**). A key focus for this Inquiry is whether or not those existing conditions should be maintained, enhanced or otherwise altered, and includes a consideration of their application to all electricity generators or other parties.

The technical conditions are in place because the national framework does not deal adequately with the technical and system impacts of inverter-connected (or non-synchronous) electricity generators. Were such a framework in place for existing inverter-connected electricity generators and other emerging generation and storage technologies, specific licence conditions in South Australia might be unnecessary.

1.1 Background

The Commission's primary objective under the ESC Act is to protect the long-term interests of South Australian consumers with respect to the price, quality and reliability of essential services.

The Commission's role and functions in the electricity sector are set out in the Electricity Act. One of those functions is to licence electricity generators. Under the Electricity Act, a person is not permitted to generate electricity (other than for their own use or if the generator is small with a maximum nameplate output of 100 kVA or less) unless they hold a licence issued by the Commission.²

In performing that function, the Commission has, since 2005, put in place, through licence conditions under the Electricity Act, additional technical requirements for wind-powered electricity generators in South Australia. Those conditions oblige wind-powered electricity generation licensees to provide additional capability and performance to support the network.

² For a more detailed description of the legal framework refer to Appendix A.

The need for these conditions was first identified by the Commission in a review it had completed by 2005, the scope and findings of which were further reviewed and confirmed by the Commission in 2010. Those reviews occurred in the context of the then growing interest in wind-powered electricity generation in this State. They identified that the interest was driven by the development of technologies and national climate change policy responses, with South Australia the focal point of that interest given the availability of high quality wind resources in this State and their proximity to the transmission network.

Through both the 2005 and 2010 reviews, the Commission identified that, given the different technical characteristics of wind-powered electricity generators and the likely level of investor interest in bringing such technology to market, the then prevailing provisions of the National Electricity Rules (**NER**) did not adequately cater for their integration into the South Australian power system.³

Absent those requirements, wind-powered generators could have operated in South Australia with capabilities lower than the NER permits through its negotiation framework for network connection. While the NER has provision for higher technical standards, generators are only obliged to meet the minimum standards it contains. The Commission's reviews identified that those lower levels were unlikely to be suitable for the future South Australian power system.

The existing national regulatory frameworks have not had, and do not appear to have, the flexibility and speed to change to meet the new challenges presented by the rapid emergence of these new technologies. The Commission has been driving change in this area since 2005, when it first introduced special licence conditions to cater for the differing electrical and physical characteristics of wind-powered generators compared to existing conventional generators. These special conditions required new wind-powered generators to meet higher performance standards than were specified under the NER at the time.

In that context, the Commission's licence conditions require licensees to have plant and equipment in place that will meet the highest standards permitted, but not required, under the NER for access to the network in terms of their ability to ride through faults and disturbances on the network and to provide reactive power. Specifically, they require large wind-powered electricity generators connected to the network:

- ▶ to have a capability at the highest standard provided under the NER, to ride through a fault or event on the power system (referred to as the fault ride-through capability), and
- ▶ to generate and absorb reactive power and to control voltage during and immediately after a fault at the highest standard provided under the NER (referred to as reactive power capability). This additional capability is required so that:
 - a contribution to local voltage control is made during, and immediately, after a disturbance, and
 - the impact of further wind-powered electricity generators on the power system would be minimised, thereby deferring the time at which voltage control might become an issue.

³ For a more detailed discussion of the history of this matter refer to Appendix B.

The conditions also impose requirements in relation to:

- ▶ central dispatch⁴
- ▶ wind forecasting⁵
- ▶ ancillary services,⁶ and
- ▶ medium sized wind-powered electricity generators rated at between five and 30 MW (which have lesser technical requirements placed on them).⁷

In implementing the conditions, the Commission recognised that a state-based licensing solution is a second-best outcome and that these technical matters ought to be addressed at the national level (through the NER). In that sense, the Commission has always regarded the conditions as transitional.

1.2 Purpose of the Inquiry

Since 2010, the underlying generation mix in South Australia has changed markedly. There has been a shift from large-scale, synchronous, centrally-dispatched generation towards distributed and intermittent (or variable) non-synchronous generation, connected to the power system through solid state inverters. These include wind-powered electricity generators, as well as a growing proportion of non-dispatched solar photovoltaic (PV) systems throughout the distribution grid.

The displacement of thermal power stations (such as at Port Augusta) and the proliferation of wind and inverter-connected generation sources was never anticipated nor was it adequately catered for under the existing national regulatory rules and arrangements.

In the past, when large, synchronous, thermal generators were retired they were replaced by other thermal synchronous generators with similar electrical and physical characteristics. Over recent years, the increasing proliferation of non-synchronous generators combined with the withdrawal of ageing synchronous generators has meant that the inherent properties and qualities of large synchronous generators and the essential system services that they provided are becoming scarce. When the National Electricity Market (NEM) was established in 1998, there was little prospect of significant amounts of wind-powered generation, grid-scale (or even small-scale) solar photovoltaic arrays or other inverter-connected non-synchronous generation, nor was the prospect of large-scale battery storage realistically anticipated.

Rapid technological advances, changing climate change policies and shifting customer consumption patterns and behaviour, mean that the traditional model of energy being produced by large synchronous electricity generators is under challenge. Further, the underpinning national regulatory rules and arrangements were not designed to directly address the associated challenges.

The prospect that the power system, particularly in South Australia, may at times, operate only with non-synchronous generators, is a real one. Managing such a system requires a different approach because of differing characteristics between non-synchronous and synchronous generators.

⁴ Wind generators must not apply to be classified as a non-scheduled generator under the NER.

⁵ Under the NER, all semi-scheduled wind generators are required to provide data for wind forecasting and the wind licence conditions extend this to all wind generation in South Australia.

⁶ To ensure that the performance of wind generators is considered in the allocation of the costs of ancillary services, all wind generators in South Australia must be registered as market generators.

⁷ The need, or otherwise, for these smaller generators to be classified as semi-scheduled is assessed on a case by case basis.

This changing generation mix will ultimately impact on all generation markets – South Australia, Australia and internationally. However, with an abundance of renewable energy sources, South Australia has both the benefit and challenge of being a world leader in this regard. The precise nature of the future is uncertain; it will depend on many factors. From a broader perspective, this transition is more about making the South Australian power system security highly adaptable and resilient to changes the future may bring.

The present nature of the power system emphasises the need for short-term adjustments to the current framework to allow for both conventional generation and newer technologies to co-exist during transition – hence the need to consider the Commission’s current licensing arrangements and the reviews being undertaken by national bodies such as AEMO, the Australian Energy Market Commission (AEMC) and the Chief Scientist of Australia, Dr Alan Finkel.

1.3 Scope

As noted earlier, the Commission is conducting this Inquiry to review the special licence conditions and technical standards applicable to electricity generators.

The Inquiry is focusing on the technical licensing requirements for electricity generators to determine whether or not additional requirements continue to be required for South Australia and, if so, what form they should take and to whom they should apply.

In particular, the Commission is inquiring into:

- ▶ whether the current licence conditions for the grid connection of wind-powered electricity generators should be removed, retained or varied, and
- ▶ whether any additional or amended technical requirements should be imposed on other grid-scale inverter-connected electricity generators (such as solar generation) or other generation technologies and sources (including conventional synchronous generation).

As a part of this Inquiry, the Commission has sought advice from AEMO on the appropriate technical standards for electricity generators (**Final Advice**). AEMO’s Final Advice to the Commission is attached as Appendix D (or may be accessed from the Commission’s website⁸).

During the course of this Inquiry, AEMO will update its advice to the Commission once submissions are received at the conclusion of the Commission’s consultation process on this Draft Report.

With the conclusion of stakeholder consultation, the Commission will prepare a Final Report for release in July 2017.

⁸ AEMO, *Recommended technical standards for generator licensing in South Australia*, Final advice to the Commission, 31 March 2017, available at <http://bit.ly/Inquiry-SAGeneratorLicensingArrangements-RecommendedTechnicalStandards-AEMOAdvice>.

1.4 Work undertaken by other parties

Several reviews related to this Inquiry are under way or have been completed recently including:

- ▶ AEMO's joint work with the AEMC on the System Security Market Framework Review⁹
- ▶ AEMO's Future Power System Security program (FPSS)¹⁰
- ▶ the Independent Review into the Future Security of the National Electricity Market by the Chief Scientist of Australia (**Finkel Review**),¹¹ and
- ▶ AEMO's investigations into recent power system events (including the Black System event¹²).

The Commission and AEMO continue to monitor the developments in these areas.

⁹ AEMC, *System Security Market Framework Review*, July 2016, available at: <http://www.aemc.gov.au/Markets-Reviews-Advice/System-Security-Market-Frameworks-Review>.

¹⁰ AEMO, *Future Power System Security Program*, available at: <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/FPSSP-Reports-and-Analysis>.

¹¹ Australian Government Department of the Environment and Energy, *Independent Review into the Future Security of the National Electricity Market*, available at: <http://www.environment.gov.au/energy/national-electricity-market-review>.

¹² AEMO, *Black System South Australia 28 September 2016*, March 2017, p. 9, available at: http://aemo.com.au/-/media/Files/Electricity/NEM/Market_Notices_and_Events/Power_System_Incident_Reports/2017/Integrated-Final-Report-SA-Black-System-28-September-2016.pdf.

2 Matters raised by stakeholders

On 2 December 2016, the Commission published an Issues Paper¹³ for this Inquiry which sought feedback from stakeholders on key issues. Twelve submissions¹⁴ were received to the Issues Paper as outlined in Table 2.1.

Table 2.1 – Submissions received to the Issues Paper

Contributor	Role
AGL Energy (AGL)	Generator/Retailer
Australian Energy Council (AEC)	Peak body
Clean Energy Council (CEC)	Peak body
Department of State Development (DSD)	South Australian Government
ElectraNet	Transmission network service provider (NSP)
Energy & Water Ombudsman SA (EWOSA)	Independent Ombudsman
ENGIE	Generator/Retailer
K Summers	Private individual
Meridian Energy Australia	Renewable energy developer and generator
Reach Solar Energy	Solar generation developer
SA Power Networks	Distribution NSP
Tilt Renewables	Wind-powered generator and developer

2.1 Consideration of matters raised by stakeholders

The issues raised by stakeholders were carefully considered. Where relevant, certain arguments and submissions have been mentioned in the text of this Draft Report, either by direct quotation or by reference to themes or arguments, to assist stakeholders to understand the proposed positions that have been reached.

However, a failure to reference an argument or submission does not mean that it has not been taken into account in reaching the proposed positions. While not all of the positions received during consultation have been accepted, all views expressed during consultation have assisted in informing the Commission's consideration of each of the relevant issues and viewpoints.

¹³ The Commission's, *Issues Paper: Inquiry into licensing arrangements under the Electricity Act 1996 for inverter-connected generators*, 2 December 2016, is available at: <http://www.escosa.sa.gov.au/ArticleDocuments/1046/20161202-Inquiry-LicensingArrangementsInverter-connectedGenerators-IssuesPaper.pdf.aspx?Embed=Y>.

¹⁴ Submissions are available at: <http://www.escosa.sa.gov.au/projects-and-publications/projects/inquiries/inquiry-into-licensing-arrangements-for-inverter-connected-generators>.

2.2 Key issues raised in submissions

The issues emerging from submissions can be broadly themed into the following:

- ▶ **Existing frameworks are working/regulatory duplication:** The NER provides a framework for AEMO and a new generator wishing to connect to the power system and achieve the desired outcomes. Any additional conditions required by the Commission creates regulatory duplication.
- ▶ **Application of new licensing conditions to existing licensees:** The application of new licensing conditions would require existing licensees to incur additional cost conditions. Further, there is potential for sovereign risk, unforeseen higher costs, and stranding of assets.
- ▶ **Technology neutral:** Application should be to both synchronous and non-synchronous generation irrespective of the underlying technology.
- ▶ **Market solutions preferred:** If change is required then market-based solutions should be the preferred mechanism to source the requisite power system services.
- ▶ **Consultation:** No decisions should be made without a detailed technical analysis followed by wider consultation across the industry.
- ▶ **Additional matters:** Concerns were expressed with the forecasting/dispatch processes, the proper functioning of ancillary markets and the allocation of costs, and concerns that the design and implementation of the market rules and the behaviour market participants are having on the achievement of good power engineering system practice.

The Commission's draft position on those matters is set out below.

2.2.1 Existing frameworks are working/regulatory duplication

2.2.1.1 Submissions

Several submissions questioned the need for jurisdictional licence conditions, stating that the NER already provides AEMO with the ability to manage the connection of new generators through the negotiated framework for generator performance standards (GPS).¹⁵ In particular, stakeholders expressed views that inclusion of the Commission's licence conditions are unnecessary and an additional layer of regulation.¹⁶

Tilt Renewables noted that if technology is replaced or upgraded at the end of a generator's life, then there would be a requirement under the NER to re-negotiate the GPS. Should the Commission demonstrate a need for special conditions to the licences, they could potentially be re-considered at times of significant technology upgrade or replacement.¹⁷

¹⁵ AGL Energy, submission to *Inquiry into licensing arrangements under the Electricity Act 1996 for inverter-connected generators*, Issues Paper, January 2017, p. 4, available at <http://bit.ly/Inquiry-SAGeneratorLicensingArrangements-Submission-AGL>; AEC submission to *Inquiry into licensing arrangements under the Electricity Act 1996 for inverter-connected generators*, Issues Paper, February 2017, p. 1, available at <http://bit.ly/Inquiry-SAGeneratorLicensingArrangements-Submission-AustEnergyCouncil>; CEC, submission to *Inquiry into licensing arrangements under the Electricity Act 1996 for inverter-connected generators*, Issues Paper, January 2017, p. 5, available at <http://bit.ly/Inquiry-SAGeneratorLicensingArrangements-Submission-CleanEnergyCouncil>; ENGIE submission to *Inquiry into licensing arrangements under the Electricity Act 1996 for inverter-connected generators*, Issues Paper, January 2017, p.3, available at <http://bit.ly/Inquiry-SAGeneratorLicensingArrangements-Submission-ENGIE>; Reach Solar, submission to *Inquiry into licensing arrangements under the Electricity Act 1996 for inverter-connected generators*, Issues Paper, January 2017, p. 16, available at <http://bit.ly/Inquiry-SAGeneratorLicensingArrangements-Submission-ReachSolarEnergy>; Tilt Renewables, submission to *Inquiry into licensing arrangements under the Electricity Act 1996 for inverter-connected generators*, Issues Paper, January 2017, pp. 1-2, available at <http://bit.ly/Inquiry-SAGeneratorLicensingArrangements-Submission-TiltRenewables>.

¹⁶ AGL Energy, submission to Issues Paper, pp. 1-2; ENGIE, submission to Issues Paper, p. 3.

¹⁷ Tilt Renewables, submission to Issues Paper, p 3.

DSD supported the continuation of applying state licence conditions in South Australia, as it considers the current licence conditions for grid connection of wind power electricity are necessary to cater for the State's unique circumstances.¹⁸

2.2.1.2 Commission's consideration

The Commission's position has been that a national or NEM-wide approach to GPS is preferable. As noted in its request for advice to AEMO and in its Issues Paper, the Commission has consistently stated that its focus, in relation to its responsibilities in licensing and regulating generators, is to remove any unnecessary local requirements once it is satisfied that the NER deal adequately with power system integrity and reliability issues posed by intermittent generation in this State.

In its request for advice to AEMO, the Commission asked whether the current licence conditions for wind generators be retained, removed or varied and whether they should also be applied to inverter-connected generators.¹⁹ Rather than recommend removal of these special conditions, the Commission notes that AEMO, as a national body, identified that the NER (and incorporating technical standards) are insufficient to meet the State's current circumstances and that the GPS as defined in the NER require updating (including providing greater clarification) to reflect the needs of a changing power system.

Further, AEMO's review of the Black System event has led it to recommend to the Commission several changes to generation licence conditions in South Australia and to request to the AEMC that similar changes be made to the NER, to address deficiencies in performance standards identified.²⁰

In its report on the Black System event, AEMO advised the Commission that it intends to submit a Rule change to the AEMC, by July 2017, requesting appropriate revisions. In the interim, AEMO sees it as appropriate to maintain special licence conditions that apply in South Australia because of the unique characteristics of its power system.

The Commission therefore maintains that until amendments are made to the NER it is appropriate for the Commission to include special licence conditions to account for the specific characteristics of the South Australian power system.

2.2.2 Application of proposed conditions to existing licensees

2.2.2.1 Submissions

Several submissions supported the Commission applying new licence conditions to existing licensees in certain circumstances.²¹

¹⁸ DSD, submission to *Inquiry into licensing arrangements under the Electricity Act 1996 for inverter-connected generators*, Issues Paper, January 2017, p. 1, available at <http://bit.ly/Inquiry-SAGeneratorLicensingArrangements-Submission-DeptStateDevelopment>.

¹⁹ The Commission's request for advice to AEMO is available at http://www.escosa.sa.gov.au/ArticleDocuments/1046/20161202-Inquiry-RequestForAdvice_WindFarmAndInverterGeneration-ESCOSAletter.pdf.aspx?Embed=Y.

²⁰ AEMO, *Black System South Australia 28 September 2017*, p. 9.

²¹ DSD, submission to Issues Paper, p. 2; ElectraNet submission to *Inquiry into licensing arrangements under the Electricity Act 1996 for inverter-connected generators*, Issues Paper, January 2017; p. 3, available at: <http://bit.ly/Inquiry-SAGeneratorLicensingArrangements-Submission-ElectraNet>; EWOSA, submission to *Inquiry into licensing arrangements under the Electricity Act 1996 for inverter-connected generators*, Issues Paper, January 2017, p. 1; available at: <http://bit.ly/Inquiry-SAGeneratorLicensingArrangements-Submission-EWOSA>; SA Power Networks submission to *Inquiry into licensing arrangements under the Electricity Act 1996 for inverter-connected generators*, Issues Paper, January 2017, p. 2, available at <http://bit.ly/Inquiry-SAGeneratorLicensingArrangements-Submission-SAPowerNetworks>.

ElectraNet and SA Power Networks submitted that while, as a general principle, new licence conditions do not apply to existing licensees, there may be some cases where the existing licensees' equipment is able to meet new conditions at a low cost. As such, the Commission should limit the application of any new conditions to those required to comply in a cost effective manner.²²

DSD's submission also noted that it is not unusual for energy entities to comply with changes in laws or rules so long as there has been reasonable consultation and an assessment of the costs and benefits. Further, DSD considers that existing generators will be significant beneficiaries of security in the power system and therefore any additional conditions that ensure security of the South Australian power system should be applied to new and existing generators.²³

However, several submissions expressed concerns regarding the Commission applying changes, or additional licence conditions, to existing generators.²⁴ In particular, several generators or peak bodies representing energy generators and retailers submitted that there is a risk that imposing new conditions for some existing licensees may not be financially viable and may lead to investment uncertainty and sovereign risk.²⁵ The AEC also noted that it may not be technically possible to alter some existing generators.²⁶

AGL and the AEC also submitted that market-based solutions were preferred but, if the market was unable to deliver, contracts could be established to procure the additional services required.²⁷

2.2.2.2 Commission's consideration

The Commission takes a considered and measured approach to making changes to regulatory instruments that may affect current licensees but this is balanced against the need to ensure that the Commission is able to meet its primary objective of protecting the long-term interests of consumers.

The application of any new licence conditions to new entrant generators does not resolve the issues that the electricity network in South Australia is currently experiencing or is likely to experience in the near future with the current generation fleet. It is likely then that the benefits of these recommendations would not necessarily be realised for a number of years.

Further, there are a number of existing generators in South Australia that will continue to be operational for a similar timeframe as any new generators. There may be a need in some circumstances for current generators to provide the additional capabilities detailed to improve system security and resilience in the long term.

Accordingly, the Commission's preliminary position is that there may be a need for current licensed generators to provide additional capabilities and services to the power system to meet the specific challenges faced in South Australia. However, the Commission also recognises that there may be some current licensed generators that are unable to meet those additional requirements and the costs to upgrade plant to meet such capabilities would be inefficient.

²² ElectraNet, submission to Issues Paper, p. 3; SA Power Networks, submission to Issues Paper, p. 2.

²³ DSD, submission to Issues Paper, p. 2.

²⁴ AGL, submission to Issues Paper, p. 5; AEC, submission to Issues Paper, pp. 1-2; CEC, submission to Issues Paper, p. 14; ENGIE, submission to Issues Paper, p. 4; Meridian Energy submission to *Inquiry into licensing arrangements under the Electricity Act 1996 for inverter-connected generators*, Issues Paper, January 2017; p. 2, available at: <http://bit.ly/Inquiry-SAGeneratorLicensingArrangements-Submission-MeridianEnergy>; Reach Solar Energy; submission to Issues Paper, pp. 13-14; Tilt Renewables, submission to Issues paper, pp. 2-3.

²⁵ AGL, submission to Issues Paper, p. 5; AEC, submission to Issues Paper, pp. 1-2; ENGIE, submission to Issues Paper, p. 4; Meridian Energy; submission to Issues Paper, p. 2; Reach Solar Energy, submission to Issues Paper, pp. 13-14; Tilt Renewables, submission to Issues paper, pp. 2-3.

²⁶ AEC, submission to Issues Paper, pp. 1-2.

²⁷ AGL, submission to Issues Paper, pp. 4-5; AEC, submission to Issues Paper, p. 2.

The Commission has identified the following possible approaches to applying new licence conditions to existing licensees:

- ▶ not apply the new licence conditions to an existing licensee
- ▶ apply the new licence conditions to existing licensees – unless the licensee can provide sufficient evidence that they are either unable to meet any of these additional requirements or that it would be inefficient to do so, or
- ▶ apply all or some of the new licence conditions to existing licensees.

The Commission proposes to work with existing licensees and with AEMO to assess the extent of any barriers and costs involved for existing licensees to meet any proposed new licence conditions. This will include seeking information on the current capability of specific generators to provide the proposed services as required by any new licence conditions, the type of generation equipment and associated plant, any costs involved to upgrade the generator capabilities including to plant and communication systems, and any benefits that may arise from providing these services.

2.2.3 Technology neutral

2.2.3.1 Submissions

The CEC raised concerns that applying additional licence conditions to only inverter-connected generators may penalise one technology type over another.²⁸ It recommended that a framework should be created that applied to all generating technologies.²⁹

However, Meridian Energy and Reach Solar submitted that inverter technology can provide additional benefits that synchronous generators cannot. Furthermore, Meridian Energy also noted that new conditions pertaining to frequency control, the rate of change of frequency and system strength would provide all participants with clarity and ensure that current and future technologies align with the prevailing regulatory environment.³⁰

2.2.3.2 Commission's consideration

Throughout this Inquiry, the Commission has advocated a technology neutral approach to the adoption of technical standards or conditions – primarily so as not to harm innovation nor to create any unnecessary artificial barriers to market entry.

The Commission notes that unless there are unavoidable technical limitations as to why a given technology cannot provide a particular service characteristic, standards should apply consistently to all generation types (subject to size thresholds). In this respect, AEMO has advised that its recommendations have been developed with a view that they should apply to both synchronous and non-synchronous generation where technically feasible to do so.

AEMO has recommended that the Commission require additional licence conditions on all new generators (regardless of technology) such that the South Australian generation fleet is equipped with the capabilities needed to provide a secure and resilient power supply. However, AEMO also noted that there will be a need to recognise the differences between the capabilities of various technologies and that licence conditions must be flexible to suit; for example, where there are fundamental physical differences between the capabilities of synchronous and non-synchronous generators, such as the capabilities:

²⁸ CEC, submission to Issues Paper, p. 13, Reach Solar Energy, submission to Issues Paper, p. 14.

²⁹ CEC, submission to Issues Paper, p. 8.

³⁰ Meridian Energy, submission to Issues Paper, p. 1; Reach Solar Energy, submission to Issues Paper, p. 14.

- ▶ to provide inertia (and system strength) by synchronous generators (that non-synchronous generators cannot provide to the same extent), or
- ▶ to respond to very high rates of change of frequency by inverter-connected non-synchronous generators (that is not possible by synchronous generators and some non-inverter-connected non-synchronous generators).

The Commission has considered the concerns raised by stakeholders to date and notes that any differences in licence conditions will only occur where differences in the capability of the technology make it infeasible for certain generators to comply with a licence condition.

The Commission is of the preliminary view that AEMO's proposals satisfy the concerns raised by stakeholders.

2.2.4 Market solutions preferred

2.2.4.1 Submissions

Many submissions to the Issues Paper stated that should change be required then market-based solutions are the preferred mechanism to provide incentives for the competitive delivery of the requisite power system services rather than requiring licence conditions or the mandating of any particular solution.³¹ In particular, AGL³² noted that:

...a number of technical and market solutions can more appropriately and cost effectively address underlying power system performance – when compared to imposing a greater regulatory burden on wind farms and other emerging technologies.

AGL also noted that:

A market-based approach to reactive power and frequency control requirements will provide the right incentives for wind, or solar, farm proponents to consider providing these two services as part of their connection – if it is in their commercial interests to do so.

The AEC also noted that:

Market based solutions are the most effective option where it is identified that the market can appropriately take the place of regulatory prescription.³³

2.2.4.2 Commission's consideration

The Commission has noted its general preference for an appropriate market-based response to meet the needs, and the protection, of the long-term interests of consumers.

In 2005, the Commission introduced licence conditions for wind generators as it considered, at the time, that the rapid growth in wind-powered generators seeking to connect to the power system posed potential problems for the power system and consumers. In the decade or so since then, the market and the national rules have yet to move on to the point that South Australian consumers' needs are adequately protected.

³¹ AGL, submission to Issues Paper, p. 2, AEC, submission to Issues Paper, p. 2; ElectraNet, submission to Issues Paper, p. 3; ENGIE, submission to Issues Paper, p. 1; Reach Solar Energy, submission to Issues Paper, p. 14.

³² AGL, submission to Issues Paper, p. 2.

³³ AEC, submission to Issues Paper, p. 2.

Given the limited level of uptake in the ancillary services markets by generators other than incumbent thermal synchronous generators, changes may be required to ensure that all new generators be required to have the capability to provide these ancillary services (also referred to as system security services) if directed by AEMO where required.

2.2.5 Consultation

2.2.5.1 Submissions

Some stakeholders also suggested that the Commission should not make any decisions without a detailed technical analysis followed by wider consultation across the industry.³⁴

2.2.5.2 Commission's consideration

The Commission's Charter of Consultation and Regulatory Practice³⁵ outlines how it proposes to engage with stakeholders including:

...consulting with particular respondents or affected parties to ensure that we have the best access to all relevant facts and evidence...

... We aim to be accessible and make sure that stakeholders have the opportunity to provide information, to raise concerns, and to present research and analysis to inform our decision making processes...

Our determinations and recommendations are a result of weighing this evidence and making the necessary trade-offs to ensure the long-term interests of South Australian consumers of essential services are protected.

In order to inform its deliberations on the matter of licensing conditions for generators, the Commission sought detailed technical advice from AEMO, which is attached to this Draft Report. The Commission's intention is to encourage an open discussion on the matters raised in its Issues Paper, this Draft Report and the recommendations included in AEMO's Final Advice. As previously noted, the Commission will consult for a six-week period on both AEMO's advice and its own Draft Report and will also host a stakeholder workshop in Adelaide on Tuesday, 16 May 2017.

2.2.6 Additional matters

Cost benefit analysis of proposals

Several stakeholders recommended that the Commission undertake a cost benefit analysis of any proposed changes to licence conditions for either new or existing generators.

The Commission is seeking, through consultation on this Draft Report, to review the impacts of the proposed requirements on individual licensees. Stakeholders will have the opportunity to provide information and analysis to inform the Commission's analysis of the costs and benefits of the proposals.

AEMO has advised that in arriving at its recommendations for the technical standards for generator licensing in South Australia that it has sought to minimise regulatory costs, where possible.

³⁴ Tilt Renewables, submission to Issues Paper, p. 1 and AGL, submission to Issues Paper, p. 5.

³⁵ The Commission's *Charter of Consultation and Regulatory Practice*, September 2014, p. 5, available at: <http://www.escosa.sa.gov.au/consultation/charter-of-consultation-and-regulatory-practice>.

Matters falling outside the scope of the Commission's remit

During consultation, some matters were raised that were out of the scope for the Inquiry. While the Commission has considered these matters, they relate to issues that are outside the Commission's remit and fall within the responsibility of AEMO or other regulators.

These additional matters relate to concerns with forecasting and dispatch processes, the proper functioning of ancillary markets and the allocation of costs, and that the NER are driving behaviours of market participants that may be compromising good power engineering system practice.

The Commission notes that these additional matters are being addressed by several other reviews including:

- ▶ the Finkel Review
- ▶ AEMO's review of FCAS markets and the causer pays regime
- ▶ AEMC/AEMO System Security Frameworks Review, and
- ▶ AEMO's Future Power Systems Security Program.

The Commission will therefore not pursue these matters through this Inquiry.

3 Matters considered by AEMO

The Commission has received AEMO's Final Advice³⁶ on its recommendations for the technical standards to apply to generators seeking to connect to the South Australian power system. The Commission is now seeking feedback from stakeholders and other industry participants on AEMO's recommendations.

In preparing its Final Advice to the Commission, AEMO has considered stakeholders' submissions raised in response to the Commission's Issues Paper, as well as its consideration of the several reviews under way. In addition, AEMO has consulted with technology providers, international grid operators and has also engaged consultants expert in the integration of non-synchronous machines into power systems. In addition, AEMO's advice has been informed by its investigations into the South Australian Black System event.

From its analysis into these investigations and these other reviews, AEMO has highlighted that the power system in South Australia is likely to experience the following situations more frequently:

- ▶ the increasing possibility of long periods where the ratio of non-synchronous to synchronous generation is very high
- ▶ periods where the South Australian power system was separated (or islanded) from the national electricity network or that islanding was a credible contingency, and
- ▶ periods of low or zero demand due to increasing volumes of generation within the distribution network.³⁷

AEMO has noted that the high proportion of non-synchronous, intermittent generation in South Australia means that the impact of this type of generation technology on the power system is significantly greater than elsewhere in the NEM.

It has reaffirmed that, as a consequence of the changing dynamics of the power system and consumer actions and behaviour, the Commission should retain a considered and measured approach to generator licensing.

Furthermore, AEMO has concluded that this warrants additional or tighter technical standards than those that currently apply. AEMO is recommending to the Commission that all future generation licences approved by the Commission should be subject to additional conditions, over and above the current set of licence conditions, in order to provide greater ability to manage the technical changes affecting the South Australian power system.

AEMO also advises that for the South Australian power system to be resilient and to operate securely under the above situations, it is no longer appropriate to rely on synchronous generators alone to provide the power system with the essential system services necessary for its proper functioning. AEMO has recommended that these essential system services will need to be obtained from non-synchronous generators or as network services. The transition to a power system dominated by non-synchronous generation technologies, like wind, solar and batteries, will require these generators to provide some of the services previously offered by synchronous plant.

³⁶ AEMO, *Recommended technical standards for generator licensing in South Australia*, Final advice to the Commission, 31 March 2017, available at <http://bit.ly/Inquiry-SAGeneratorLicensingArrangements-RecommendedTechnicalStandards-AEMOAdvice>.

³⁷ This low or zero demand can result from the substantial volume of small scale rooftop solar systems embedded throughout the distribution network which effectively serves consumers demand first thereby offsetting the need for large scale generation (at the wholesale market level).

AEMO has proposed to the Commission that careful consideration must be given to ensuring a secure, resilient, and reliable power system for the State in the context of a greater, and variable, proportion of non-synchronous generation. Among others, AEMO's key recommendations are that new generators should provide the following capabilities:

- ▶ power system voltage and frequency disturbance ride-through, and
- ▶ active power control.

AEMO does not recommend relaxation of the existing power system disturbance (or fault) ride-through and reactive power licence conditions, although changes have been recommended to how these conditions are expressed.

Furthermore, AEMO has advised the Commission to apply these recommendations on all new generators (regardless of technology) such that the South Australian generation fleet is armed with the capabilities to provide a secure and resilient power system.

A broad outline of AEMO's recommendations follow with more detail contained in its Final Advice to the Commission (refer to Appendix D).

3.1 AEMO's recommendations

The key elements of AEMO's recommendations seek to ensure that generators are better able to ride through power system disturbances and, with active power controls, will have the ability to both better control their energy output during a dispatch period as well as being able to assist with the control of voltage and frequency if required. These two key elements are briefly outlined below with AEMO's specific recommendations following.

Voltage and frequency disturbance ride-through recommendations

From its analysis of the Black System event, AEMO has recommended more detailed standards for the fault ride-through capability of both synchronous and non-synchronous plant including:

- ▶ Greater clarity on performance requirements under low and high voltage conditions – that is, how long generation must stay connected if voltage is higher or lower than nominal during a fault. This will include provisions that more clearly specify how plant should operate while it is riding through to support secure operation of the power system.
- ▶ Requirements for generators to ride through multiple faults, regardless of number up to a cumulative time limit consistent with best practice international standards.
- ▶ Requirements to withstand frequency changes over and above what is in the current Rules.

Active power control recommendations

Frequency control ancillary services (**FCAS**) are used to maintain the power system in a nominal band that supports the ongoing secure operation of the power system. Currently, FCAS is provided by precisely increasing or decreasing the active power output from generators. To date, no wind or solar plant has provided these active power services.

AEMO has recommended that all new entrant plant, whether synchronous or non-synchronous, have active power control capability to:

- ▶ provide regulation and contingency FCAS services
- ▶ be controlled by AEMO via Automatic Generation Controls (**AGC**)

- ▶ limit changes in active power output in each five minute dispatch period, and
- ▶ communicate the status of its active power controls in real time.

Furthermore, AEMO has recommended that all new entrant generators register for FCAS, which will allow for these frequency capabilities to be used if required.

Summary of AEMO's specific recommendations

AEMO's recommendations to the Commission include the consideration of a range of matters including:

- ▶ static and dynamic reactive power requirements
- ▶ voltage control capability
- ▶ performance during, and subsequent to, contingency events
- ▶ inertia
- ▶ system strength (except to ensure that plant is designed to maintain certain standards), and
- ▶ fast frequency response (FFR)
- ▶ active power control facilities
- ▶ the ability to assist with system restart
- ▶ the provision of simulation models, and
- ▶ regular updates to the Commission's framework.

AEMO has not recommended that generator licence conditions include the requirement to provide electrical inertia or system strength (or fast frequency response). AEMO considers that prescriptive requirements on new or existing South Australian plant, alone, would be inefficient and, instead, is considering alternative means to procuring these services which are being considered as part of other concurrent broader technical reviews.

AEMO's specific recommendations are outlined below and greater detail is provided in AEMO's Final Advice (refer Appendix D).

3.1.1 Static and dynamic reactive power requirements

AEMO has recommended to the Commission that the current model licence conditions (included as Appendix C) relating to reactive power capability (clauses 10.1, 10.2, 10.3, and 10.4) should be replaced with a new set of licence conditions defined in terms of a generator's performance during, and subsequent to, contingency events and system disturbances. These new conditions build upon the existing benchmark for reactive power capability in South Australia, while better describing how it will be used.

Under this recommendation, generators will still be required to supply sufficient reactive power to meet the performance obligations specified within the GPS negotiated under NER schedule 5.2.5 and defined in the Commission's licence conditions.

3.1.2 Voltage control capability

Flexibility in the control characteristics of generation enables operation of the power system to be optimised. The ability to use the reactive power capability of a generator to control voltage during normal operations allows the power transfer capability of the system to be maximised.

AEMO has recommended that the existing licence conditions relating to voltage control (10.5, 10.6, and 10.7) should be retained. While the licence conditions generally reflect the NER clause S5.2.5.5 and S5.2.5.13 requirements, the NER does not impose mandatory voltage control for generators connection to systems rated at less than 100 kV. AEMO considers that voltage control within distribution networks to be highly beneficial and for this reason recommends retention of the current model licence conditions set out in 10.5, 10.6 and 10.7.

3.1.3 Performance during and subsequent to contingency events

To ensure that generators provide supportive and coordinated responses during, and subsequent to, contingency events, AEMO has proposed that the performance of generators should be explicitly defined (in greater detail than is present in the existing NER and the Commission's generator licence conditions). Conditions are proposed that prescribe and provide greater clarity of the performance of generators during the following:

- ▶ contingency (fault) events
- ▶ in the recovery period following the clearance of faults events
- ▶ in the event of multiple contingency events occurring, and
- ▶ for voltage disturbance (under and over voltage) events.

AEMO has recommended that the Commission's licence conditions for disturbance ride-through capability is amended to cover:

- ▶ active power and reactive power responses to a variety of network disturbances
- ▶ under and over voltage disturbance ride-through
- ▶ a requirement for generators to remain in continuous uninterrupted operation for a number of repeated fault events
- ▶ stronger frequency disturbance ride-through capabilities
- ▶ combined voltage and frequency disturbance ride-through capabilities, and
- ▶ the ability to withstand certain voltage phase angle shifts.

These performance requirements have been specified to ensure that all generators act in a coordinated manner to support the network insofar as possible during contingency events and ensure that in the period following contingency events, all available resources can be used to stabilise and secure the power system.

3.1.4 Inertia

AEMO has recommended that the Commission does not introduce any generator licence conditions associated with the provision of inertia.

AEMO is currently providing active support to the AEMC, which is progressing a proposed Rule change regarding new market or regulatory arrangements for investment and dispatch of inertia and FFR services in the NEM.

3.1.5 Fast frequency response

AEMO advises that analysis has shown that enabling FFR services in the NEM may allow the frequency operating standards to be met with a lower level of synchronous inertia, and potentially a lower cost in the long term. However, there is little global experience in procuring or operating FFR, and careful consideration of the specific requirements of the NEM will be required.

AEMO has indicated that its recommendations regarding active power control capabilities are seen as broadly compatible with FFR provision from generators, without prescribing at this time specifically how these responses must be delivered. Therefore, AEMO has not recommended additional licence condition requirements specifically for FFR capability.

3.1.6 System strength

To address the underlying drivers of reductions in system strength, AEMO has recommended that the Commission considers:

- ▶ a licence condition on NSPs to maintain a short circuit ratio at each connection point within a range agreed in each connection agreement, and
- ▶ licence conditions on connecting generators to ensure that their plant is designed to maintain certain standards, taking into account the prevailing network conditions.

3.1.7 Active power control facilities

AEMO has recommended that all new generators in South Australia have active power control facilities capable of providing the following functionality:

- ▶ capability for automatic active power response to frequency changes
- ▶ capability for automatic generation control
- ▶ capability to limit the rate of change of active power, and
- ▶ remote monitoring requirements.

These capabilities must be installed and fully tested at the time of plant commissioning, including the development of accurate simulation models. Where the generation is dependent on an inherently variable energy source, testing and commissioning of these capabilities must be performed under a range of energy input conditions.

These recommendations would not require the requisite active power control capabilities to be made continuously active, or bid into existing markets for frequency control services.

However, these capabilities must be continuously available for service – when directed to do so by AEMO, or when required to do so under any other arrangements with the local NSP and, if so desired, by the generation operator.

In order to be available for service, all new entrant generators would be required to register with AEMO for the provision of Regulation and Contingency FCAS.

3.1.8 Ability to assist with system restart

With the current state of the technology, non-synchronous generation is unable to provide system restart ancillary services (SRAS). This primarily stems from the source intermittency and the need for a minimum system strength or fault level which is not available during black system conditions. However, their contribution to voltage and reactive power control during system restoration could be important

provided that a number of synchronous machines are already restarted in order to provide the minimum fault level required for stable operation of non-synchronous generating units, dynamic reactive support plant and battery storage units.

To assist with system restoration following a potential black system event, AEMO has recommended that the Commission require certain capabilities from all new-entrant generators.

3.1.9 Simulation models

Operational experience with the South Australian power system has identified a need for clearer guidelines regarding the simulation models that generators must provide during the connection process. Until such time as these guidelines are clearly stated under the NER, AEMO recommends that, as part of the licence application process, for new generators, the Commission emphasise the following:

- ▶ pre-validation against the actual response of generating system elements including all protection or control systems deployed with the operational generator
- ▶ the provision of more detailed models where standard generating system models are deemed insufficient, and
- ▶ changing control systems and/or settings of the individual generating system elements if the submitted models exhibit uncharacteristic or unexpected responses.

The absence of a particular generator protection feature in wind farm simulation models submitted to AEMO was a relevant factor in events which led to the Black System event.

The Commission notes that the recommendations regarding simulation models is part of AEMO's process and outside the Commission's remit. However, the Commission may request licence applicants provide that information as part of its licence application where that information is required for AEMO to assess an applicant's ability to meet the Commission's licence conditions.

3.1.10 Regular updates to the Commission's framework

The power system's transition means that new technical issues affecting the operation of the NEM are likely to continue to emerge. As the energy transition progresses, the regulatory framework must also evolve in order to maintain the security and reliability of the power system. In some cases, these emerging issues are most efficiently addressed via new or updated technical standards.

AEMO has recommended that there would be merit in establishing a framework that allows the technical standards to be regularly updated to reflect changing power system needs and technological developments.

This recommendation is consistent with the approach adopted by the United States national reliability body, the North American Electric Reliability Corporation (NERC). A key conclusion of the NERC's major review of US reliability standards was that it is necessary to conduct annual updates.

AEMO has proposed that the Commission consider the costs and benefits of establishing a framework where the technical standards that apply to generator licence conditions are reviewed periodically.

The Commission notes that this recommendation is consistent with its current practice of reviewing licence conditions, but also recognises that the rate of change in the industry has increased in recent years and that there would be benefit in more frequent reviews. The Commission seeks to consult with stakeholders to determine an efficient timeframe for the review of licence conditions to ensure that they remain relevant and appropriate.

3.1.11 Additional matters

AEMO also provided comment on matters relating to the growth in small generators and energy storage systems and the potential for these to be aggregated into larger operating blocks. The potential for the growth of these systems has highlighted to AEMO the need to have access to data relating to the operation and performance of a wider range of equipment connected to the power system.

To address this challenge, AEMO has prepared a list of data requirements needed to efficiently perform its functions into the future. At the same time, AEMO is consulting with industry on the need for frameworks that will capture and make available the required data, and is collaborating with the Energy Networks Association (ENA) to explore the potential role of distribution system operators in providing this visibility.

The Commission notes AEMO's suggestion that there may be consequences in the aggregation of small generators,³⁸ which may fall outside the Commission's licensing regime, and will work with AEMO and the industry to investigate these issues and potential resolutions.

3.1.12 Application of proposed conditions to existing licensees

AEMO has recommended that the Commission considers applying some of the additional licensing conditions to existing generation licensees, having regard to:

- ▶ the physical limitations of some existing generating units
- ▶ the likely cost of enabling the capability of each generating unit, and
- ▶ the incremental benefits that would be gained by enabling existing generating units.³⁹

In particular, AEMO has recommended that the Commission explores applying additional licensing conditions on existing generating licensees in the following areas:

- ▶ voltage control capability
- ▶ susceptible items of plant within the connecting party's generating system to be capable of operating correctly down to specified system strength levels at the high voltage (HV) terminals of each item plant
- ▶ active power control capability
- ▶ disturbance ride-through capability
- ▶ simulation models, and
- ▶ system restart assistance capability.

3.1.13 Intention to submit a Rule change

Finally, AEMO has advised the Commission that it considers that the technical standards in the NER require updating as soon as is practicable. To that end, AEMO has indicated that it intends to submit a Rule change to the Australian Energy Market Commission (by July 2017) requesting appropriate revisions in accordance with the recommendations made in its advice to the Commission.

³⁸ The aggregation of small generators into larger operating blocks may create unintended consequences through sudden changes in generating output resulting in the prospect of frequency and voltage disturbances on the power system when these blocks are switched in and out of service.

³⁹ AEMO, Final Advice p. 4.

3.2 Commission's consideration

The Commission supports the general intent of AEMO's recommendations. However, it recognises that further consultation is required with industry participants regarding the general and specific details of these recommendations.

AEMO's advice to the Commission is comprehensive and extensive. Although there are specific matters considered in some detail, there are also other areas that will require working with stakeholders to progress.

As part of its consultation, the Commission will hold a workshop in Adelaide on Tuesday, 16 May 2017, and all stakeholders and other interested industry participants are invited attend. This workshop will provide stakeholders with the opportunity to discuss the Commission's Draft Report and AEMO's recommendations. In addition to this workshop, the Commission invites stakeholders to make written submissions on the matters covered in this Draft Report, AEMO's Final Advice and discussions arising from the stakeholder workshop. Stakeholders have the opportunity to provide information, raise matters, and provide any research and analysis to inform the Commission's decision-making process.

4 Next steps

The Commission seeks and welcomes all views on matters relevant to this Inquiry. Written submissions on this Draft Report are invited by Friday, 9 June 2017. Information on how to make a submission to the Inquiry is set out on the inside front cover of this Draft Report.

However, the Commission's consultation is not limited to the receipt of stakeholders' written submissions: it is seeking to engage directly with a broad range of stakeholders and will also continue to work closely with AEMO in relation to technical matters.⁴⁰

The Commission is holding a workshop (in collaboration with AEMO) on Tuesday, 16 May 2017, to discuss the Draft Report with stakeholders and to gain the benefit of their views. Intending participants should register their interest with the Commission by registering on its web site.

Following a consideration of the issues raised through consultation on the Draft Report and AEMO's recommendations, and taking into account any subsequent advice from AEMO arising from the consultation phase, the Commission will release a Final Report in July 2017.

In addition to the Final Report, the Commission will publish a set of associated draft licence conditions containing the obligations that will be required from licensees and potential licensees. Those draft licence conditions (including the timeframes for review and updating of licence conditions) will then be open for a separate consultation period with stakeholders.

Under the Inquiry provisions of the ESC Act, a copy of the Inquiry's Final Report must be provided to the Treasurer who is then required to lay before both Houses of Parliament a copy of a Final Report within 12 sitting days after its receipt.

4.1 Timetable for this review

The intended timeframes for the upcoming stages of this Inquiry are provided below.

Stage	Timing
Draft Report released	1 May 2017
Public consultation	May/June 2017
Stakeholder Workshop	16 May 2017
Consultation closes	9 June 2017
Final Report released	July 2017

⁴⁰ The Commission's approach to consultation is detailed in its Charter of Consultation and Regulatory Practice which may be accessed at: <http://www.escosa.sa.gov.au/consultation/charter-of-consultation-and-regulatory-practice>.

Appendix A — Legal Framework

Powers and functions of the Essential Services Commission under the Essential Services Commission Act 2002

The regulatory functions of the Essential Services Commission (**Commission**) are set out in Section 5 of the Essential Services Commission Act 2002 (**ESC Act**). Functions relevant to the regulation of inverter-connected generators include:

5 – Functions

The Commission has the following functions:

- (a) *to regulate prices and perform licensing and other functions under relevant industry regulation Acts;*
- (b) *to monitor and enforce compliance with and promote improvement in standards and conditions of service and supply under relevant industry regulation Acts;*
- (c) *to make, monitor the operation of, and review from time to time, codes and rules relating to the conduct or operations of a regulated industry or regulated entities;*

In performing these functions, the following objectives (including the Commission's primary objective when undertaking any function) inform and guide the Commission. They are set out in Section 6 of the ESC Act.

6 – Objectives

In performing the Commission's functions, the Commission must –

- (a) *have as its primary objective protection of the long term interests of South Australian consumers with respect to the price, quality and reliability of essential services; and*
- (b) *at the same time, have regard to the need to –*
 - (i) *promote competitive and fair market conduct; and*
 - (ii) *prevent misuse of monopoly or market power; and*
 - (iii) *facilitate entry into relevant markets; and*
 - (iv) *promote economic efficiency; and*
 - (v) *ensure consumers benefit from competition and efficiency; and*
 - (vi) *facilitate maintenance of the financial viability of regulated industries and the incentive for long term investment; and*
 - (vii) *promote consistency in regulation with other jurisdictions.*

With regard to the Commission's principal statutory objective, three elements of service delivery are captured – price, quality and reliability.

The electricity industry is declared to be a regulated industry for the purposes of the ESC Act.⁴¹ This allows the Commission to regulate electricity by requiring operators to hold a licence subject to various conditions. It does not set prices for generation operations that are connected to the National Electricity Market. There is a market-based mechanism that sets wholesale prices.

⁴¹ Electricity Act 1996, section 14D.

Commission's licensing functions under the Electricity Act 1996

The Commission has licensing functions for the electricity industry, including the issuing of a licence and ensuring compliance with a licence once issued.

Under section 15 of the Electricity Act 1996 (**Electricity Act**), a person must not carry on operations in the electricity market unless they hold a licence authorising those operations. This includes the generation, transmission, distribution, retailing of electricity, and the system control over a power system.

The Commission has commenced an Inquiry into the licence conditions that should apply to the generation of electricity. However, there may also be some impacts for those licences related to operation of transmission and distribution networks.

Pursuant to the Electricity Act, generation means the operation of any kind of electricity generating plant and all incidental and related operations, but does not include anything declared by regulation not to be generation of electricity.⁴² As such, the following types of generation are required to hold a licence:

- ▶ thermal generation systems
- ▶ hydro generation systems
- ▶ tidal generation systems
- ▶ solar PV systems, and
- ▶ energy storage systems.

A person carrying out the operation of generating electricity is not required to be licensed, if:

- ▶ the operations are carried out for self-consumption
- ▶ consumption is by a designated body⁴³
- ▶ consumption by a person at premises occupied or used by the person as a tenant or licensee where that person is not charged for supply of electricity except as an unspecified part of rent or charges for the occupation or use of the premises⁴⁴
- ▶ the generating plant has a rated nameplate output of 100 kVA or less, or
- ▶ they do not supply electricity for reward to or by means of a transmission or distribution network.⁴⁵

Additionally, section 80(1) of the Electricity Act provides that the Commission can, with the approval of the Minister for Mineral Resources and Energy (**Minister**), issue an exemption from the requirements of Part 3 of the Electricity Act, including the requirement to be licensed (or from various licence conditions). Exemptions are only granted by the Commission in exceptional circumstances where the regulatory burden of being licensed would outweigh any benefits the wider community receives. It must be evident to the Commission that licensing is simply not appropriate.

⁴² Electricity Act 1996, section 4(1).

⁴³ A designated body is defined by the Electricity (General) Regulations as a body or group of persons designated by the Minister by notice in the Gazette.

⁴⁴ Electricity (General) Regulations 2012, regulation 15(1).

⁴⁵ Electricity (General) Regulations 2012, regulation 15(2).

Licence applications

A person or entity seeking an electricity licence must make an application to the Commission by filling out an application form and providing all information required for the issue of a licence. Prior to the Commission reviewing a licence application, a person must also pay the appropriate application fee set by the Minister.

Once an application is received, the Commission must consider that application and may issue, or refuse to issue, the licence.

Section 17(2) of the Electricity Act provides that in considering a licence application, the Commission must have regard to its objectives set out in the ESC Act and may only issue a licence if satisfied that:

- ▶ the applicant is a suitable person to hold the licence
- ▶ the issue of the licence will not result in the same person holding both a licence authorising the operation of a distribution network and a licence authorising retailing of electricity
- ▶ in the case of a licence authorising the generation of electricity – the generating plant (or proposed generating plant) will generate electricity of the appropriate quality for the relevant transmission or distribution network
- ▶ in the case of a licence authorising the operation of a transmission or distribution network – the network has (or the proposed network will have) the necessary capacity for transmitting or distributing electricity safely
- ▶ in the case of a licence authorising retailing of electricity – the applicant will be able to meet reasonably foreseeable obligations under contracts for the sale of electricity
- ▶ in the case of a licence authorising system control over a power system – the applicant will be able to adequately exercise system control functions
- ▶ in the case of a licence authorising other operations in the electricity supply industry for which a licence is required under the Electricity (General) Regulations – the applicant meets any special requirements imposed for holding that licence, and
- ▶ any criteria or conditions prescribed by regulation.

In order to assess the licence application, the Commission requires applicants to provide sufficient information with the applications. As a minimum, applicants are required to submit information addressing the following matters:

- ▶ corporate and legal information
- ▶ regulatory information, including:
 - information to satisfy the Commission that the applicant can meet the relevant licence conditions and has (or will have) a robust compliance program in place to ensure this, and
 - information to satisfy the Commission that the issuing of a licence is consistent with its objectives.

- ▶ technical and human resource information, including:
 - information in relation to the technical capacity of the applicant to comply with the conditions of the licence, and
 - evidence that the applicant can properly and safely conduct the business authorised by the licence, including details of experience in the energy market and copies of its risk management strategy and compliance program, and
- ▶ financial information.

Prior to issuing a licence for an operation that is connected to the national electricity market, the Commission may seek advice from the Australian Energy Market Operator (**AEMO**) on matters of technical capacity. In particular, for a wind generation licence, the Commission will seek advice from AEMO on whether the applicant will be able to meet key special licence conditions (as summarised below).

Licence conditions

Each electricity licence issued by the Commission contains a variety of conditions. Sections 21-24A of the Electricity Act requires the Commission to make a licence subject to various conditions.

Specifically, section 21 provides that for all electricity licences:

21 – Licence conditions

(1) The Commission must make a licence subject to conditions determined by the Commission –

- (a) requiring compliance with applicable codes or rules made under the ESC Act*
- (b) requiring compliance with specified technical or safety requirements or standards*
- (c) relating to financial or other capacity to continue operations under the licence*
- (d) requiring the licensee to have all or part of the operations authorised by the licence audited and to report the results of the audit to the Commission*
- (e) requiring the licensee to notify the Commission about changes to officers and, if applicable, major shareholders of the entity*
- (f) requiring the licensee to provide information to the Commission*
- (g) requiring the licensee to comply with the requirements of any scheme approved and funded by the Minister for the provision by the State of customer concessions or the performance of community service obligations by licensees, and*
- (h) any further conditions the Commission is required by regulation to impose.*

In addition, the Commission may also make a licence subject to any further conditions it considers appropriate.⁴⁶

Sections 22-24A of the Electricity Act contain additional licence conditions that the Commission must include for the different licensed operations. This includes specific licence conditions for the operations of transmission, distribution, generation, retailing and system control.

⁴⁶ Electricity Act 1996, section 21(3).

In particular, section 22 applies to licences authorising the generation of electricity:
22—Licences authorising generation of electricity

- (1) *The Commission must make a licence authorising the generation of electricity subject to conditions determined by the Commission—*
- (i) *requiring compliance with directions of the system controller; and*
 - (j) *requiring the electricity entity not to do anything affecting the compatibility of the entity's electricity generating plant with any transmission or distribution network so as to prejudice public safety or the security of the power system of which the generating plant forms a part; and*
 - (k) *requiring the electricity entity—*
 - (i) *to prepare and periodically revise a safety, reliability, maintenance and technical management plan dealing with matters prescribed by regulation; and*
 - (ii) *to obtain the approval of the Commission (which may only be given by the Commission on the recommendation of the Technical Regulator) to the plan and any revision; and*
 - (iii) *to comply with the plan as approved from time to time; and*
 - (iv) *to audit from time to time the entity's compliance with the plan and report the results of those audits to the Technical Regulator; and*
 - (l) *requiring the electricity entity to provide to AEMO such information as it may reasonably require for the performance of its functions; and*
 - (m) *requiring the electricity entity—*
 - (i) *to grant to each electricity entity holding a licence authorising the operation of a transmission or distribution network rights to use or have access to the entity's electricity generating plant that are necessary for the purpose of ensuring the proper integrated operation of the State's power system and the proper carrying on of the operations authorised by the entity's licence; and*
 - (ii) *in the absence of agreement as to the terms on which such rights are to be granted, to comply with any determination of the Commission as to those terms; and*
 - (iii) *to comply with any code provisions in force from time to time under the Essential Services Commission Act 2002 establishing a scheme for the resolution of disputes in relation to such rights; and*
 - (n) *requiring the electricity entity to maintain insurance against any liability for causing a bushfire and to provide the Commission with a certificate of the insurer or the insurance broker by whom the insurance was arranged certifying (in a manner approved by the Commission) that the insurance is adequate and appropriate given the nature of the operations carried on under the entity's licence and the risks entailed in those operations.*

In accordance with the Commission's powers to make a licence subject to additional conditions, the Commission has included specific licence conditions for wind generation. These conditions include requirements regarding:

- ▶ reactive power, and
- ▶ fault ride-through capability.

These conditions are detailed in Appendix C.

Appendix B – Overview of the electricity generation market in South Australia and the development of licence conditions

South Australia's electricity generation market has been transitioning from one based on conventional large centrally-located, thermal electricity generators to one that is based on smaller, distributed, renewable generation technologies, with variable (or intermittent) output characteristics. The Australian Energy Market Operator (**AEMO**) notes that the transition from the old to the new generation technologies has been more extensive than anywhere else in Australia.

An overview of the development of the generation market from the early 2000s to the present day follows.

The generation market to 2004

Independent regulation of the electricity industry commenced in South Australia in 1999, following the commencement of the NEM in 1998. Since that time, the Essential Services Commission (**Commission**) has been the statutory licensing authority for all new electricity generators.

Prior to 2004, the Commission generally licensed coal, gas and diesel-fired electricity generators – collectively referred to as conventional thermal generation – that had largely been installed under an earlier regime.

Towards the end of 2004, there was increased interest in wind-powered generation in the State due to its sound wind resources, which are in close proximity to transmission lines. In addition, the commencement of a Federal Government subsidy scheme (Renewable Energy Target (**RET**)), along with Federal, State and Local Government support, provided a supportive environment for investors.

This created a keen interest in wind-powered generation and led to the installation of approximately 450 MW of wind-powered electricity generation by November 2004. At that time, the Commission was also aware of proposals for approximately 1,260 MW of new wind-powered generating capacity. This new wind-powered capacity of 1,700 MW (installed and proposed) was in the context of an existing total South Australian market capacity of 3,454 MW at that time.

As the licensing authority, the Commission needed to be satisfied that South Australian consumers' long-term interests would be appropriately protected (with respect to the price, quality and reliability of electricity) when considering whether or not to agree to issue a licence to a new wind-powered electricity generator.

The 2005 review

Given the significant number of wind-powered generation proposals seeking licences (more than 10 individual projects), during 2005 the Commission took advice from AEMO's South Australian predecessor, the Electricity Supply Industry Planning Council (**ESIPC**), as to whether or not it could licence those proposed projects while still protecting the long-term interests of consumers. The Commission was concerned that the differing electrical characteristics of wind-powered electricity generators compared to existing conventional electricity generators may create unintended consequences.

ESIPC's advice was that significant levels of wind-powered generation would have major technical implications, given the prevailing National Electricity Rules (NER). It advised that:

- ▶ the level of wind could be capped, or
- ▶ additional technical licence requirements could be placed on wind-powered electricity generators to make them deliver additional electrical performance to better contribute to system stability, quality and reliability.

ESIPC also advised that it was not possible to predict market pricing impacts from wind-powered generation, given that there was insufficient evidence of practices and behavioural changes (if any) which might arise from the intermittent nature of such generation.

Having noted that these technical issues would best be dealt with by revising the NER (as it considered that non-conventional generation would eventually become a national issue, particularly given Federal Government subsidies for renewables such as the RET), the Commission determined that it would adopt the second option.

The Commission did not want to artificially restrict any technologies nor to introduce the likelihood of any market distortions a cap might bring. It noted that it would look to revise or remove the local requirements once the NER adequately catered for wind and related technologies.

The Commission therefore developed technical licensing principles and conditions, the effect of which was to require wind-powered electricity generators to participate in the dispatch process of the national market (as until then they had been regarded as 'negative demand'), to have additional plant and equipment installed and to provide wind forecasting information.⁴⁷

The 2010 review

In 2010, the Commission reviewed the above arrangements and found that, while the NER had advanced, they still did not cater for South Australia's unique circumstances with respect to the relative contribution of wind-powered generation to the State's total generating capacity.

Therefore, while it made some adjustments to the terms of its technical licence conditions, the Commission retained special conditions for wind-powered electricity generators.

The Commission also noted that, while the introduction of wind had resulted in an increase in spot price volatility in the wholesale electricity market, the pricing impacts of wind were a matter for the national market rather than technical licence conditions.

The Commission's standard additional technical conditions for wind-powered generators required them to meet higher performance standards with respect to fault ride-through capability and reactive power capability. The conditions also maintained the requirements in relation to central dispatch, wind forecasting and ancillary services.

Finally, the Commission confirmed its position that the technical principles and special licence conditions were intended to be transitional and that the NER were the most appropriate way to deal with the technical issues raised by non-conventional generation.

⁴⁷ The Commission's *Statement of Principles for Wind Licensing*, available at: <http://www.escosa.sa.gov.au/library/100430-LicenceConditionsWindGenerators-FinalDecision.pdf>.

The South Australian generation market in 2017

The changing supply mix

Over the last seven years and particularly so in the last 12 to 18 months, changes across the South Australian electricity generation market have accelerated, including:

- ▶ the withdrawal of coal-fired plant, which has changed the generation mix fundamentally (as it proportionally increases the penetration of wind generation and other non-synchronous forms of generation, refer to Figure 1)
- ▶ continuing interest in new investment in wind, solar and other generation sources
- ▶ the growing commercial and technical viability of battery storage and related technologies
- ▶ the increasing interest in micro-grid technologies (whether stand-alone or connected to the National Electricity Market (NEM))
- ▶ risks which arise if the high voltage interconnectors with Victoria are out of service, and
- ▶ the availability and pricing of gas for electricity generation.

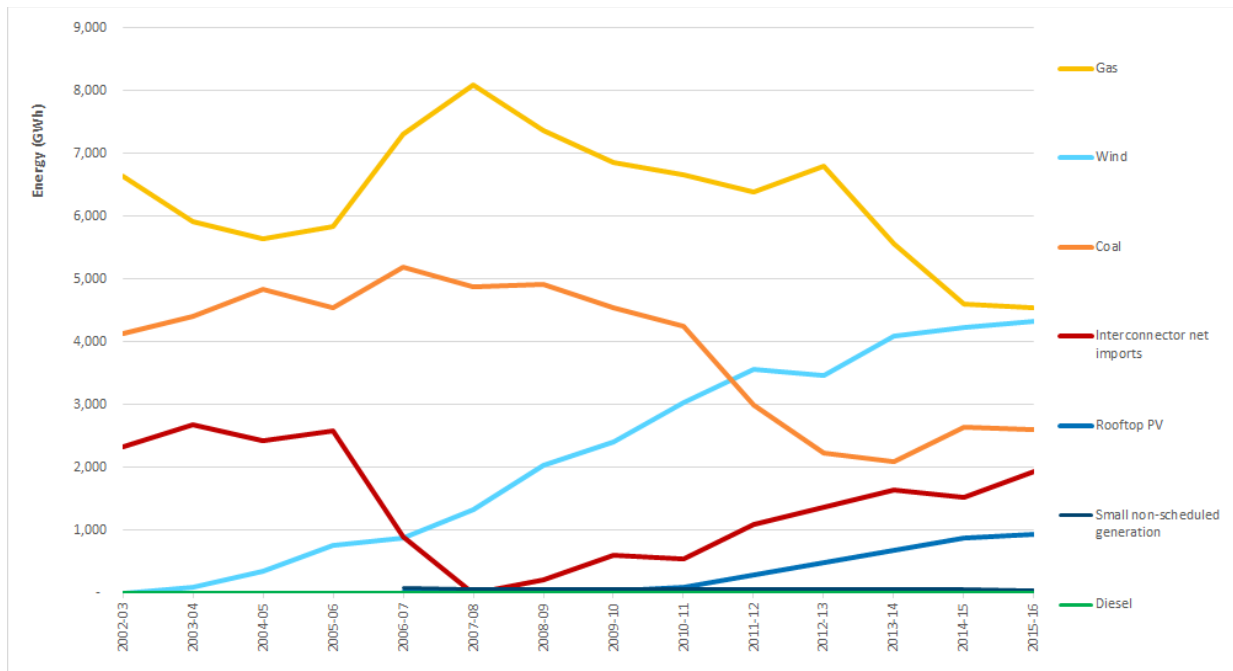
The size of the South Australian generation market

By April 2017, the Commission had issued 40 electricity generation licences throughout South Australia – 35 of which authorise the operation of approximately 5,021 MW of grid-connected generation plant. Of those, 18 are licensed wind-powered electricity generators (17 national electricity market participants and one non-market), with a total capacity of 1,696 MW – over one-third of the State's total grid-connected generation capacity. As a result, South Australia has the highest penetration of wind generation compared to total generating capacity in Australia, and also ranks among the highest penetration levels to be found in the world.

Furthermore, SA Power Networks advise that there were approximately 195,042 small-scale rooftop solar PV installations with a total approved capacity of 777 MW resulting in an effective capacity of 629 MW connected to its distribution network in South Australia by 31 December 2016.

The extent of the growth in renewable generation technologies, both in large-scale wind-powered and small-scale solar photovoltaic (PV) generation, is shown in Figure 1. It highlights the changing generation mix in South Australia and the speed of that transition since 2003-04, when the first wind-powered electricity generators were installed. Electricity generation from coal and gas-fired plants has reduced over that period and culminated in the withdrawal of coal-fired generation in May 2016.

Figure 1: South Australian energy generation by fuel type/source, 2002-03 to 2015-16 (GWh)



Source: The Commission from AEMO data

Note: Data not available for Rooftop PV and small non-scheduled generation prior to 2006-07.

Application of special licence conditions

Since 2002, there have been two major changes to the Commission's 'model' licence conditions arising from the 2005 and 2010 reviews. Consequently, South Australia's fleet of wind-powered electricity generators are currently subject to three slightly differing sets of licence conditions:

- ▶ The first set of licence conditions reflected the general licensing conditions for all electricity generators prior to the Commission undertaking studies on this matter and were applied to the very first wind-powered generator farm (Starfish Hill – which was licensed on 29 January 2002).
- ▶ The second set of licence conditions were introduced on 30 September 2005 and incorporated a set of special licensing conditions and wind licensing principles following the Commission's 2005 review.
- ▶ The third set of licence conditions were introduced on 3 May 2010 following the Commission's 2010 review of the applicability of national regulatory frameworks within the South Australian context.
- ▶ Additional licence conditions were placed on Hornsdale Wind Farm Stage 2 after advice from AEMO in February 2017.

Table B.1 identifies the capacity of the wind-powered electricity generation plant currently installed in South Australia and the relevant version of the licence conditions applicable to each plant.

Table B.1: South Australian wind-powered generation plant installed as at 11 April 2017

Generator	Licensed capacity (MW)	Date licence issued	Special licence conditions	Year and version of applicable special licence conditions
Semi-scheduled market generators				
Clements Gap Wind Farm	57.8	03/06/2005	N	-
Hallett 1 (Brown Hill) Wind Farm	94.5	10/03/2006	Y	2005 v1
Hallett 2 (Hallett Hill) Wind Farm	71.4	13/03/2008	Y	2005 v1
Hallett 4 (North Brown Hill) Wind Farm	132.3	09/12/2009	Y	2005 v1
Hallett 5 (The Bluff) Wind Farm	52.5	25/09/2012	Y	2010 v2
Hornsedale Stage 1 Wind Farm	100	12/05/2016	Y	2010 v2
Hornsedale Stage 2 Wind Farm	100	13/02/2017	Y	2010 v2 plus additional items
Lake Bonney Stage 2 Wind Farm	159.5	22/03/2006	Y	2005 v1
Lake Bonney Stage 3 Wind Farm	39	23/12/2009	Y	2005 v1
Snowtown Wind Farm	98.7	09/01/2007	Y	2005 v1
Snowtown Stage 2 South Wind Farm	126	23/07/2013	Y	2010 v2
Snowtown Stage 2 North Wind Farm	144	10/07/2012	Y	2010 v2
Waterloo Wind Farm Stage 1	111	16/10/2009	Y	2005 v1
Waterloo Wind Farm Stage 2	19.8	17/12/2015	Y	2010 v2
Non-scheduled market generators				
Canunda Wind Farm	46	01/10/2004	N	-
Cathedral Rocks Wind Farm	66	22/10/2004	N	-
Lake Bonney Wind Farm	80.5	22/07/2002	N	-
Mount Millar Wind Farm	70	23/09/2004	N	-
Starfish Hill Wind Farm	34.5	29/01/2002	N	-
Wattle Point Wind Farm	90.75	14/04/2004	N	-
Non-market generator				
Barunga Range	2.1	09/02/2011	N	-

In summary, the number and size of wind farms subject to the three different sets of licence conditions, at 11 April 2017, include:

- ▶ Eight wind farms representing approximately 448 MW of installed capacity that are subject to the requirements of the NER that were applicable at the time (and are not subject to special licence conditions)
- ▶ Seven wind farms representing approximately 706 MW of installed capacity that are subject to the special licence conditions introduced in September 2005
- ▶ Five wind farms representing approximately 442 MW of installed capacity that are subject to the updated special licence conditions introduced in May 2010, and
- ▶ One wind farm of 100 MW of installed capacity (under construction) that is subject to the May 2010 special licence conditions and also subject to additional requirements as advised by AEMO.

Licence applications and other new generation proposals

New licence applications

During the course of this Inquiry, in February 2017, the Commission approved a generation licence for the second stage of the Hornsdale Wind Farm Project (HWF 2) for a total installed capacity of 100 MW. In April 2017, the developers of the Hornsdale Wind Farm Project submitted an application for a generation licence for the third and final stage (HWF 3) for a total installed capacity of 109 MW.

In addition, the Commission anticipates that Reach Solar Energy will submit an application for a generation licence for the first stage of its Bungala Solar Power Project (~100 MW).

Proposed new generation

The attractiveness of South Australia's wind resources, the access to appropriately sized network infrastructure and favourable development processes makes South Australia a desirable renewable energy investment location, as reflected by the growing number of new generation projects.

In addition, to the licence applications noted above, other publicly announced generation projects to receive funding from the Australian Renewable Energy Agency (**ARENA**), include:

- ▶ Tailem Bend Solar Farm (~128 MW solar PV generator system)
- ▶ Spencer Gulf Pumped Hydro-station (~100 MW)
- ▶ Roxby Downs Solar Project incorporating a solar PV system and battery storage (~100 MW)
- ▶ Crystal Brook Energy Park incorporating a solar PV system, wind and battery storage (~250 MW), and
- ▶ Upper Spencer Gulf Solar Plant incorporating a solar PV system and battery storage (~100 MW).

As a consequence of the increasing uptake of these potential generation development projects and with no other change to mitigate this impact, the risk to the power system in South Australia will be that it may continue the displacement of large thermal synchronous generation.

Total forecast generation proposals

As at 11 April 2017, the Commission is aware of at least 51 potential new NEM generation proposals (totalling approximately 7,698 MW of capacity) for connection to the South Australian power system (including the Government's recent announcements⁴⁸). These proposals consist of four fossil fuelled generation projects (with a capacity of 1,199 MW) and 47 renewable generation projects⁴⁹ (of 6,499 MW) as shown in Table B.2.

These forecasts do not include the South Australian Government's plans to have:

- ▶ network service providers install approximately 200 MW of temporary generation throughout the transmission and distribution network, and
- ▶ 496 GWh of its electricity requirements sourced in two packages made up as follows:
 - 113 GWh of dispatchable renewable supply, and
 - 383 GWh from a new entrant.

Table B.2: New generation proposals identified as at 11 April 2017

New generation projects by fuel type	No of projects	Maximum capacity (MW)
Fossil	4	1,199
Coal gasification	1	600
Diesel	1	29
Gas	2	570
Renewable	47	6,499
Battery storage	1	150
Biomass	2	20
Pumped hydro	1	100
Solar PV	4	769
Solar PV including Battery storage	5	750
Solar thermal	2	280
Wind	32	4,430
Grand Total	51	7,698

⁴⁸ More details of the South Australian Government's Energy Plan may be accessed from www.ourenergyplan.sa.gov.au.

⁴⁹ This includes approximately 16 wind-powered generation projects totalling 1,038 MW whose status is currently unknown.

Appendix C – Current model licence conditions for wind-powered generation licensees

The model licence conditions⁵⁰ currently applied to wind-powered generation licensees in relation to fault ride-through and reactive power requirements are set out below.

9. Fault Ride-Through Capability

- 9.1 Each generating unit which the licensee is authorised 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.
- 9.2 The licensee is not required to comply with clause 1(b) in respect of a generating unit which the licensee is authorised 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.
- 9.3 The licensee is not required to comply with clause 1(c) in respect of a generating unit which the licensee is authorised 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.

10. Reactive Power Capability

- 10.1 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.
- 10.2 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 per cent of the reactive power required to meet the power factor referred to in clause 10.1 on a dynamically variable basis; and
 - (b) the balance of the reactive power required to meet the power factor referred to in clause 10.1 on a non-dynamic basis.

⁵⁰ The full suite of the Commission's model electricity generator licence conditions may be accessed at: <http://www.escosa.sa.gov.au/industry/electricity/licensing/licence-applications>.

- 10.3 *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.*
- 10.4 *For the purposes of clause 10.2(a):*
- (a) 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 milliseconds and a rise time (as defined in clause S5.2.5.13 of the NER) of less than 1 second following a voltage disturbance on the network; and*
 - (b) for a period of not more than 2 seconds on any single occasion, a short-term overload capability may be used to meet the 50 per cent requirement, provided that use of that short-term overload does not cause a breach of any other licence condition.*
- 10.5 *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.*
- 10.6 *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.*
- 10.7 *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.*

Appendix D – AEMO’s Final Advice



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