

SA minimum synchronous generator requirements

Stakeholder update package
September 2022



Objective

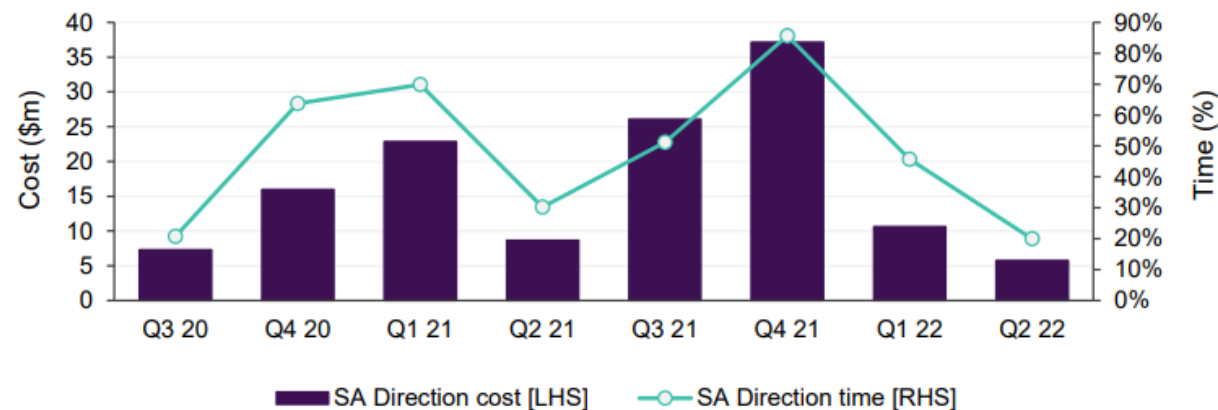
- Provide status update on investigation of SA minimum synchronous generator requirements
- Aligning approach to potentially moving minimum SA synchronous generator requirement from two to one generating units
- Understanding risks and technical requirements that must be met
- Setting out next steps

Background

- With four synchronous condensers in operation, the minimum SA synchronous generator requirement has been reduced from four to two
- Consequently, the quarterly duration of AEMO directions have reduced from 80% in Q4 2021 to 10% in Q2 2022
- AEMO has been exploring how directions could be reduced further (refer previous industry updates on the topic)

Figure 56 South Australian direction costs continue to decline

Time and cost of system security directions (energy only) in South Australia



Note: direction costs are preliminary costs which are subject to revision

Approach to minimum units

- Currently AEMO dispatches a minimum of two synchronous generators, with the second generator catering for the loss of the first.
- The recent addition of fast start synchronous generators in SA, as well as contracted Fast Frequency Response services, provides the opportunity to explore reducing the minimum synchronous generator requirement to a single unit.
- The following technical requirements must first be satisfied:
 - Grid reference
 - Adequate voltage control (including compliance with S5.1.8 and AS61000.3.7)
 - Ramping and reserve
 - Frequency control including emergency frequency control schemes (UFLS, OFGS, SIPS)
 - Transmission and distribution protection adequacy, as per S5.1.9(c)
 - Revision to impacted limit advice

Grid formation and grid reference

- The SA power system currently requires at least one large synchronous generator for grid formation and grid reference
- Results of power system analysis suggest a synchronous generator may not be required for grid reference
 - This means grid-following inverter based resources can ‘latch-on’ to the voltage waveform supplied by the synchronous condensers
- System tests will be required to demonstrate grid formation and grid reference in a power system the size and scale of South Australia with no synchronous generating units online.
- The exploration of alternative grid formation capability will continue as the industry gains experience with grid-forming Inverter Based Resources (IBR) (e.g. batteries) and other new technologies

Adequate voltage control

- AEMO NSCAS assessment has identified a voltage control gap (reactive power absorption) north of Adelaide for a scenario where the requirement for two synchronous generators to be online in South Australia may be removed. The gap was identified for periods of low demand or low transfers between South Australia and Victoria.
- In parallel ElectraNet has identified voltage control challenges at periods of low demand and a lack of dynamic reactive reserves in the Adelaide Metro area.
- ElectraNet is initiating a RIT-T to address both of the above.
- These challenges are currently further exacerbated by the ongoing outage of the Para SVC #2.
- ElectraNet needs to confirm adequacy of voltage control in the short-term before AEMO considers a minimum of one synchronous generator requirement.

Ramping

- AEMO's analysis confirms a continuous minimum two unit requirement in SA is not required to manage ramping events.
- Aside from this, there are challenges managing increasingly large wind and solar ramping events.
- AEMO intends to explore mechanisms to mitigate risks associated with ramping events (e.g. constraining IBR when needed and/ or contracting fast start units).

Frequency control

- No material impact on system frequency if the SA synchronous generator requirement moves from two to one unit when SA is interconnected
 - During an island, reliance is on Fast Frequency Response (FFR) and availability of fast start units to synchronise within 30 mins
- Emergency frequency control schemes
 - The existing SA Regulation 88A constraints limit flow on the Heywood interconnector based on inertia and load. The reduction to a minimum of one unit has negligible impact on the effectiveness of UFLS and OFGS
 - ElectraNet has highlighted there could be an impact on the performance of System Integrity Protection Scheme (SIPS) with increased short-term risk prior to WAPS implementation in 2023

Network protection adequacy

- Heywood interconnector in service, combined with the worst network outage (line or transformer):
 - Distribution system protection is presently adequate with one synchronous generator online and 3 synchronous condensers operational
 - Transmission system protection is presently adequate with one synchronous generator online and 4 synchronous condensers operational (adequacy to be confirmed with one synchronous condenser out of service)
- SA islanded, one synchronous generator online and 4 synchronous condensers operational, combined with the worst network outage:
 - ElectraNet is undertaking a review of protection adequacy
 - Any identified risk may be mitigated by dispatching more synchronous generation

Impact of Project Energy Connect

- A minimum synchronous generator requirement in SA is not expected to be required under system normal conditions once:
 - Project Energy Connect Stage 2 interconnector (PEC) is operational;
 - ElectraNet implement a scheme to effectively manage non-credible loss of PEC or Heywood.
- Changes may be necessary to Regulation 88A requirements to take into account PEC.

Updated limits advice

- At least the following limits advice will have to be reviewed for operation with a single synchronous generator:
 - System damping
 - Allowable levels for inverter-based resources
 - Voltage and transient stability
 - Conformation of compliance of S5.1.9(c)
- Revised limits advice may impact the market as follows:
 - Increased occurrence of RoCoF constraint binding, due to less inertia in the system
 - Potential reduction of the instantaneous non-synchronous generation dispatch limit
 - Potential reduction in Heywood interconnector transfers due to voltage and transient stability
- Any change to minimum synchronous generator requirements would also require re-assessment of some planning assessments by both AEMO and ElectraNet.
- ElectraNet to review non-credible events as required (NER S5.1.8), as part of the WAPS implementation

Technical requirements summary

Requirement	Responsibility	Status
Adequate voltage control	ElectraNet	Need to confirm short-term adequacy of voltage control with a minimum one synchronous generator requirement
Grid reference	AEMO	Possible to maintain grid formation in South Australia under system normal conditions, in at least some circumstances and pending system testing, with no synchronous generating units online
Ramping	AEMO	Possible to manage power system ramping in South Australia under system normal conditions, in at least some circumstances, with no synchronous generating units online
Frequency control	AEMO	Possible to manage power system frequency control in South Australia under system normal conditions, in at least some circumstances, with no synchronous generating units online
Protection adequacy	ElectraNet	Protection adequacy assessment underway for interconnected (with one synchronous condenser out of service) and islanded operation
Updated limits advice	ElectraNet	Relevant limits advice needs to be updated for operation with a single synchronous generator

Next steps

- Further work required to address technical requirements
- Next stakeholder update to come later in 2022 including:
 - AEMO:
 - Confirm frequency control and ramping management strategy:
Management of ramping and frequency control following SA separation
 - ElectraNet:
 - Voltage control adequacy assessment
 - Protection adequacy
 - Revision to impacted limit advice
- Ongoing system monitoring



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