Transfer Limit Advice – System Strength in SA and Victoria

January 2022

For the National Electricity Market

Important notice

PURPOSE

AEMO has prepared this document to provide information about the levels of system strength required to securely operate the South Australian and Victorian regions of the NEM with high levels of non-synchronous generation, as at the date of publication.

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VERSION CONTROL

Version	Release date	Changes
41	14 January 2022	Removed SA_12 and SA_ISLE_88 (duplicates), added SA_21, SA_45 to 53 (2 syn cons) and renumbered zero syn con combinations. Added clarifying notes for steam turbine operation at Pelican Pt and Osborne.
40	26 November 2021	Added VIC_38 and 39. Reorganised SA combinations into a single table for system normal and islanding and relabelled combinations. Added combinations SA_7 to 21.
39	25 October 2021	Minor edits and fixes. Clarified Pelican Pt steam turbine. Removed generator combinations with >1 TIPS A units. Revised sections on syn cons to reflect new limit advice from ElectraNet indicating the combinations for 2 Davenport syn cons can now be for any two syn cons out of the four syn cons in South Australia.
38	16 July 2021	Added system normal combinations for post commissioning of Davenport and Robertstown syn cons.
37	16 June 2021	Added 3 combinations for Victoria (VIC35, 36 and 37)
36	23 April 2021	Added SA combination LOW_59
35	14 April 2021	Added SA combinations LOW_57 and LOW_58
34	16 March 2021	Added 11 combinations for SA island/risk of island for post commissioning of Davenport syn cons. Added 4 combinations to SA island/risk of island.
33	12 February 2021	Added new combinations for SA islanding (43-52), added 8 combinations for post commissioning of Davenport syn cons, updated limits advice for Canunda and Lake Bonney in an SA island, added LOW_56.
32	21 January 2021	Added combinations for post commissioning of Davenport syn cons
31	8 December 2020	Added a new combination for SA islanding (#42)
30	4 December 2020	Added new combinations for SA islanding (Mintaro and Dry Creek)
29	1 October 2020	Removed all combinations with 3 or 4 TIPS A units
28	25 September 2020	Fixed URLs on AEMO website. Added VIC_34. Changed tables (Vic and SA island) to use numbers for units. Revised combinations for SA island/risk of island and combined into a single table (one new added).
27	13 July 2020	Added new combinations for SA islanding (replaces previous SA+APD+Mortlake island combinations) and risk of islanding
26	14 February 2020	Added 4 combinations for islanded SA + Mortlake + APD
25	10 February 2020	Added 12 combinations for islanded SA + Mortlake + APD, Barker Inlet combinations in Table 1 are now just as a number
24	20 December 2019	Added SA combinations LOW_51 to LOW_55 which include Barker Inlet
23	26 November 2019	Added low inertia condition for SA risk of or actual islanding
22	24 October 2019	Updated VIC_26 and added new combinations VIC_27 to VIC33 and added note on which Murray units can be used in the combination.
21	26 September 2019	Added Vic system strength combination VIC_26, reorganised Vic table to have fast start units in the last columns (similar to the SA table).

Version	Release date	Changes
20	13 September 2019	Added Victorian system strength combinations, renamed document, revised the limit values for the SA LOW combinations and added SA risk of islanding and islanding limits, Bungala now included in the SA limit following further analysis
19	5 December 2018	Added higher cap levels (1350 to 1460 MW) for 21 combinations.
18	26 November 2018	Revised section on excluded generators/batteries and added Bungala to this list. Added link to System Strength methodology
17	13 September 2018	New AEMO template. Removed HIGH_14 (subset of HIGH_13). Added LOW_39 to LOW_50. Replaced LOW_25, LOW_26, LOW_30 and LOW_35 with new combinations with less generators (mainly removed QPS5). Removed LOW_23B and LOW32. Added note on Dalrymple battery.
16	12 July 2018	Added HIGH_13 and HIGH_14
15	5 July 2018	Added LOW_38
14	28 June 2018	Added LOW_36 and LOW_37
13	30 May 2018	Added LOW_35
12	25 May 2018	Added LOW_34
11	22 May 2018	Added LOW_31, LOW_32 and LOW_33
10	18 May 2018	Renamed LOW_18 as LOW_18A, LOW_17A as LOW_17 and LOW_20A as LOW_20. Removed LOW_17B and LOW_20B. Added ten new combinations LOW_18B and LOW_23 to LOW_30 (these include Mintaro).
9	8 May 2018	Renamed LOW_22 as LOW_22B, LOW_23 as LOW_22A, LOW_17 as LOW_17A and LOW_20 as LOW_20A. Added two new combinations LOW_17B and LOW_20B.
8	27 April 2018	Added five new combinations LOW_19, LOW_20, LOW_21, LOW_22 and LOW_23
7	24 April 2018	Removed LOW_12 (subset of LOW_14) Added two new combinations LOW_17 and LOW_18
6	4 April 2018	Renamed LOW_5 as LOW_5A and added LOW_5B
5	5 March 2018	Added three new combinations (LOW_14, LOW_15 and LOW_16). Added text on how to land securely post-contingency and replaced Table 2 with more detailed examples.
4	8 December 2017	Updated based on new studies. Includes an increase to the non-synchronous generation (for both levels), relabelled conditions, added three new conditions (LOW_11, LOW_12 and LOW_13), and added recommended N-1 scenarios.
3	13 October 2017	Added conditions LOW_9 and LOW_10
2	2 October 2017	Fix to 1700_9 condition (was missing TIPS B)
1	18 September 2017	Initial version

Contents

Tables

1. Introduction

This document describes the requirements for system strength in South Australia (SA) and Victoria as well as the methodology for determining these requirements.

System strength reflects the sensitivity of power system variables to disturbances. It indicates inherent local system robustness, with respect to properties other than inertia.

System strength affects the stability and dynamics of generating systems' control systems, and the ability of the power system to both:

- Remain stable under normal conditions, and
- Return to steady-state conditions following a disturbance (such as a fault).

Large synchronous machines (hydro, gas, and coal generation, and synchronous condensers) inherently contribute to system strength.

Non-synchronous generation (batteries, wind, and solar photovoltaic (PV) generation) does not presently provide inherent contribution to system strength.

1.1 Related AEMO publications

AEMO has published a detailed assessment of system strength requirements in South Australia in its South Australia System Strength Assessment[1] report. Requirements for system strength in all regions is included in the System Strength Requirements and Fault Level Shortfalls[2] document.

Other limit advice documents are located at: https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/congestion-information-resource/limits-advice.

The system strength requirements methodology, requirements and fault level shortfalls is located at: https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/System-Security-Market-Frameworks-Review/2018/System_Strength_Requirements_Methodology_PUBLISHED.pdf

This document does not describe how AEMO implements these limit equations as constraint equations in the National Electricity Market (NEM) market systems. That is covered in the Constraint Formulation Guidelines, Constraint Naming Guidelines, and Constraint Implementation Guidelines, all available in the Congestion Information Resource on AEMO's website, at: https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/congestion-information-resource.

1.2 Methodology

For a complete discussion on the methodology AEMO used to determine system strength requirements in South Australia, see its South Australia System Strength Assessment report.

To develop the Power Systems Computer Aided Design (PSCAD) model of South Australia, AEMO:

1. For a given non-synchronous dispatch level (such as 1,200 MW), identified and downloaded a recent matching load flow (PSS®E) case from AEMO's Operations and Planning Data Management System (OPDMS).

[1] AEMO. South Australia System Strength Assessment, September 2017. Available at: http://www.aemo.com.au/Media-Centre/South-Australia-System-Strength-Assessment.

[2] AEMO. System Strength Requirements Methodology and System Strength Requirements and Fault Level Shortfalls, 1 July 2018. Available at: https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/System-Security-Market-Frameworks-Review/2018/System_Strength_Requirements_Methodology_PUBLISHED.pdf

2. Manually modified the PSS®E case to convert it from a snapshot to a system normal case with the required generator dispatch, including:
   - Switching reactive plant to ensure all transmission elements were operating at nominal voltage levels.
   - Dispatching necessary generation in the Adelaide metro area to meet Heywood flow targets.
   - Constraint checks to ensure no existing network limits were being violated.
3. Converted the PSS®E model to an equivalent PSCAD model using the Electranix E-TRAN software and associated libraries.
   - The Murraylink HVDC interconnector was considered to be out of service, to simplify the model, and because Murraylink provides no active power response, and only a minor contribution to fault current during disturbances.
   - The non-SA network was equivalenced at Moorabool in Victoria, with the 500 kV network from Moorabool to Heywood represented in PSCAD. This was the only equivalent bus in the case. It was set to regulate frequency to 50 Hz and maintain a terminal voltage of 1.03 pu.
4. Within this (now) PSCAD case, replaced simplified generating system model with full PSCAD models.
   - Non-synchronous generating systems were replaced with models provided by the manufacturer/asset owner, and wind farms with Suzlon S88 turbines were replaced with a S88 model developed by Manitoba Hydro Research Centre (MHRC) and AEMO based on information from each installation.
   - AEMO developed synchronous generating system models with data from OPDMS, R2 validation reports, datasheets, and protection settings provided by generators.
   - Para and South East SVC models were replaced with vendor-specific PSCAD models provided by ElectraNet. Model responses were verified as part of the South Australia black system review work.
5. Added the Heywood Interconnector loss of synchronism relay model with current settings to the PSCAD model. Care was taken with the equivalencing process of the remainder of the NEM, to ensure the behaviour and modelling of the loss of synchronism relay remained realistic
6. Due to the large processing power and differing timestep requirements and incompatibility between some models running in the same case, placed generator models in individual PSCAD cases and linked back to the "top" case using the E-TRAN Plus for PSCAD tool.
   - This tool allows each PSCAD case to be allocated to its own core within a CPU, and communicates with the master PSCAD case using TCP/IP. This method isolates each PSCAD case, avoiding issues relating to two or more incompatible versions of a model being in the same PSCAD case.
7. Replaced load models within the case with a custom PSCAD load component, developed by MHRC that allows the load to be scaled at runtime while still allowing voltage and frequency indexes to be applied.
   - Loads within the South Australia network were set to a Voltage Index for Real Power (Np) of 1.0 and a Voltage Index for Reactive Power (Nq) of 3.0.

1.3 Secure Operation

While the combinations in Table 1 and Table 3 are secure, the ability to return to a secure state within 30 minutes following a contingency is limited, because many of the synchronous plant take longer than 30 minutes to start up. As such the system needs to land in a secure combination post contingent or return to secure combination within 30 minutes by utilising fast start plant (these are the last columns in the tables).

2. SA System Strength Requirements

2.1 System Normal

Table 1 summarises the combinations of synchronous generating units that are required to withstand a credible fault and loss of a synchronous unit, at different non-synchronous generation levels for different number of synchronous condensers online in South Australia.

Table 1 South Australia minimum generator combinations for a secure state

Combination	Non-sync generation level	Syn Cons^	Torrens Island A	Torrens Island B	Pelican Point*	Osborne GT + ST#	Quarantine 5	Dry Creek	Mintaro	BIPS
SA_1	≤ 2,500 MW	4		2						
SA_2	≤ 2,500MW	4		1	1					
SA_3	≤ 2,500MW	4		1		1				
SA_4	≤ 2,500MW	4		1			1			
SA_5	≤ 2,500MW	4			1				1	
SA_6	≤ 2,500MW	4			1	1				
SA_7	≤ 2,500MW	4		1				2		
SA_8	≤ 2,500MW	4		1						8
SA_9	≤ 2,500MW	4		1					1	4
SA_10	≤ 2,500MW	4			1		1			
SA_11	≤ 2,500MW	4			1			2		
SA_13	≤ 2,500MW	4			1					4
SA_14	≤ 2,500MW	4				1	1			

Combination	Non-sync generation level	Syn Cons^	Torrens Island A	Torrens Island B	Pelican Point*	Osborne GT + ST#	Quarantine 5	Dry Creek	Mintaro	BIPS
SA_15	≤ 2,500MW	4				1		2		
SA_16	≤ 2,500MW	4				1			1	
SA_17	≤ 2,500MW	4				1				4
SA_18	≤ 2,500MW	4					1			12
SA_19	≤ 2,500MW	4					1	3		4
SA_20	≤ 2,500MW	4					1		1	8
SA_21	≤ 2,500MW	4					1	3	1	
SA_22	≤ 2,500MW	4			2					
SA_30	≤ 1,900 MW	2		1	1					
SA_31	≤ 2,000 MW	2		2						
SA_32	≤ 1,900 MW	2			1	1				
SA_33	≤ 1,900 MW	2			1		1			
SA_34	≤ 1,900 MW	2			1				1	
SA_35	≤ 2,000 MW	2		1		1				
SA_36	≤ 2,000 MW	2				1	1		1	
SA_37	≤ 1,900 MW	2			1			3		
SA_38	≤ 2,000 MW	2		1			1		1	
SA_39	≤ 1,900 MW	2		1				2	1	
SA_40	≤ 2,000 MW	2					1	3	1	8
SA_41	≤ 1,900 MW	2	1		1					

Combination	Non-sync generation level	Syn Cons^	Torrens Island A	Torrens Island B	Pelican Point*	Osborne GT + ST#	Quarantine 5	Dry Creek	Mintaro	BIPS
SA_42	≤ 2,000 MW	2	1			1	1			
SA_43	≤ 2,000 MW	2	1			1			1	
SA_44	≤ 2,000 MW	2	1				1	2	1	
SA_45	≤ 1,900 MW	2		1			1	2		
SA_46	≤ 1,900 MW	2		1			1			4
SA_47	≤ 1,900 MW	2				1				12
SA_48	≤ 1,900 MW	2				1		3		4
SA_49	≤ 1,900 MW	2				1			1	8
SA_50	≤ 1,900 MW	2				1	1	2		
SA_51	≤ 1,900 MW	2				1	1			4
SA_52	≤ 1,900 MW	2					1		1	12
SA_53	≤ 1,900 MW	2						2	1	12
SA_70	≤ 1,300 MW			2	1					
SA_71	≤ 1,700 MW			2		1		3		
SA_72	≤ 1,700 MW			2		1	1			
SA_73	≤ 1,450 MW				1	1	1			
SA_74	≤ 1,450 MW				1	1		3		
SA_75	≤ 1,700 MW			1	2					
SA_76	≤ 1,350 MW			1		1	1	3		
SA_77	≤ 1,300 MW			2			1		1	

Combination	Non-sync generation level	Syn Cons^	Torrens Island A	Torrens Island B	Pelican Point*	Osborne GT + ST#	Quarantine 5	Dry Creek	Mintaro	BIPS
SA_78	≤ 1,300 MW			2				3	1	
SA_79	≤ 1,600 MW			1	1		1	3		
SA_80	≤ 1,350 MW				1	1			1	
SA_81	≤ 1,350 MW				1		1		1	
SA_82	≤ 1,350 MW				1			3	1	
SA_83	≤ 1,450 MW				1		1	3		
SA_84	≤ 1,450 MW				2	1				
SA_85	≤ 1,400 MW				2				1	
SA_86	≤ 1,450 MW				2		1			
SA_87	≤ 1,450 MW				2			3		
SA_88	≤ 1,450 MW			1		1	1		1	
SA_89	≤ 1,450 MW			1		1		3	1	
SA_90	≤ 1,300 MW			1	1					4
SA_91	≤ 1,400 MW			2			1	3		6
SA_92	≤ 1,400 MW			1		1			1	8
SA_93	≤ 1,600 MW						1	3	1	8
SA_94	≤ 1,300 MW			2					1	10
SA_95	≤ 1,300 MW			2		1			1	
SA_96	≤ 1,550 MW			3		1			1	
SA_97	≤ 1,700 MW			3		1				4

Combination	Non-sync generation level	Syn Cons^	Torrens Island A	Torrens Island B	Pelican Point*	Osborne GT + ST#	Quarantine 5	Dry Creek	Mintaro	BIPS
SA_98	≤ 1,300 MW			3		1				
SA_99	≤ 1,750 MW			4		1				
SA_100	≤ 1,700 MW			4			1			
SA_101	≤ 1,700 MW			4				3		
SA_102	≤ 1,650 MW			4					1	
SA_103	≤ 1,600 MW		1	1	1	1				
SA_104	≤ 1,700 MW		1		2					
SA_105	≤ 1,700 MW		1	3		1				
SA_106	≤ 1,300 MW		1	1	1		1			
SA_107	≤ 1,300 MW		1	1	1			3		
SA_108	≤ 1,700 MW		1	3			1			
SA_109	≤ 1,700 MW		1	3				3		
SA_110	≤ 1,400 MW		1	2			1	3		
SA_111	≤ 1,350 MW		1			1	1	3		
SA_112	≤ 1,400 MW		1	1		1			1	
SA_113	≤ 1,300 MW		1	2			1		1	
SA_114	≤ 1,300 MW		1	2				3	1	
SA_115	≤ 1,700 MW		1	3					1	
SA_116	≤ 1,700 MW		1	4						
SA_117	≤ 1,450 MW		1			1	1		1	

Combination	Non-sync generation level	Syn Cons^	Torrens Island A	Torrens Island B	Pelican Point*	Osborne GT + ST#	Quarantine 5	Dry Creek	Mintaro	BIPS
SA_118	≤ 1,450 MW		1			1		3	1	
SA_119	≤ 1,600 MW		1	1			1	3	1	

* Pelican point number covers the GTs only. The steam turbine can be in or out of service. This only applies to 0 or 4 syn cons in service.

Osborne steam turbine can be in or out of service. This only applies for 4 syn cons in service.

^ For four synchronous condensers the combinations are secure for the loss of a synchronous condenser

Example 1:

If 4x Syn Cons, 2 x Torrens Island B, 1 x Pelican Point units and Osborne were online this would satisfy SA_1, SA_2, SA_3 and SA_6 combinations. If any of these units were to trip one of the combinations would be still satisfied e.g. if Osborne trips SA_1 and SA_2 are satisfied, if a Torrens Island B generator trips SA_2 and SA_6 are satisfied.

Example 2:

If 4x Syn Cons and 2 x Torrens Island B were online this would only satisfy SA_1 pre-contingency. Adding Quarantine 5 or 2 x Dry Creek post-contingency will satisfy the SA_4 and SA_7 combinations post-contingency.

2.1.1 Non-synchronous generation

The limitation on non-synchronous generation includes all semi-scheduled and non-scheduled plant in South Australia, except where studies show the plant has no impact (positive or negative). Excluded plant includes:

- Hornsdale battery
- Dalrymple battery
- Lake Bonney battery

2.1.2 Transmission outages for four Synchronous Condensers in service

The non-synchronous generation level is limited to 2,200 MW for outages of all 275kV lines in SA except for the following:

- Belalie to Davenport 275kV line
- Para to Robertstown 275kV line
- One Para SVC
- One Davenport synchronous condenser
- One Robertstown synchronous condenser

2.2 Risk of Islanding or SA Island

2.2.1 Generator combinations for Four Synchronous Condensers

The generator combinations for four synchronous condensers are the same as the for the system normal combinations for four synchronous condensers.

The non-synchronous generation level and individual generator limits are the same as in section 2.2.3.

2.2.2 Generator combinations for zero or two Synchronous Condensers

Table 2 summarises the generator combinations that are needed for risk or island or SA islanding. The combinations for an SA island is to provide sufficient inertia, frequency responsive plant and generation enabled in the over-frequency generation shedding scheme (OFGS) to ensure power system security is maintained in the South Australia island following a credible contingency.

Table 2 SA risk of islanding/islanding minimum generator combinations with zero or two syn cons in service

Combination	Non-sync generation level	Syn Cons	Torrens Island A	Torrens Island B	Pelican Point*	Osborne GT + ST#	Quarantine 5	Dry Creek	Mintaro	Secure for Island
SA_ISLE_30	≤ 1,900 MW	2		1		1		2	1	TRUE
SA_ISLE_31	≤ 1,900 MW	2		1	1					TRUE
SA_ISLE_32	≤ 1,900 MW	2			1	1				TRUE
SA_ISLE_33	≤ 1,900 MW	2			1		1			TRUE
SA_ISLE_34	≤ 1,900 MW	2			1				1	TRUE
SA_ISLE_35	≤ 1,900 MW	2		2		1				TRUE

Combination	Non-sync generation level	Syn Cons	Torrens Island A	Torrens Island B	Pelican Point*	Osborne GT + ST#	Quarantine 5	Dry Creek	Mintaro	Secure for Island
SA_ISLE_36	≤ 1,900 MW	2		2			1		1	TRUE
SA_ISLE_37	≤ 1,900 MW	2		3						TRUE
SA_ISLE_38	≤ 1,900 MW	2	1		1					TRUE
SA_ISLE_39	≤ 1,900 MW	2	1	2			1			TRUE
SA_ISLE_40	≤ 1,900 MW	2	1	1			1	2	1	TRUE
SA_ISLE_50	≤ 1,300 MW			2	1	1				TRUE
SA_ISLE_51	≤ 1,300 MW			2	2					TRUE
SA_ISLE_52	≤ 1,300 MW			1	2	1				FALSE
SA_ISLE_53	≤ 1,300 MW			2	1		1			TRUE
SA_ISLE_54	≤ 1,300 MW			2		1	1			TRUE
SA_ISLE_55	≤ 1,300 MW			2	1				1	TRUE
SA_ISLE_56	≤ 1,300 MW			2		1			1	TRUE
SA_ISLE_57	≤ 1,300 MW			2	1			2		TRUE
SA_ISLE_58	≤ 1,300 MW			2		1		2		TRUE
SA_ISLE_59	≤ 1,300 MW			1	2		1			TRUE
SA_ISLE_60	≤ 1,300 MW			1		1	1		1	TRUE
SA_ISLE_61	≤ 1,300 MW			2			1		1	TRUE
SA_ISLE_62	≤ 1,300 MW			1		1	1	2		TRUE
SA_ISLE_63	≤ 1,300 MW			2			1	2		TRUE
SA_ISLE_64	≤ 1,300 MW			1	1		1		1	TRUE

Combination	Non-sync generation level	Syn Cons	Torrens Island A	Torrens Island B	Pelican Point*	Osborne GT + ST#	Quarantine 5	Dry Creek	Mintaro	Secure for Island
SA_ISLE_65	≤ 1,300 MW				2		1	2		TRUE
SA_ISLE_66	≤ 1,300 MW				2		1		1	TRUE
SA_ISLE_67	≤ 1,300 MW				2	1	1			TRUE
SA_ISLE_68	≤ 1,300 MW				1	1	1		1	TRUE
SA_ISLE_69	≤ 1,300 MW			3		1				TRUE
SA_ISLE_70	≤ 1,300 MW			3	1					TRUE
SA_ISLE_71	≤ 1,300 MW			3			1			TRUE
SA_ISLE_72	≤ 1,300 MW			3					1	TRUE
SA_ISLE_73	≤ 1,300 MW			3				2		TRUE
SA_ISLE_74	≤ 1,300 MW			4						TRUE
SA_ISLE_75	≤ 1,300 MW		1	2		1				TRUE
SA_ISLE_76	≤ 1,300 MW		1	1	1	1				TRUE
SA_ISLE_77	≤ 1,300 MW		1	2	1					TRUE
SA_ISLE_78	≤ 1,300 MW		1	2			1			TRUE
SA_ISLE_79	≤ 1,300 MW		1	1		1	1			TRUE
SA_ISLE_80	≤ 1,300 MW		1	2					1	TRUE
SA_ISLE_81	≤ 1,300 MW		1	1		1			1	TRUE
SA_ISLE_82	≤ 1,300 MW		1	2				2		TRUE
SA_ISLE_83	≤ 1,300 MW		1	1		1		2		TRUE
SA_ISLE_84	≤ 1,300 MW		1	1			1		1	TRUE

Combination	Non-sync generation level	Syn Cons	Torrens Island A	Torrens Island B	Pelican Point*	Osborne GT + ST#	Quarantine 5	Dry Creek	Mintaro	Secure for Island
SA_ISLE_85	≤ 1,300 MW		1			1	1		1	TRUE
SA_ISLE_86	≤ 1,300 MW		1	1			1	2		TRUE
SA_ISLE_87	≤ 1,300 MW		1			1	1	2		TRUE

* Pelican point number covers the GTs only. The steam turbine can be in or out of service. This only applies to 0 or 4 syn cons in service.

Osborne steam turbine can be in or out of service. This only applies for 4 syn cons in service.

2.2.3 Other limits for zero Synchronous Condensers

The following limits apply when SA is on a credible risk of island or operating as an island:

- All non-synchronous generators (except the Hornsdale, Dalrymple and Lake Bonney batteries) limited to 1300 MW
- Total generation at Bungala 1 and 2 limited to 130 MW
- Lake Bonney (1, 2 and 3) and Canunda are likely to trip on islanding of SA so these units need to be limited so that the impact on SA is no more than 50 MW loss

For SA operating as an island Total Generation at Lake Bonney (1, 2 and 3) and Canunda limited to 50 MW and a maximum of 14 turbines at Lake Bonney (1,2 and 3) and a maximum of 5 turbines at Canunda.

2.2.4 Other limits for two Synchronous Condensers

The following limits apply when SA is on a credible risk of island or operating as an island:

- All non-synchronous generators (except the Hornsdale, Dalrymple and Lake Bonney batteries) limited to 1900 MW
- Total generation at Cathedral Rocks limited to 10 MW
- Total generation at Canunda limited to 10 MW and 5 turbines online
- Total generation at Lake Bonney (1, 2 and 3) limited to 40 MW and 14 turbines online

3. Victorian System Strength Requirements

Table 3 summarises the combinations of synchronous generating units that would provide sufficient system strength in Victoria to withstand a credible fault and loss of a synchronous unit (the most critical contingency for these combinations is loss of a Loy Yang A unit). This limit applies during system normal and outage conditions.

Table 3 Victorian system strength minimum generator combinations for a secure state

Combination	Transfer to Vic[3]	Loy Yang (A or B)	Yallourn W	Newport	Dartmouth	Bogong*	Murray2#	Mortlake	Jeeralang (A or B)	Valley Power
VIC_1		3	2							
VIC_2		4		1						
VIC_3		4	1							
VIC_4		3		1			2			
VIC_5		3		1	1	1				
VIC_6		3	1							3
VIC_7		3	1						3	
VIC_8		3		1					3	
VIC_9		3		1						3
VIC_10		3	1	1						

[3] This is calculated as the flow from NSW on Buronga to Red Cliffs (OX1) 220 kV line, Wodonga to Dederang 330k line, Murray to Dederang (1 & 2) 330 kV lines and from Tasmania on Basslink

Combination	Transfer to Vic[3]	Loy Yang (A or B)	Yallourn W	Newport	Dartmouth	Bogong*	Murray2#	Mortlake	Jeeralang (A or B)	Valley Power
VIC_11		3					2		3	
VIC_12		3			1	1	2			
VIC_13		4							2	
VIC_14		4								2
VIC_15		4			1	1				
VIC_16		4						1		
VIC_17		3	1				2			
VIC_18		4					2			
VIC_19		4			1		1			
VIC_20		3	1						1	2
VIC_21		3	1						2	1
VIC_22		3	1					1		
VIC_23		4							1	1
VIC_24		3	1				1		1	
VIC_25		3	1				1			1
VIC_26		2	2	1			1			
VIC_27		2	2	1	1	1				
VIC_28		2	2				2			
VIC_29		2	2		1				3	
VIC_30	≤ 850 MW	2	2							3
VIC_31	≤ 850 MW	2	2						3	

Combination	Transfer to Vic[3]	Loy Yang (A or B)	Yallourn W	Newport	Dartmouth	Bogong*	Murray2#	Mortlake	Jeeralang (A or B)	Valley Power
VIC_32	≤ 850 MW	2	2					1		
VIC_33	≤ 850 MW	2	3							
VIC_34		6								
VIC_35		5					1			
VIC_36		5							1	
VIC_37		5								1
VIC_38	≤ 800 MW	3						2		
VIC_39	≤ 800 MW	3								6

* McKay Creek units are not equivalent to a Bogong unit.

Murray 2 refers to Murray units 11 to 14. The units operating in generator or syn con mode will satisfy this requirement.

Glossary

This document uses many terms that have meanings defined in the National Electricity Rules (NER). The NER meanings are adopted unless otherwise specified.

Term	Definition
Constraint equation	The mathematical representations AEMO uses to model power system limitations and frequency control ancillary services (FCAS) requirements in the National Electricity Market Dispatch Engine (NEMDE).
System normal	The configuration of the power system where: • All transmission elements are in service, or • The network is operating in its normal network configuration.