

South Australia

Four synchronous condensers and minimum of two large synchronous thermal units

System normal limits advice for four synchronous condensers in South Australia has been published since July 2021, and AEMO published updated limit advice for any two synchronous condensers on 25 October 2021. This factsheet contains summary information and a Q&A on the current advice.

Summary information

- The minimum number of large synchronous generating units online can be reduced to two in normal system conditions following full operation of the four synchronous condensers with high inertia flywheels installed at Davenport and Robertstown.
- Some conditions (abnormal system conditions) may require additional levels of synchronous generation to maintain system security.
- There is no shortfall in system strength in South Australia with the full operation of the four synchronous condensers, allowing dispatch of up to ~2,500 MW of online inverter-based resources.
- For now, at least two large synchronous thermal generators are required online in South Australia to provide essential system support that may not otherwise be provided in the South Australian system, including:
 - Active power (frequency control/frequency reference) support required to maintain the rate of change of frequency in line with current limits advice.
 - Maintenance of sufficient ramping control under system normal conditions.
 - Maintenance of reactive voltage support.
- Additional challenges have emerged in recent times in South Australia, including the need to cater for the net loss of distributed photovoltaics (PV) as part of a contingency event.
- Project EnergyConnect (PEC), a new synchronous connection between South Australia and New South Wales, is expected to remove the need for a minimum level of synchronous generation online in normal system operation, subject to network support and control requirements being met.

- AEMO is finalising assessment of detailed parameters of the South Australian Network Support and Control Ancillary Services (NSCAS) gaps which will arise when no large synchronous generating units are online, previously assumed to occur after PEC operation. This will be outlined in AEMO's 2021 NSCAS report, to be published in December 2021.

AEMO continues to study the capability of the South Australia power system to function with fewer than two synchronous generating units online, prior to PEC operation, including consideration of the NSCAS gaps in South Australia which are expected in these conditions.

Questions and answers

Q: When will the four synchronous condensers be operationalised?

A: ElectraNet has completed all commissioning and system tests. Currently, AEMO is working with and encouraging ElectraNet to complete limits advice for when South Australia is islanded. This limits advice is expected to be received by the end of November 2021. Soon after receiving this advice, AEMO will operationalise the four synchronous condensers with minimum synchronous generation combinations.

Q: Why do two synchronous generators need to be kept online once the synchronous condensers are commissioned?

A: The synchronous condensers have satisfied the system strength requirements for South Australia for normal operating conditions. The South Australia power system now has requirements for a level of reactive support and active power control for rate of change of frequency (RoCoF) control and ramping control due to large variable power swings in the supply and load. This capability is not always available in the power system, and with the present assets in South Australia can only be provided for with a minimum combination of two large synchronous generating units.

The operating envelope for the South Australia power system with no synchronous generating units is yet to be determined. Neither AEMO nor any other grid operator has proven whether a gigawatt-scale power system with the configuration of South Australia can be operated with no synchronous generating units.

There will continue to be operational conditions prior to PEC where more than two units may be required online to manage system security conditions.

Q: Why aren't ElectraNet or AEMO contracting to keep generators on rather than relying on AEMO directions?

A: AEMO is committed to minimising the need to rely on AEMO directions to the extent possible, but AEMO has a limited role in the procurement of system security services. There are limited regulatory avenues to contract for the type of support that the South Australia power system requires and is currently being provided through synchronous generation. Transmission network service providers (TNSPs) are able to procure NSCAS at any time (subject to the applicable regulatory tests) in order to meet network performance requirements, and AEMO's studies will identify NSCAS gaps that would arise prior to PEC operation with no online synchronous generation. This will be reviewed early in 2022. Depending on the nature and amount of those gaps, successful procurement of services by ElectraNet may reduce or replace the need for directions in normal conditions. As with the system strength solution following AEMO's declaration in 2017, however, it is possible that a feasible contract solution will not be found.

Q: Is AEMO directing generators because it's cheaper than contracting them?

A: AEMO only uses its directions powers to maintain power system security when it becomes necessary to do so. If and when suitable security services were made available via TNSP contracts, AEMO would use them ahead of directions wherever possible,

Q: Why is AEMO only now discovering gaps in other requirements now that the system strength gap has been filled?

A: ElectraNet's Economic Evaluation report dated 18 February 2019¹ had anticipated the requirement for two synchronous generators to remain online, and this was factored into the economic evaluation. The anticipated requirement for two synchronous generators to remain online was further confirmed in AEMO's 2020 *Integrated System Plan (ISP)*, Appendix 7, Section 7.6.5.

Also, since the declaration of the South Australia system strength gap in 2017, the South Australian power system has continued to evolve, including the introduction of

circa 2,000 megawatts (MW) of distributed PV. Conditions are consistently and rapidly changing, and as AEMO develops load side models and understands the changing South Australia power system mix, its operation and sensitivities to daily weather, AEMO is able to determine requirements for proper system control and security.

Q: Will AEMO be looking into operating South Australia with fewer than two synchronous generating units?

A: Yes. AEMO has studied the South Australia power system with no synchronous generating units online and in its present form the system requires reactive control, RoCoF, and ramping support. Presently the only assets on the ground in South Australia to provide this are large synchronous generating units.

AEMO is continuing to study the South Australia power system. As it further develops and new assets are commissioned, gaps and operating limits will be revised.

AEMO is also working with ElectraNet on these limits for operation after the completion of PEC.

Q: Why two synchronous generating units – can't it be one?

A: To cover the credible loss of a unit, a second unit must be online. It is either zero or two. One unit may provide the requirements, however AEMO must cover the credible loss of that service and hence a second unit is required.

Q: Why can't the requirements be met by procuring more frequency control ancillary services (FCAS)?

A: FCAS is a reserve market and is not the suitable service for providing the technical parameters required to operate South Australia in its present conditions. As the system continues to evolve, AEMO is reviewing FCAS requirements for South Australia.



Where can I find more information?

For any further enquiries, please contact AEMO's Information and Support Hub via

- supporthub@aemo.com.au or
- call 1300 236 600

¹ See <https://www.aer.gov.au/system/files/ElectraNet%20-%20System%20Strength%20Economic%20Evaluation%20Report%20-%202018%20February%202018.PDF>, section 5.1.