UPDATE TO THE 2016 NATIONAL TRANSMISSION NETWORK DEVELOPMENT PLAN

FOR THE NATIONAL ELECTRICITY MARKET

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AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

IMPORTANT NOTICE

Purpose

AEMO has prepared the Update to the 2016 National Transmission Network Development Plan under clause 5.20.2 of the National Electricity Rules. This report is based on information available to AEMO up to 14 August 2017.

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Version control

Version	Release date	Changes
1	13/09/2017	

UPDATE TO THE 2016 NTNDP

On 12 December 2016, AEMO published the 2016 *National Transmission Network Development Plan* (NTNDP).[1] The NTNDP assessed whether further Network Support and Control Ancillary Services (NSCAS) are required in the next five years. NSCAS are non-market ancillary services designed to maintain power system security and reliability, and to maintain or increase the power transfer capability of the transmission network.

Transmission Network Service Providers (TNSPs) have the primary responsibility for acquiring NSCAS. Each year, AEMO identifies any NSCAS need forecast to arise over a five-year minimum planning horizon (NSCAS gap). This assists TNSPs with decision-making about their NSCAS procurement.

In the 2016 NTNDP, AEMO identified an NSCAS gap to provide system strength in South Australia, and stated that the gap would be confirmed in 2017 following completion of more detailed analysis. AEMO has since published a report which evaluates the adequacy of system strength in South Australia for various levels of synchronous and non-synchronous generation.[2]

This document confirms that the NSCAS gap identified in the 2016 NTNDP exists now, and provides details about the NSCAS gap size and trigger date.

1.1 System strength

System strength is an inherent characteristic of any power system, and can materially impact its operation. Higher fault levels, or high currents following a fault, are typically found in a stronger power system, while lower fault levels are representative of a weaker power system.

System strength also reflects the sensitivity of system variables such as voltage magnitude and angle to a disturbance. Low system strength can increase the difficulty of managing power system stability.

The NTNDP highlighted that system strength is expected to decline across the National Electricity Market (NEM), particularly in areas of high non-synchronous generation like South Australia. The emerging challenges resulting from declining system strength include:

- Generator[3] fault ride-through.
- Correct operation of protection.

Failure of generator fault ride-through can result in multiple generators disconnecting from the system in unison. Inappropriate operation of protection could result in excessive disconnection of transmission or generation, or failure to clear faults (a risk to safety and equipment).

The primary concern in South Australia is a sudden loss of generation that ultimately results in the disconnection of the Heywood Interconnector and a state-wide frequency or voltage collapse (i.e. a state-wide blackout). The 2016 NTNDP discussed the implications of these challenges in detail. AEMO is continuing to support ElectraNet in assessing the system strength requirements of appropriate protection operation, and will update the NTNDP if increased support services are required.

On 8 September 2016, the AEMC initiated a rule making process for managing system strength.[4] The current draft rule allocates responsibility for the management of system strength, providing a framework

[1] AEMO. 2016 *National Transmission Network Development Plan*, December 2016. Available at: http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Transmission-Network-Development-Plan.

[2] AEMO. South Australia System Strength Assessment. http://www.aemo.com.au/Media-Centre/South-Australia-System-Strength-Assessment. Viewed 7 September 2017.

[3] Both synchronous and inverter-connected generator fault ride-through is considered.

[4] AEMC. Managing power system fault levels. Available at: http://www.aemc.gov.au/Rule-Changes/Managing-power-system-fault-levels#.

for Network Service Providers (NSPs) to maintain system strength at generating connection points above an agreed minimum level.

1.2 Minimum operating requirement

On 2 December 2016, AEMO determined that at least two large synchronous generating units must be online in South Australia to ensure sufficient fault level available to synchronous machines, wind generation, and dynamic reactive support plant, and therefore to maintain a secure operating state.[5] On 6 September 2017, considering the available equipment presently installed in South Australia, and following a series of in-depth power system simulation studies, AEMO determined that more complex combinations of large synchronous generating units must be online[6].

One or more of the following combinations of existing online synchronous generators are likely to maintain sufficient system strength for different levels of non-synchronous generation output.

When non-synchronous generation output is below 1,200 megawatts (MW):

- Two Torrens Island B units + Half Pelican Point Combined-Cycle Gas Turbine (CCGT) (i.e. Steam Turbine (ST) + One Gas Turbine (GT))
- Two Torrens Island B units + Quarantine unit 5 + Osborne CCGT (i.e. Steam Turbine (ST) + Gas Turbine (GT))
- Two Torrens Island B units + Dry Creek Power Station[7] + Osborne CCGT
- Half Pelican Point CCGT + Osborne CCGT + Quarantine unit 5
- Half Pelican Point CCGT + Osborne CCGT + Dry Creek Power Station[7]
- Two Torrens Island B units + Three Torrens Island A units
- One Torrens Island B unit + Full Pelican Point CCGT (i.e. ST + 2 GTs)
- Two Torrens Island A units + Half Pelican Point CCGT + Quarantine unit 5
- Two Torrens Island A units + Half Pelican Point CCGT + Dry Creek Power Station[7]
- One Torrens Island A unit + One Torrens Island B unit + Half Pelican Point CCGT + Osborne CCGT

When non-synchronous generation output is between 1,200 MW and 1,700 MW:

- Three Torrens Island A units + Half Pelican Point CCGT + Quarantine unit 5
- Three Torrens Island A units + Half Pelican Point CCGT + Dry Creek Power Station[7]
- Three Torrens Island B units + Full Pelican Point CCGT
- Two Torrens Island B units + Three Torrens Island A units + Half Pelican Point CCGT
- Two Torrens Island B units + Quarantine unit 5 + Osborne CCGT + Half Pelican Point CCGT
- Two Torrens Island B units + Dry Creek Power Station[7] + Osborne CCGT + Half Pelican Point CCGT
- Three Torrens Island B units + Half Pelican Point CCGT + Osborne CCGT
- Full Pelican Point CCGT + Osborne CCGT + Quarantine unit 5
- Full Pelican Point CCGT + Osborne CCGT + Dry Creek Power Station[7]
- Two Torrens Island B + Full Pelican Point CCGT + Quarantine unit 5
- Two Torrens Island B + Full Pelican Point CCGT + Dry Creek Power Station[7]

[5] AEMO. Market Notice 56089. Available at: https://www.aemo.com.au/Market-Notices?currentFilter=&sortOrder=&searchString=56089.

[6] AEMO. South Australia System Strength Assessment. Available at: http://www.aemo.com.au/Media-Centre/South-Australia-System-Strength-Assessment.

[7] All three Dry Creek units must be online and generating above 35 MW each.

- Two Torrens Island B units + Two Torrens Island A units + Half Pelican Point CCGT + Quarantine unit 5
- Two Torrens Island B units + Two Torrens Island A units + Half Pelican Point CCGT + Dry Creek Power Station[7]
- Two Torrens Island B units + Full Pelican Point CCGT + Osborne CCGT

Rather than being provided by synchronous generating units, this system strength requirement could be provided through other means (such as synchronous condensers). The equivalent fault level requirement at the Para Substation 275 kV connection point is between 2,600 MVA and 4,000 MVA.

Any new services proposed to provide system strength must be validated through detailed Electromagnetic Transient (EMT) studies.

1.3 NSCAS gap for system strength in South Australia

AEMO now confirms the NSCAS gap for system strength in South Australia. This NSCAS gap:

- Requires the provision of system strength services, including fault current, for areas of South Australia with high non-synchronous penetration levels.
- Is required for maintaining power system security.
- Exists today, and is required for the remainder of the current five-year NSCAS planning horizon (until 1 July 2021) and beyond.

AEMO will collaborate with ElectraNet to validate the technical capability of any proposed solutions to ensure power system security.

The indicative fault level requirement to meet this NSCAS gap in South Australia (as measured at Para 275 kV connection point) is between 2,600 to 4,000 MVA each year for the remainder of the current five year NSCAS planning horizon and beyond.

The provision of fault current should be shared across a specific combination of plants, so that credible contingency events can be withstood. The fault levels identified are a broad metric and indicative only – any proposed solutions will need to be validated with EMT studies. In the short term, AEMO will ensure the commitment of generating unit combinations outlined in section 1.2.

1.4 Next steps

AEMO will continue to review the technical capability of different solutions (including synchronous condensers and combinations of generating units) to providing power system security, and will update its website[8] with any findings.

AEMO has requested ElectraNet to advise when and what arrangements it will have in place to meet this NSCAS gap by 5 December 2017. If ElectraNet does not commit to meeting this NSCAS gap, AEMO will consider whether to acquire the NSCAS in accordance with clause 3.11.3 of the National Electricity Rules.

[8] AEMO. South Australia System Strength Assessment. Available at: http://www.aemo.com.au/Media-Centre/South-Australia-System-Strength-Assessment.