Electricity

Inquiry into the licensing arrangements for generators in South Australia

FINAL REPORT

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The work of the Commission is the result of many people's contributions and this project is no different; however, special mention is required for those individuals who made significant and substantial contributions to this Inquiry:

- Kara O'Sullivan, and
- Kate Morrison.

Executive Summary

The Essential Services Commission (**Commission**) has conducted an Inquiry (under Part 7 of the Essential Services Commission Act 2002) to determine whether or not there should be any changes to its technical licensing conditions for electricity generators connected to the National Electricity Market (**NEM**). In particular, the Commission has inquired into:

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

The technical conditions are in place because current national regulatory frameworks and arrangements do not deal adequately with the technical and system impacts of new electricity generation technologies in South Australia, particularly where those are intermittent or otherwise variable. Were such a framework in place, specific local licence conditions may be unnecessary.

The Commission's overall findings and conclusions, reached having considered technical advice from the Australian Energy Market Operator (**AEMO**) and with the benefit of stakeholder submissions obtained through a public consultation process, are that:

- South Australian consumers require a modern, secure, resilient and reliable power system that delivers to them electricity of an appropriate quality standard
- the South Australian power system is undergoing a fundamental transformation, with the technical and system impacts of that transformation not adequately dealt with under the existing national regulatory framework
- during this transformation the power system must integrate all generation technologies including existing and new — into an appropriately diversified generation portfolio that provides energy and essential system security services that meet South Australians' needs
- the provisions of the National Electricity Rules and associated instruments and arrangements do not yet cater for the efficient integration of a changing mix of generation technologies in the South Australian sector of the NEM
- all new generators, regardless of technology or type, seeking to connect to the South Australian power system must have the capabilities to contribute to a secure and resilient power system that meets the modern (and future) needs of South Australian consumers
- there is, therefore, a need for the Commission to continue to impose transitional technical conditions within licences for new electricity generators which are to be connected to the NEM (regardless of generation type) – on the basis that this will assist the Commission in meeting its paramount statutory objective (under the Essential Services Commission Act 2002) of protecting South Australian consumers' long-term interests with respect to the price, quality and reliability of electricity services
- those transitional technical conditions, which will be consistent with and not duplicate existing national rules and frameworks, will require new generators to be better able to:
    - ride through power system disturbances without prematurely disconnecting and also be available to assist with remediating contingency events

- control their energy output to maintain stable operation of the power system (as well as being able to assist with the control of voltage and frequency, if required)
- manage and control voltages to support the network during disturbances and to efficiently transfer power
- be capable of operating in weak system conditions (where limited fault current is available), and
- assist with power system restoration, should there be a major outage on the power system.

- while the new technical conditions will not apply to existing generators at this time, over the coming year (2017-18) the Commission will work with AEMO, network service providers and existing generators to understand the extent to which additional services could be provided by those generators in a cost-efficient manner, and
- the Commission will monitor and review developments in this sector – with a particular focus on changes in NEM rules and associated arrangements – with a view to removing its local technical licence conditions.

The Commission has decided not to impose a requirement on generators to provide electrical inertia (or a fast frequency response) at this time, given other recent regulatory and statutory developments in this area. Among those are a new proposed change to the national electricity rules that aims to require network service providers to provide a threshold level of inertia and for the institution of a new market to facilitate the delivery of inertia above that minimum level.

Overall, the Commission's new conditions will enable all new generators to incorporate cost-effective features to contribute towards a secure and resilient power system as it evolves over time. They will assist in promoting the security, resilience, and reliability of the South Australian power system under a range of scenarios, including the potential for a greater proportion of non-synchronous and other new generation technologies.

Nevertheless, the Commission confirms its position that, were a robust national framework in place for the connection of new generation technologies, specific licence conditions in South Australia may be unnecessary and the licence conditions could be removed.

Background to this Inquiry

This is the third review that the Commission has undertaken into this matter, following reviews in 2005 and 2010.

In those first two reviews, there was a focus on wind-powered electricity generators. This 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 promoted ongoing system stability. The emergence of those proposals was driven by a combination of government policies, particularly the national Renewable Energy Target, as well as the significant wind resource available in South Australia in relatively close proximity to the transmission system.

The finding of those earlier reviews was that NEM rules and arrangements did not, at that time, adequately cater for that integration of new electricity generation technologies. As a result, the Commission developed and imposed additional technical licence conditions as an interim measure, pending changes to those rules and arrangements.

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

However, the national rules and arrangements have not developed in a similar fashion to meet the challenges presented by the rapid emergence of these new technologies.

Absent those changes, and in the context of its existing technical licence conditions and the changing market in this State, the Commission determined it appropriate to conduct a further review of the licence conditions.

Specific findings and conclusions

The Commission's specific findings and conclusions on the matters relevant to this Inquiry are as follows.

1. Disturbance ride-through capability

The licence conditions for disturbance ride-through capability (and reactive power capability) will be amended and expanded for all new generators to include greater detail in the following areas:

- 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
- power system load reduction (partial load rejection), and
- stronger frequency disturbance ride-through capabilities.

2. Voltage control capability

The reactive power capability licence conditions specifically relating to voltage control will be restated for all new generators to incorporate the following intent:

- The generating system must be capable of control by a fast-acting, continuously variable, voltage control system. The voltage control system must be able to receive a local and remote voltage set point.
- The generating system may operate at either a set reactive power, or a set power factor, which is able to be set locally or remotely at any time.
- The voltage, power factor or reactive power control mode of the generating system must be capable of:
    - being overridden by the disturbance ride through requirements during power system disturbances, and
    - automatically reverting to the selected control mode when the disturbance has ceased.

3. Active power control capability

All new generators will be required to incorporate active power control facilities that are capable of:

- providing an automatic active power response to frequency changes
- responding to automatic generation control signals from AEMO
- adjusting the rate of change of active power, and
- communicating the status of its active power controls to AEMO in real time — enabling remote monitoring of the generating unit's active power control settings.

4. System restoration capability

All new generating systems, in the event of a black system and while system load is being restored, will be required to be capable of:

- operating with auxiliary loads only (for a duration to be specified), and
- providing steady-state and dynamic reactive power when operating with auxiliary loads.

5. System strength capability

All new generators will be required to be capable of:

- Individual components of plant within a generating system, which includes but is not limited to generating units and dynamic reactive power plant, must be capable of operating down to the following levels at the high voltage terminals in relation to each component:
    - minimum short circuit ratio of 1.5, and
    - minimum positive sequence system inductive to resistive impedance ratio of 2.

6. Application of new conditions to existing licensees

The Commission will work with licensees to ascertain where assistance could be provided to improve the stability and security of the power system. The Commission considers that, where possible, current generator licensees should provide the additional capabilities and services to the power system to meet the very specific challenges faced in South Australia. Further engagement with licensees and other stakeholders including AEMO and network service providers will be undertaken to progress this matter.

As part of that process, the Commission will consider whether developments in the sector mean that there is still a need to consider additional requirements for existing generators. If there is a need, the Commission will work with AEMO and licensees to seek additional information such as:

- the specific technical capabilities of current generating units or systems with respect to the new technical standards established through this Inquiry
- the physical or technical limitations in meeting the new technical standards, and
- the need for, and cost of, any upgrades that may be required to satisfy the new technical standards.

Implementation and next steps

Model licence conditions reflecting this Inquiry findings and conclusions have been developed and are available for review alongside this Inquiry Report. The model conditions will be applicable to all new applications from the date of publication of this report, having regard to advice from AEMO on the specific circumstances of individual applications received.

Depending on the specific characteristics of a given generation project, the model conditions may be varied to the degree necessary to ensure that South Australian consumers' long-term interests with respect to the price, quality and reliability of electricity services are protected.