2023 System Strength Report

December 2023

A report for the National Electricity Market

Important notice

Purpose

The purpose of this publication is to report on the system strength nodes and system strength standards (minimum and efficient levels) for the coming decade, and AEMO's assessment of any identified system strength shortfalls before 2 December 2025, for the National Electricity Market. AEMO publishes this 2023 System Strength Report in accordance with clauses 5.20.7 and 11.143.14(f) of the National Electricity Rules (NER). This publication is generally based on information available to AEMO as at November 2023 unless otherwise indicated.

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Version control

Version	Release date	Changes
1.0	1/12/2023	Initial release.

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Executive summary

AEMO has assessed system strength needs over a 10-year period in the National Electricity Market (NEM), alongside an assessment shortfall during the system strength transition period until 1 December 2025. AEMO has not identified any new shortfalls.

Seven previously declared shortfalls have been confirmed across three regions, with some changes noted in their magnitudes. Remediation for these shortfalls is currently in place or is being progressed by each relevant network business. Table 1 presents a summary of these findings for each impacted region.

As part of the 2023 assessment, AEMO has also considered if any material system changes have occurred that would warrant reassessing the current system strength nodes or recalculating their associated minimum fault levels requirements. These values have subsequently remained unchanged; however, several potential new nodes were identified for consideration in future reports.

Figure 1 presents a summary of these current system nodes and minimum requirements for each region. The figure also includes updated levels of inverter-based resources (IBR) that must be accommodated at each node based on the Draft 2024 *Integrated System Plan* (ISP) *Step Change* scenario[1].

Together these outcomes form the basis of system strength investment obligations from 2 December 2025 onwards, and AEMO will continue to work closely with the network businesses to progress remediation actions against any declared shortfalls, and to facilitate use of the system strength requirements in regional RIT-Ts.

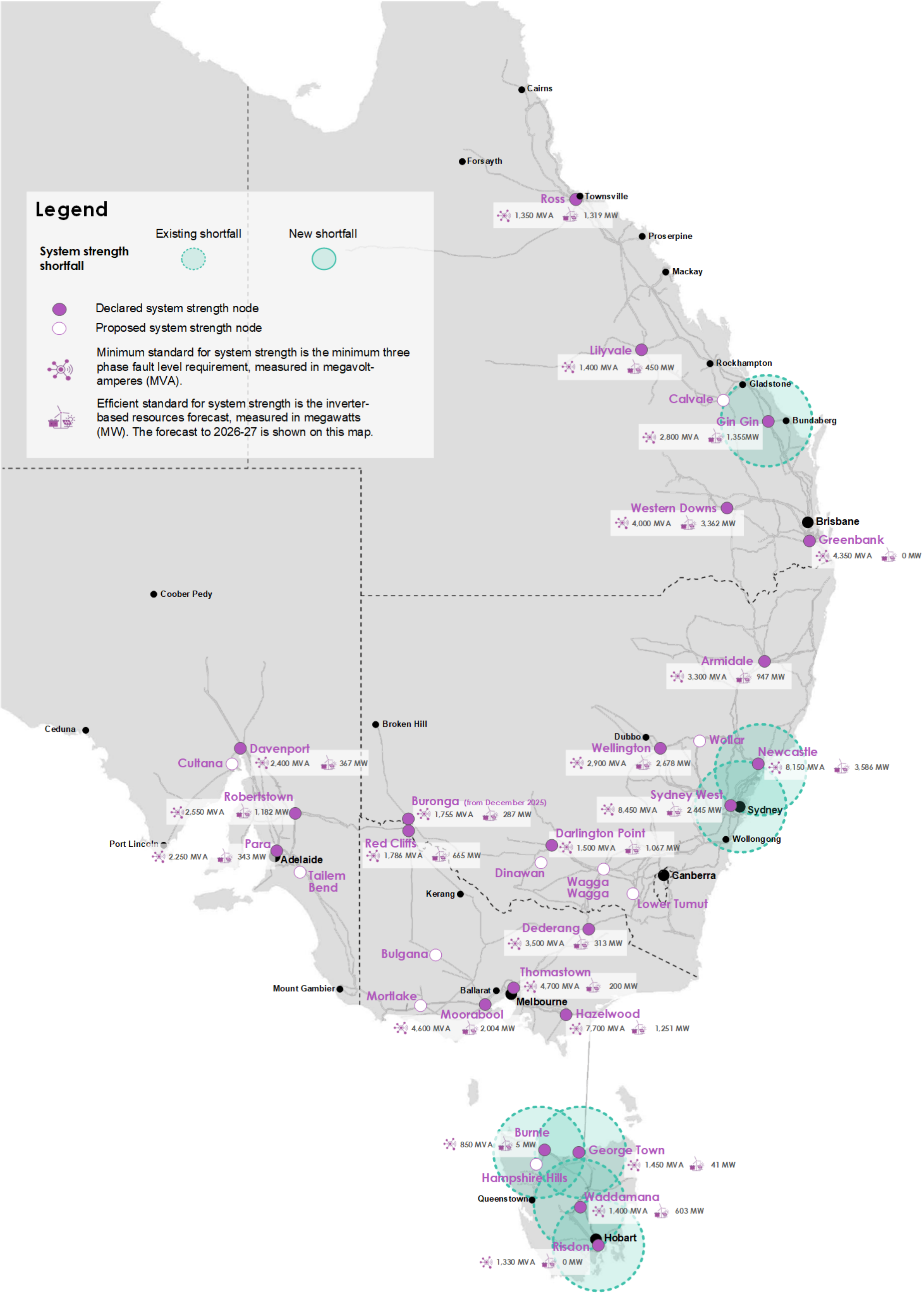
Table 1 Summary of system strength shortfalls from the 2023 assessment

Region	System strength shortfalls
New South Wales 	**AEMO notes revised shortfalls of 1,420 megavolt amperes (MVA) and 1,165 MVA at Newcastle and Sydney West respectively.** Both shortfalls apply from 1 July 2025 until 1 December 2025, and Transgrid is progressing remediation as part of its longer-term system strength RIT-T.
Queensland 	**AEMO confirms the existing shortfall of 64 MVA at Gin Gin until 1 December 2025.** This remains unchanged from the previous report, and Powerlink is progressing commercial arrangements to remediate this need from 1 July 2025. Operational processes have been agreed to manage local system security in the interim period.
Tasmania 	**AEMO confirms an ongoing shortfall at all four nodes in Tasmania.** TasNetworks has sufficient network support agreements in place to provide system strength and inertia services until 15 April 2024, beyond which time these shortfalls will reopen. TasNetworks is progressing additional service arrangements to provide coverage until December 2025.

Note: AEMO has not identified any system strength shortfalls for South Australia or Victoria.

[1] Final revisions ahead of publishing the Draft 2024 ISP in may result in minor changes compared with the modelling inputs used in this report.

Figure 1 System strength nodes, proposed new nodes, and shortfalls and standards



Proactive and coordinated investment is needed to deliver essential system security services

AEMO expects that a variety of solutions may be feasible to address the requirements identified in this report. While a minimum level of system strength must still be provided as fault current, the efficient level can be met by any technology capable of stabilising local voltages. This may include grid-forming inverters, synchronous condensers, conversion of existing thermal units, dynamic reactive plant, or contracts with market participants.

While options are diverse, investment in major network assets is subject to global supply chain issues, economic or geopolitical uncertainty, and competition against the currently heightened international demand for electricity infrastructure. Industry is reporting that the lead time for large synchronous condensers could now be more than five years, making them unavailable to support growing security needs until at least 2028-29. Proactive planning is needed to balance these risks and deliver the most cost-effective mixture of long-term solutions.

Regulatory Investment Tests for Transmission (RIT-Ts) are already underway in every NEM region to deliver the first round of system strength services by 2 December 2025. These RIT-Ts provide a substantial opportunity to deliver inertia using the same technical resource, and at a minimal incremental cost[2]. For example, flywheels could be added to any newly purchased synchronous condensers to deliver both inertia and fault current services; while fast frequency response (FFR) capabilities may be available from the same grid-forming technology being used to accommodate and stabilise future IBR. While this optimisation is possible under the current planning arrangements where timeframes align, the Australian Energy Market Commission (AEMC) is also considering changes to the inertia framework that may streamline this in future[3].

AEMO will continue to advocate for proactive, efficient, and coordinated investment across all system security services.

AEMO is seeking feedback on key inputs for the 2024 system strength assessments

AEMO takes a consultative approach to setting the system strength standards each year and intends to use feedback on each annual report to inform future reports. Stakeholders are welcome to provide feedback to planning@aemo.com.au on the matters considered in this report. This may include feedback on:

- Current, proposed, or new system strength nodes.
- Factors affecting minimum fault level requirements over time.
- Critical planned outages, and the criteria used to select them.
- The clarity, structure, and content of the report and its datasets.

Delivering adequate system strength services will be one of the highest priority matters facing the NEM over the coming decade, and AEMO looks forward to working with the System Strength Service Providers and other industry stakeholders to ensure long-term power system security.

[2] Anecdotally, AEMO understands that the incremental costs of adding a typical 1,000 megawatt seconds (MWs) flywheel to an synchronous condenser are in the order of approximately 3% if the decision is made up front. Retrofitting a flywheel is understood to be substantially more expensive.

[3] See https://www.aemc.gov.au/rule-changes/improving-security-frameworks-energy-transition.

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1 Introduction

System strength describes the ability of the power system to maintain and control the voltage waveform at a given location, both during steady state operation and following a disturbance. System strength is often approximated by the amount of electrical current available during a network fault (fault current), however the concept also encompasses a collection of broader electrical characteristics and power system interactions.

The system strength framework in the National Electricity Market (NEM) is currently in a transitionary period, following changes to the National Electricity Rules (NER) that have progressively taken effect from 1 December 2022[4]. During the system strength transition period, AEMO assesses the availability of system strength in each region and declares any projected shortfalls that commence before 2 December 2025. In parallel, AEMO also determines regional requirements over a 10-year horizon.

System Strength Service Providers (SSSPs) in each region are then responsible for delivering any services needed to address the identified shortfalls, and to meet the declared requirements from then onwards.

1.1 Scope of analysis

This report provides AEMO's 2023 assessment of system strength requirements (over a 10-year horizon), and system strength shortfalls (until 1 December 2025). All assessments have been conducted in accordance with the latest System Strength Requirements Methodology (SSRM)[5].

In completing these assessments, AEMO has reviewed the minimum system strength requirements for each region and undertaken a suite of market modelling studies to estimate the typical levels of system strength available. 'Typical' in this context refers to the 99th percentile level of availability.

While system strength shortfalls can only be declared by AEMO if they commence before 2 December 2025[6], AEMO has indicated the underlying projections of available system strength for a five-calendar year period. Market modelling has been conducted on a financial year basis over six years, and all analysis leverages the latest available inputs and results from the *Step Change* scenario of the Draft 2024 *Integrated System Plan* (ISP)[7]. Further details of these input assumptions and the market modelling approach are presented in Appendix A2.

Review of system strength nodes

A system strength node is a physical location on the transmission network, at which AEMO must determine system strength requirements and apply those requirements for power system security. AEMO applies engineering, market and policy judgement to select and review the nodes for each region. This considers the general principles and criteria detailed in the SSRM, and AEMO undertakes its review of nodes in close collaboration with the SSSPs to ensure they can support efficient investment outcomes.

[4] AEMC. Efficient management of system strength, at https://www.aemc.gov.au/rule-changes/efficient-management-system-strength-power-system.

[5] AEMO. System Strength Requirements Methodology 1 December 2022, at https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/system-strength-requirements/system-strength-requirements-methodology.pdf?la=en.

[6] Under the transitional rules for the Efficient management of system strength rule change, at https://www.aemc.gov.au/rule-changes/efficient-management-system-strength-power-system: see NER 11.143.14.

[7] Final revisions ahead of publishing the Draft 2024 ISP in may result in minor changes compared with the modelling inputs used in this report.

AEMO has not declared any new nodes in this report, however recent renewable energy zone (REZ) policy announcements, generator connections, and network projects may justify including additional locations to maximise the effectiveness of system strength investments. AEMO has identified these potential nodes in each regional summary and welcomes any stakeholder feedback on the utility of these (or other) network locations.

Review of minimum fault level requirements

The minimum fault level requirement is intended to deliver enough system strength to maintain overall system stability and ensure that network protection and voltage control devices can operate correctly, even as traditional fault current sources withdraw from the system.

This requirement is specified as a fault current value and must therefore be met by solutions capable of delivering fault current. Technologies options may include synchronous condensers, contracts with market participants to provide fault current services, or the conversion of existing thermal units into synchronous condensers.

Minimum requirements are determined in consultation with relevant network businesses and must include consideration for correct operation of protection systems, stable switching of voltage control devices, and detailed power system analysis to demonstrate stability under a range of dispatch patterns and contingency events.

Optimised forecast of future inverter-based resources (IBR) investment

The efficient level of system strength is intended to deliver system strength investment at optimised network locations, sufficient to accommodate or encourage future IBR connections near those locations. This requirement is specified as a capacity of IBR that must be able to connect without voltage stability issues, assuming all other generator performance standards are met.

As such, the efficient level can be met by any existing or new technology capable of improving the resilience of the local voltage waveform. This could include synchronous machines, as well as dynamic reactive devices, network reconfigurations, or grid-forming technology customised to the needs of specific network locations.

Efficient levels are typically based on the most likely scenario published in the AEMO's most recent ISP. Requirements in this report are based on the Draft 2024 ISP *Step Change* scenario[8]. Requirements are specified by node, technology and year.

Treatment of grid-forming and grid-following inverters

The technical parameters and capabilities of future IBR connections is an important consideration when planning to meet the efficient level of system strength. For example, grid-forming IBR is likely to require much less (or no) remediation compared to a grid-following project.

The current ISP investment modelling does not explicitly make a distinction between these two technology types, and all IBR is effectively treated as grid-following. While AEMO anticipates that grid-forming technology will increase over time, there is not yet sufficient evidence or investment modelling to assess this trajectory.

The 2023 efficient levels are based on those in the Draft 2024 ISP *Step Change* scenario and have therefore used the same base assumptions. This could result in a more onerous requirement, and AEMO encourages SSSPs to consider their local connections experience when determining how best to model the 'typical' performance characteristics of forecast IBR.

[8] Final revisions ahead of publishing the Draft 2024 ISP in may result in minor changes compared with the modelling inputs used in this report.

1.2 Trends impacting system strength assessments

The NEM is changing at a speed and scale never before seen, transforming the way electricity is generated, transported, and consumed. The pace of this change is still accelerating, and traditional ways of operating are being challenged as system security and reliability become increasingly complex.

As the system moves away from a historical dependence on synchronous generation, the energy future is expected to be built on low-cost renewable energy, dynamic firming technology, new network infrastructure, and adaptive operating strategies. This shift will have a significant impact on the severity and timing of system strength requirements, shortfalls, and investment needs.

Withdrawal of synchronous units and uptake of IBR is driving system strength requirements

Many critical system security needs were once met by the natural properties of a synchronous generation fleet, which allowed the power system to operate comfortably inside its technical envelope. However, security services that were once available in abundance are now diminishing as these synchronous generating units are progressively withdrawn and replaced by IBR in more remote locations. This shift is creating new challenges for maintaining sufficient fault levels to support network protection and voltage control systems, while also enabling the efficient connection of future IBR projects across the NEM.

A new framework is now in place to drive proactive system strength solutions at scale

In October 2021, the Australian Energy Market Commission (AEMC) amended the system strength framework to drive more proactivity in the provision of system strength services, to deliver a streamlined connection process, and to leverage economies of scale in larger, centralised investments. A mechanism was also introduced to allow connection applicants to decide between procuring their own system strength assets or contributing to a fleet of centrally provided services. Those changes have taken effect in the last 12 months.

Regulatory Investment Tests for Transmission (RIT-Ts) are already underway in every region to deliver the first round of investment, and this report provides a key input into those processes.

Supply chain difficulties are driving the need for proactive system security planning

Global supply chains have been under pressure for several years, and this has been exacerbated by the global economic impacts of geopolitical activity. Worldwide demand for electricity infrastructure has increased markedly and this trend is expected to continue[9]. Industry is reporting that the lead-times for delivery of major system strength equipment could now be in excess of five years. This may justify the need to invest pre-emptively, because the potential cost of delay may outweigh any benefits from fine-tuning the optimal delivery timing.

However, AEMO does not expect network assets to be the only viable means of meeting system strength requirements. While the minimum fault level must still be met by solutions capable of providing fault current, the efficient level could be met by any technology capable of stabilising voltages in its local area. This should allow for a diverse portfolio of solutions that include innovative grid-forming technologies, alongside synchronous condensers, the conversion of existing generators, and contractual arrangements with other market participants.

[9] Minerals Council of Australia, Commodity outlook, at https://www.minerals.org.au/sites/default/files/Commodity%20Outlook%202030.pdf.

Further market reforms are underway to improve security frameworks in the NEM

The AEMC is considering options to improve market arrangements for the provision of security services[10]. The AEMC released an initial draft determination for this project in late 2022, however proposed an alternative direction in May 2023 to deliver more immediate solutions.

The AEMC is currently considering submissions on its revised directions paper and expects to publish a final determination in March 2024.

1.3 Structure of this report

The 2023 *System Strength Report* contains the following information:

- For each region, AEMO's assessment of system strength requirements and shortfalls:
  - New South Wales (Section 2.1).
  - Queensland (Section 2.2).
  - South Australia (Section 2.3).
  - Tasmania (Section 2.4).
  - Victoria (Section 2.5).
- An overview of next steps related to the findings in this report (Section 3).
- An overview of the methodology and inputs used to prepare this report (Appendix A1).
- An overview of the market modelling assumptions used in preparing this report (Appendix A2).
- A summary of minimum fault level requirements to be applied operationally (Appendix A3).

The system strength assessment is primarily conducted on a regional basis, and AEMO recognises that most readers will focus on a region of interest, rather than reading all chapters sequentially. In response, AEMO has drafted each of these sections to be easily extracted or read in isolation from the others.

[10] See https://www.aemc.gov.au/rule-changes/improving-security-frameworks-energy-transition.

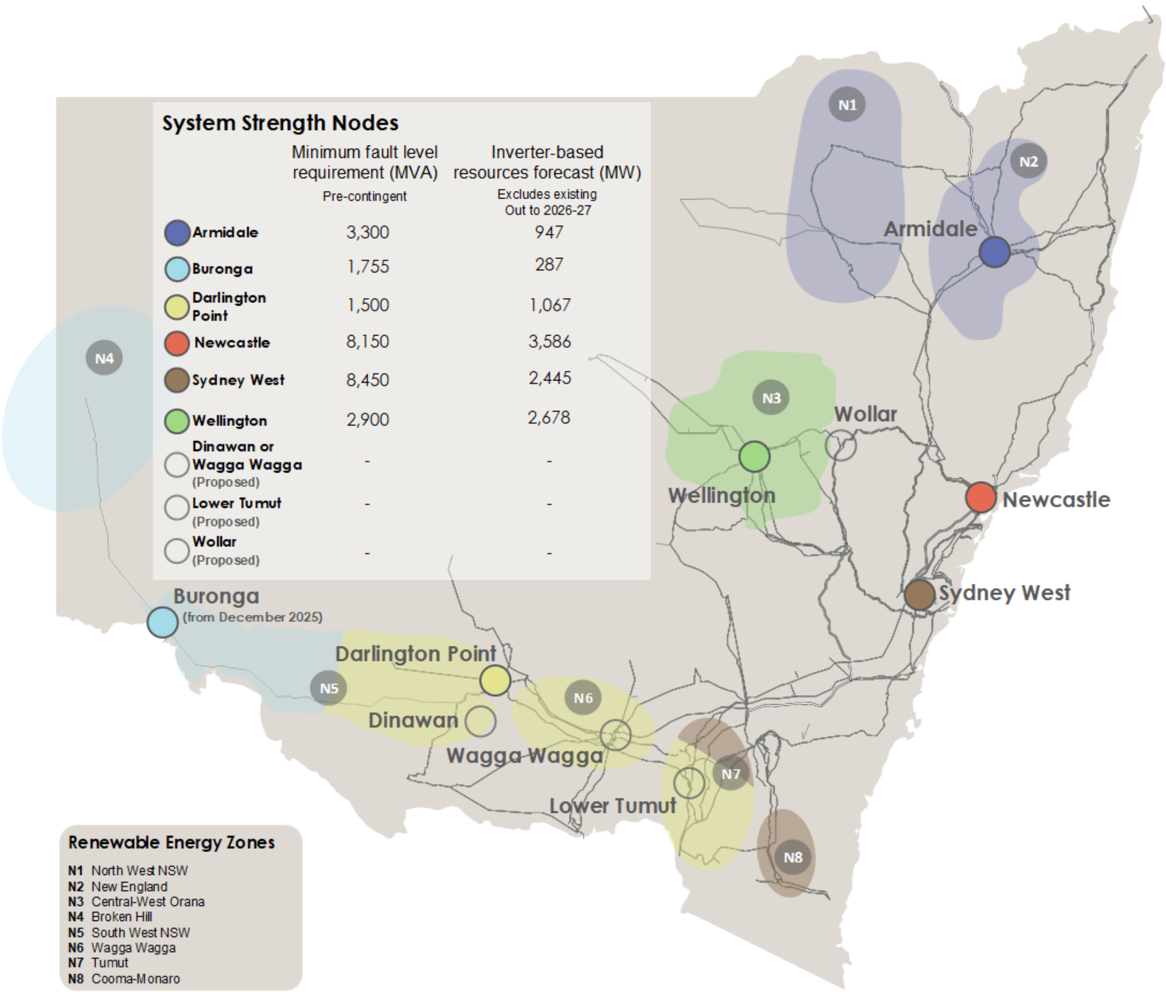
2 System strength assessment

2.1 New South Wales

AEMO has not identified any new system strength shortfalls in New South Wales. Previously identified shortfalls at Newcastle and Sydney West have increased in magnitude to 1,420 megavolt amperes (MVA) and 1,165 MVA respectively and are expected to emerge from 1 July 2025.

Figure 2 provides a summary of the system strength specification for New South Wales, including the location of system strength nodes, and the minimum fault level requirements and forecast IBR projections for each. Near-term system strength shortfalls have worsened due to announced changes in several large transmission and generation projects, with consequential impacts on the typical availability of fault current sources in the region.

Figure 2 System strength node location and system strength standard in New South Wales



Note: REZs are mapped to show where the majority of forecast IBR are expected, consistent with the ISP.

Scope of assessment

AEMO has assessed fault level shortfalls in New South Wales until 1 December 2025, and in parallel has specified a set of minimum fault level requirements and projected IBR levels over a 10-year period. These outcomes form the basis of SSSP remediation obligations under the system strength framework[11].

As part of the 2023 assessment, AEMO has considered if any material system changes have occurred that would warrant reassessment of the current system strength nodes, or a recalculation of their associated minimum fault levels requirements. No changes were subsequently made to these values.

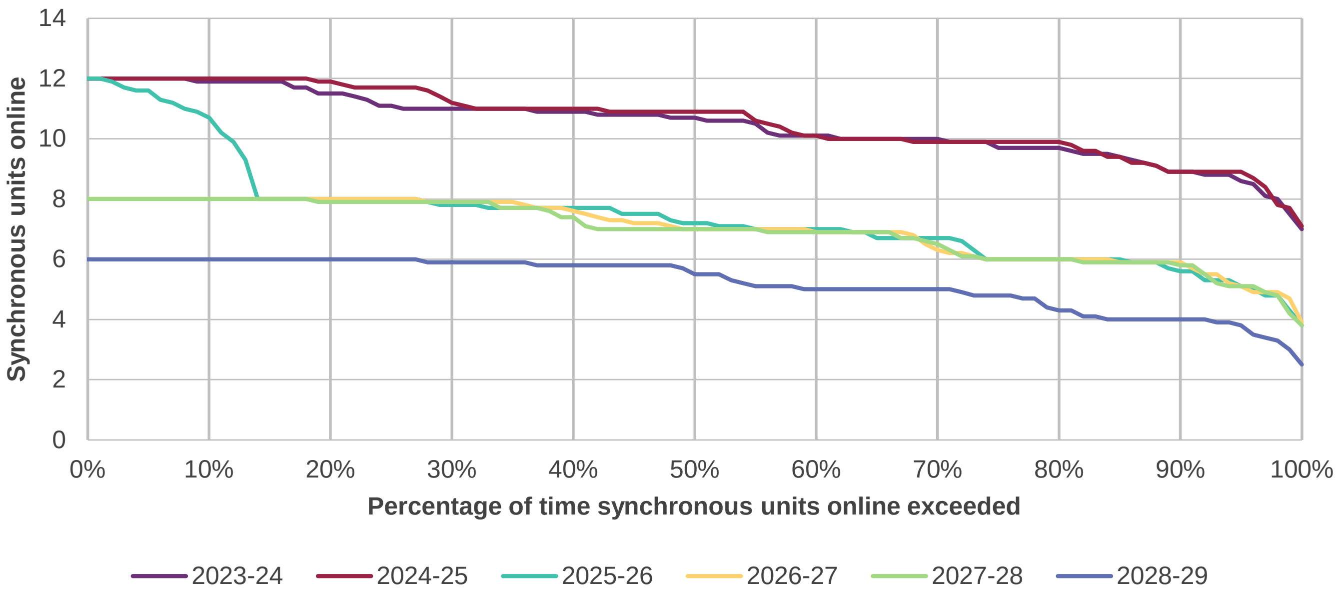
To assess shortfalls, time-sequential market modelling studies were used to estimate the typical levels of system strength available at each node across a five-year[12] study horizon. While shortfalls can only be declared until 1 December 2025, AEMO has included the full five-year availability assessment for information purposes. Appendix A1 provides further detail on the inputs, assumptions, and methodology used in this analysis.

Projected reduction in available fault current from synchronous generation

Figure 3 presents the modelled number of large synchronous generating units online in New South Wales over a five-year outlook period. This highlights a significant forecast reduction over time, as falling levels of operational demand and increasing penetration of IBR act to reduce the utilisation of these units. These curves consider changes in dispatch patterns, and the announced withdrawal of existing generating units. The modelling does not enforce existing operational unit commitment requirements, and instead reflects the full need for system strength investment in the absence of operational interventions that would otherwise be required[13].

The dispatch patterns associated with the first three years of these results are also used to inform the shortfall assessments presented in the following section.

Figure 3 Synchronous units projected online under *Step Change* scenario, New South Wales



[11] Under NER 11.143.15 for the system strength transition period, and NER 5.2.3(b) / S5.1.14 for ongoing planning and remediation.

[12] Refers to five calendar years noting that six financial years have been modelled.

[13] For example, on 16 November 2023, AEMO was required to issue Directions in New South Wales to maintain adequate system security.

Fault current requirements and shortfalls

AEMO has previously declared six system strength nodes in New South Wales; these remain unchanged since the 2022 *System Strength Report*. AEMO has also assessed whether any material system changes have occurred that would affect the associated minimum fault level requirements, and no adjustments have been made.

To identify any potential system strength shortfalls, AEMO assessed forecast levels of available system strength against these requirements until 1 December 2025. The results of this assessment are presented in Table 2, alongside the definition of each node and its current fault level requirements.

The analysis confirms the timing of previously declared shortfalls at Newcastle and Sydney West. Transgrid is progressing a RIT-T to meet these needs alongside its long-term system strength obligations.

Table 2 New South Wales system strength nodes, fault level requirements, and shortfalls

System strength node[A]	Effective date range	2023 Minimum fault level requirement (MVA)		Identified shortfall by financial year ending (MVA)		
		Pre-contingent	Post-contingent	2024	2025	2026[E]
Armidale 330 kilovolts (kV)	1 Dec 2022 onwards	3,300	2,800	0	0	0
Buronga 220 kV	2 Dec 2025 onwards	1,755[C]	TBD[C]	0	0	0
Darlington Point 330 kV	1 Dec 2022 onwards[D]	1,500	600[B]	0	0	0
Newcastle 330 kV	1 Dec 2022 onwards	8,150	7,100	0	0	1,420
Sydney West 330 kV	1 Dec 2022 onwards	8,450	8,050	0	0	1,165
Wellington 330 kV	1 Dec 2022 onwards[D]	2,900	1,800	0	0	0

A. Bus 1 of each system strength node is selected by default. Alternative buses may be selected on a case-by-case basis.
B. Secure operation of the power system may require lower fault level values under some power system configurations or contingency events.
C. Based on prior modelling and advice from Transgrid (See Appendix A2, 2022 *System Strength Report*). Values to be finalised by 1 December 2025.
D. Possibility of retirement on declaration of new nodes (see below).
E. Shortfall applies to 1 December 2025

AEMO has also considered possible future nodes in New South Wales, as described in Table 3. These nodes may be declared in a future *System Strength Report*, subject to the changing needs of the power system.

Table 3 Possible future nodes in New South Wales region and closures of existing nodes

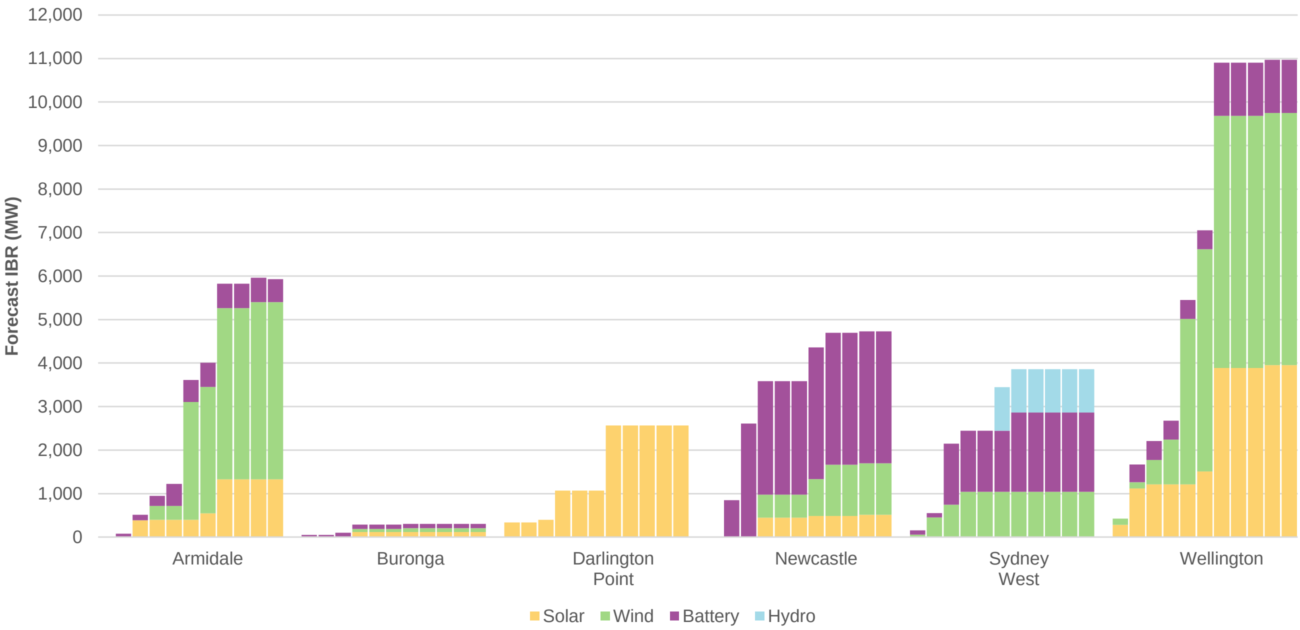
System strength node	Effective date range	Purpose of new node
Dinawan 330 kV	Project EnergyConnect commissioning	May provide better location for IBR in Southern New South Wales.
Lower Tumut 330 kV	Eraring Power Station retirement	May allow for alternative synchronous sources in New South Wales.
Wollar 330 kV	Removal of Wellington node	May provide better locations for IBR in Central West Orana.

Summary of IBR projections for New South Wales

AEMO's 10-year forecast of the quantity and technology of IBR investment in New South Wales is summarised in Figure 4, with underlying datasets for each node provided in Section 2.1.1. While these are primarily based on Draft 2024 ISP results, AEMO has applied minor adjustments in allocating these forecasts to specific nodes based on local network knowledge and engineering judgement.

AEMO expects that Transgrid, as the SSSP in New South Wales, will engage in joint planning with neighbouring SSSPs and EnergyCo to identify investment efficiencies when meeting these requirements. AEMO is supportive of SSSPs considering the latest available information and announcements to adjust these values for use in their system strength RIT-Ts between publications of the *System Strength Report*.

Figure 4 11-year forecast of IBR and market network service facilities (MNSFs) from 2023-24, New South Wales



Notes: The near-term years of the forecast may require adjustment by the SSSP as more information becomes available about committed plant, such as their technical characteristics or their elections under the system strength framework – for example to adjust requirements for projects connecting under the older framework. Further detail is provided in Appendix 1.1

Critical planned outages

SSSPs are expected to consider critical planned outages into their proposed system strength solutions on a case-by-case basis[14]. AEMO has declared several critical planned outages as impactful for maintaining system strength in New South Wales, and these are presented in Table 4.

Table 4 Critical planned outages in New South Wales for each system strength node

Affected node	Network outage	Reason for consideration as a critical outage
Armidale **Newcastle**	83 Liddell to Muswellbrook 330 kV line	Loss of another 330 kV line during this outage leaves Armidale connected to Queensland network. Post-contingency fault level at Armidale 330 kV bus depends on southern Queensland generation.
	84 Liddell to Tamworth 330 kV line	
	88 Muswellbrook to Tamworth 330 kV line	
	85 Tamworth to Uralla 330 kV line	
	86 Tamworth to Armidale 330 kV line	
	8U Uralla to Armidale 330 kV line	
Darlington Point	O51 – Lower Tumut to Wagga Wagga 330 kV line	Can lead to a reduction in significant IBR that may have power system consequences. X5, 63 and 996 lines to be opened, Yass to Wagga 132 lines to be opened as necessary.
	62- Jindera to Wagga Wagga 330 kV line	
	63 – Wagga Wagga to Darlington Point 330 kV line	
	X5 – Darlington Point to Balranald 220 kV line	
	O60 – Jindera to Dederang 330 kV line	
Newcastle	81 Liddell to Newcastle 330 kV Line	Loss of another 330 kV line will reduce the fault level contribution from Bayswater and Mt Piper significantly. These outages have been included for potential retirement of Eraring Power Station.
	82 Liddell to Tomago 330 kV Line	

[14] AEMC, 2021, Page 98, Efficient Management of System Strength on the Power System, at https://www.aemc.gov.au/rule-changes/efficient-management-system-strength-power-system.

2.1.1 Nodal assessment of minimum requirements, shortfalls, and IBR projections

Armidale 330 kilovolts (kV)

Figure 5 presents the projected levels of available three phase fault current at the Armidale 330 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 5 summarises this assessment and does not identify any shortfalls. Table 6 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 5 Armidale node fault level duration curves and minimum requirement

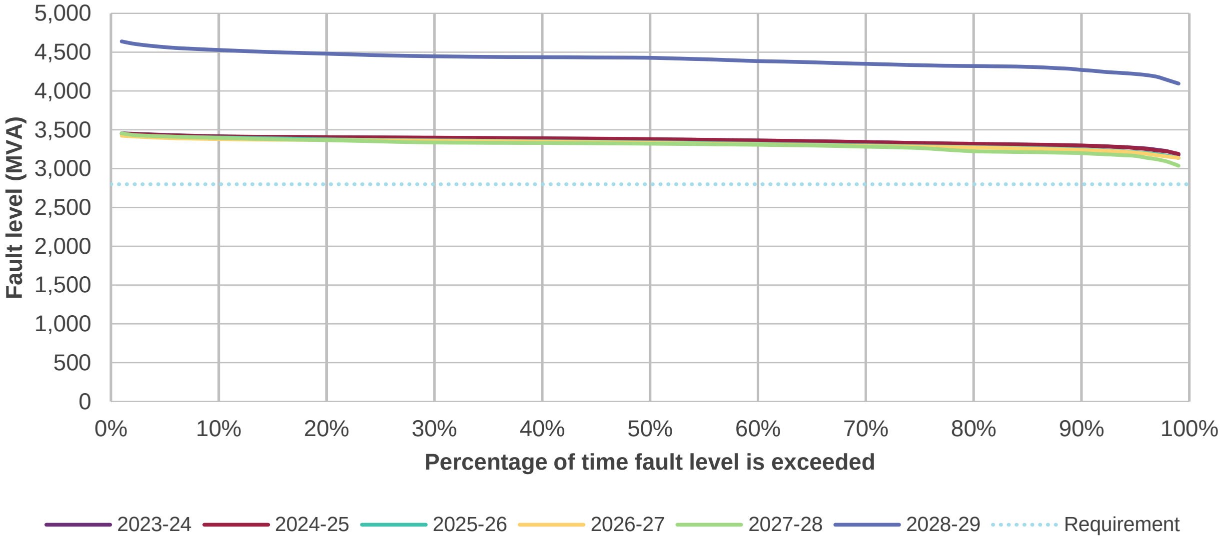


Table 5 Armidale node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Armidale 330 kV	Requirement (N)	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300
	Requirement (N-1)	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800
	Expected 99% of time	3,179	3,188	3,138	3,139	3,035	4,094					
	Declarable shortfall	**0**	**0**	**0**								

A. Minimum fault current requirements at Armidale may be impacted by New England REZ 500 kV lines and associated system strength activities.

Table 6 Armidale node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Armidale 330 kV	Solar	721	0	0	385	396	396	396	544	1,330	1,330	1,330	1,330
	Wind	442	0	0	0	321	321	2,710	2,907	3,934	3,934	4,071	4,071
	Battery	0	0	80	130	230	505	505	559	559	559	559	529
	Total IBR	**1,163**	**0**	**80**	**515**	**947**	**1,222**	**3,611**	**4,010**	**5,823**	**5,823**	**5,960**	**5,930**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly-committed IBR and market network service facilities (MNSFs).

Buronga 220 kV

Figure 6 presents the projected levels of available three phase fault current at the Buronga 330 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 7 summarises this assessment and does not identify any shortfalls as this node comes into effect from 2 December 2025 onwards, outside the shortfall declaration period. Table 8 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 6 Buronga node fault level duration curves and minimum requirement

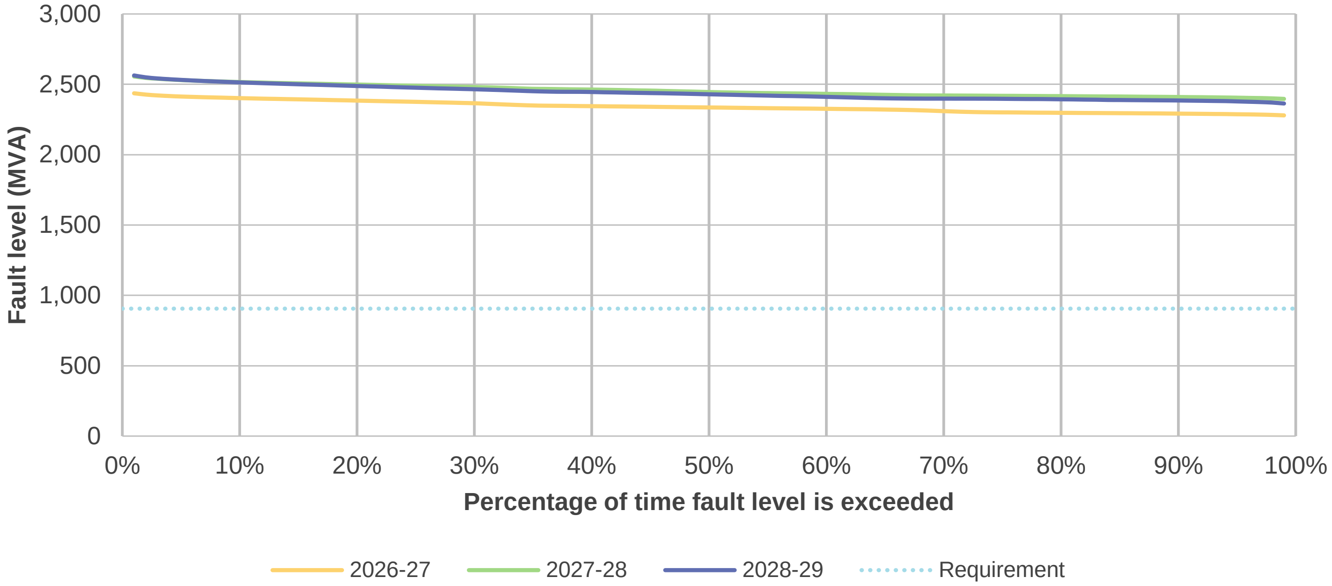


Table 7 Buronga node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Buronga 220 kV	Requirement (N)	N/A	1,755	1,755	1,755	1,755	1,755	1,755	1,755	1,755	1,755	1,755
	Requirement (N-1)	N/A	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC
	Expected 99% of time	N/A	N/A	2,205	2,279	2,380	2,363					
	Declarable shortfall	N/A	N/A	N/A								

A. Minimum fault current requirements at Buronga may be impacted by network impedance changes following commissioning of Project EnergyConnect and the Victoria – New South Wales Interconnector West (VNI West) project.

Table 8 Buronga node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Buronga 220 kV	Solar	541	0	0	0	118	118	118	118	118	118	118	118
	Wind	199	0	0	0	69	69	69	89	89	89	89	89
	Battery	0	50	50	100	100	100	100	100	100	100	100	100
	Total IBR	**740**	**50**	**50**	**100**	**287**	**287**	**287**	**307**	**307**	**307**	**307**	**307**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.

Darlington Point 330 kV

Figure 7 presents the projected levels of available three phase fault current at the Darlington Point 330 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 9 summarises this assessment and does not identify any shortfalls. Table 10 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 7 Darlington Point node fault level duration curves and minimum requirement

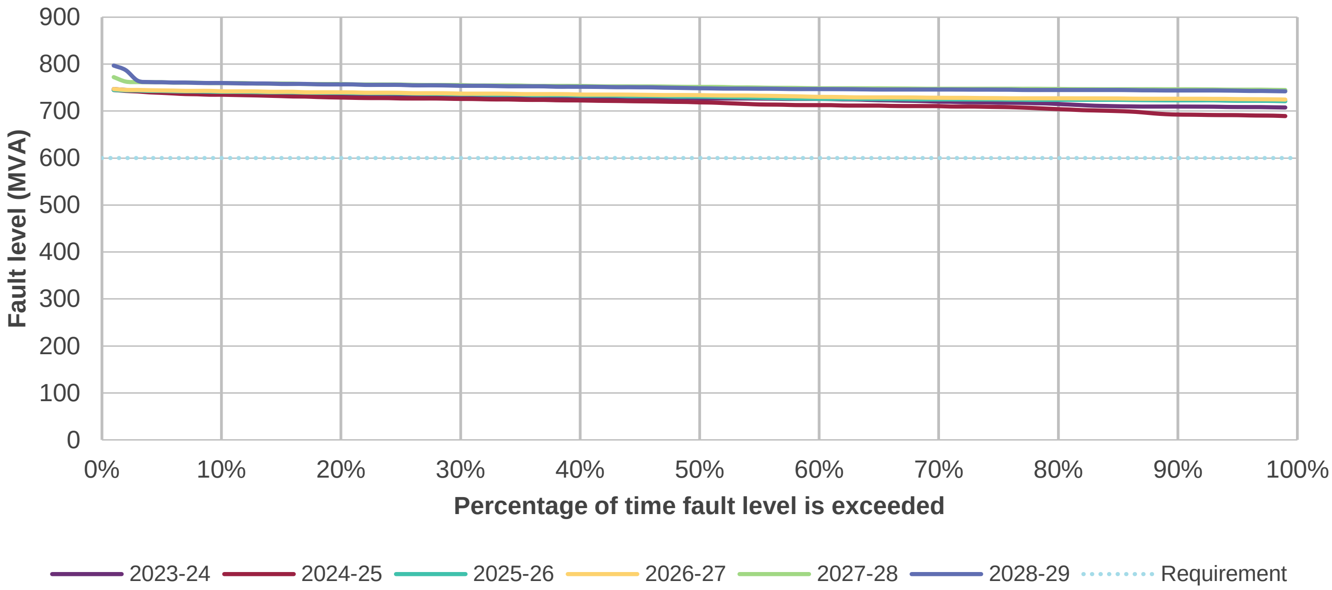


Table 9 Darlington Point node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Darlington Point 330 kV	Requirement (N)	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
	Requirement (N-1)	600	600	600	600	600	600	600	600	600	600	600
	Expected 99% of time	708	690	721	724	745	742					
	Declarable shortfall	**0**	**0**	**0**								

A. Minimum fault current requirements at Darlington Point may be impacted by network impedance changes following commissioning of Project EnergyConnect, HumeLink, and the VNI West project.

Table 10 Darlington Point node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Darlington Point 330 kV	Solar	1,458	336	336	396	1,067	1,067	1,067	2,567	2,567	2,567	2,567	2,567
	Wind	0	0	0	0	0	0	0	0	0	0	0	0
	Battery	150	0	0	0	0	0	0	0	0	0	0	0
	Total IBR	**1,608**	**336**	**336**	**396**	**1,067**	**1,067**	**1,067**	**2,567**	**2,567**	**2,567**	**2,567**	**2,567**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.

Newcastle 330 kV

Figure 8 presents the projected levels of available three phase fault current at the Newcastle 330 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 11 summarises this assessment and identifies a shortfall in 2026. Table 12 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 8 Newcastle node fault level duration curves and minimum requirement

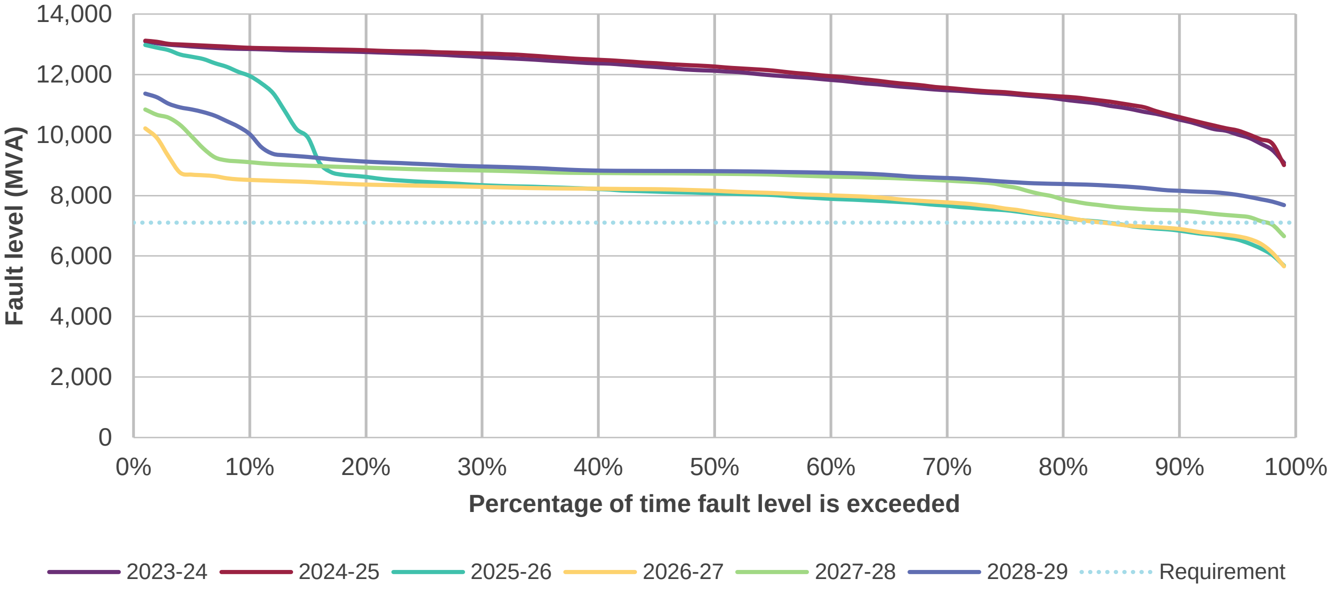


Table 11 Newcastle node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Newcastle 330 kV	Requirement (N)	8,150	8,150	8,150	8,150	8,150	8,150	8,150	8,150	8,150	8,150	8,150
	Requirement (N-1)	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100
	Expected 99% of time	9,086	9,006	5,681	5,661	6,657	7,686					
	Declarable shortfall	**0**	**0**	**1,420**								

A. Minimum fault current requirements at Newcastle may be impacted by network impedance changes following commissioning of the Sydney-Newcastle-Wollongong (SNW) Northern 500 kV loop.

Table 12 Newcastle node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Newcastle 330 kV	Solar	0	0	0	0	449	449	449	484	484	484	516	516
	Wind	0	0	0	0	525	525	525	847	1,182	1,182	1,182	1,182
	Battery	0	0	850	2,612	2,612	2,612	2,612	3,029	3,029	3,029	3,029	3,029
	Total IBR	**0**	**0**	**850**	**2,612**	**3,586**	**3,586**	**3,586**	**4,360**	**4,695**	**4,695**	**4,727**	**4,727**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly-committed IBR and MNSFs.

Sydney West 330 kV

Figure 9 presents the projected levels of available three phase fault current at the Sydney West 330 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 13 summarises this assessment and identifies a shortfall in 2026. Table 14 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 9 Sydney West node fault level duration curves and minimum fault level requirement

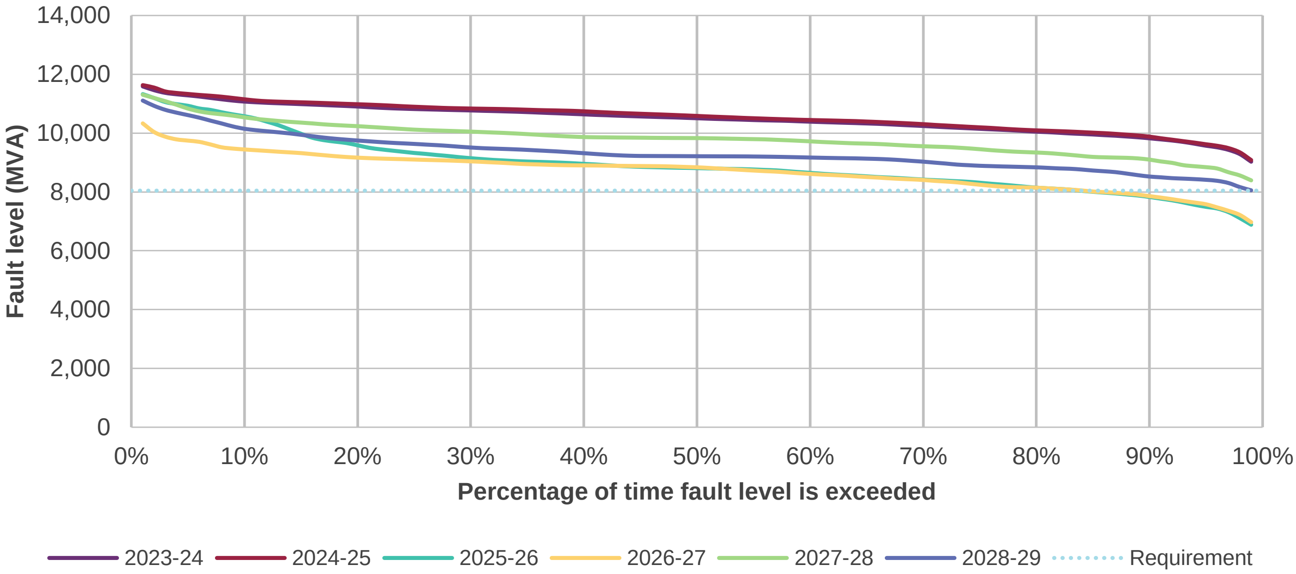


Table 13 Sydney West node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Sydney West 330 kV	Requirement (N)	8,450	8,450	8,450	8,450	8,450	8,450	8,450	8,450	8,450	8,450	8,450
	Requirement (N-1)	8,050	8,050	8,050	8,050	8,050	8,050	8,050	8,050	8,050	8,050	8,050
	Expected 99% of time	9,025	9,086	6,885	6,977	8,391	8,055					
	Declarable shortfall	**0**	**0**	**1,165**								

A. Minimum fault current requirements at Sydney West may be impacted by network impedance changes following commissioning of HumeLink, SNW Northern 500 kV loop, and VNI West.

Table 14 Sydney West node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Sydney West 330 kV	Solar	10	0	0	0	0	0	0	0	0	0	0	0
	Wind	1,328	58	454	743	1,043	1,043	1,043	1,043	1,043	1,043	1,043	1,043
	Battery	60	100	100	1,402	1,402	1,402	1,402	1,819	1,819	1,819	1,819	1,819
	Hydro	0	0	0	0	0	0	1,000	1,000	1,000	1,000	1,000	1,000
	Total IBR	**1,398**	**158**	**554**	**2,145**	**2,445**	**2,445**	**3,445**	**3,862**	**3,862**	**3,862**	**3,862**	**3,862**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly-committed IBR and MNSFs.

Wellington 330 kV

Figure 10 presents the projected levels of available three phase fault current at the Wellington 330 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 15 summarises this assessment and does not identify any shortfalls. Table 16 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 10 Wellington node fault level duration curves and minimum requirement

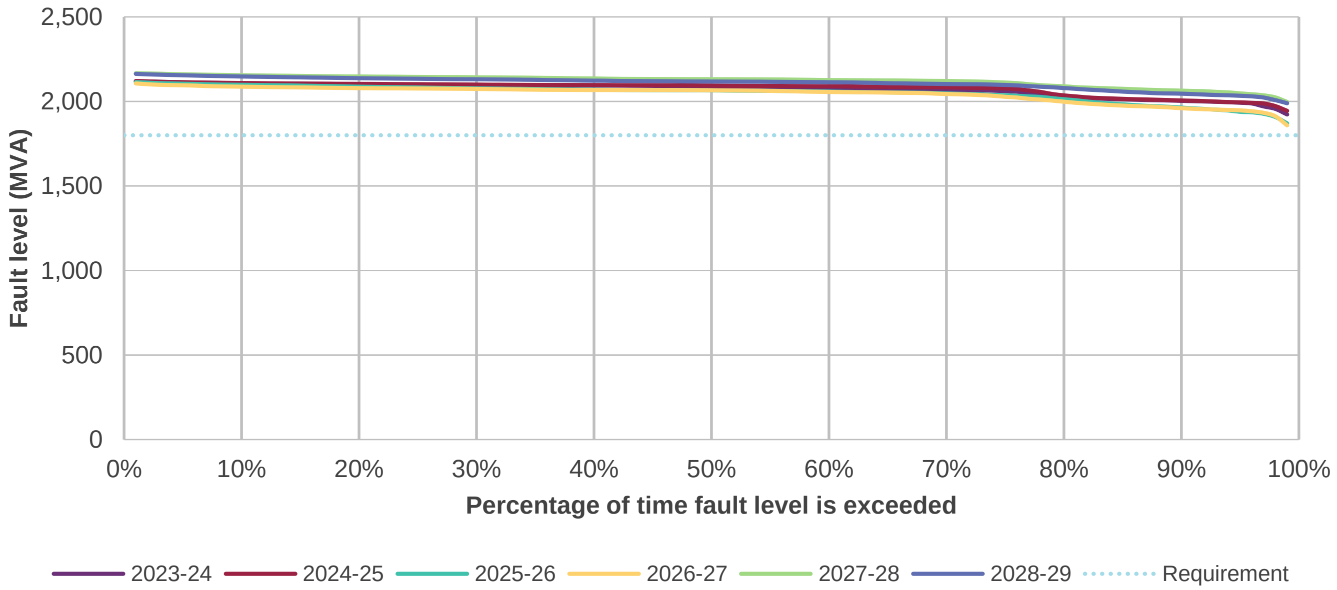


Table 15 Wellington node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Wellington 330 kV	Requirement (N)	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900	2,900
	Requirement (N-1)	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800
	Expected 99% of time	1,924	1,944	1,871	1,858	1,998	1,990					
	Declarable shortfall	**0**	**0**	**0**								

A. Minimum fault current requirements at Wellington may be impacted by the final scope and timing of the Central West Orana REZ 500 kV lines and system strength remediation.

Table 16 Wellington node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Wellington 330 kV	Solar	937	280	1,117	1,214	1,214	1,214	1,508	3,887	3,887	3,887	3,952	3,952
	Wind	255	146	146	560	1,028	3,800	5,109	5,794	5,794	5,794	5,794	5,794
	Battery	0	0	408	436	436	436	436	1,224	1,224	1,224	1,224	1,224
	Total IBR	**1,192**	**426**	**1,671**	**2,210**	**2,678**	**5,450**	**7,053**	**10,905**	**10,905**	**10,905**	**10,970**	**10,970**

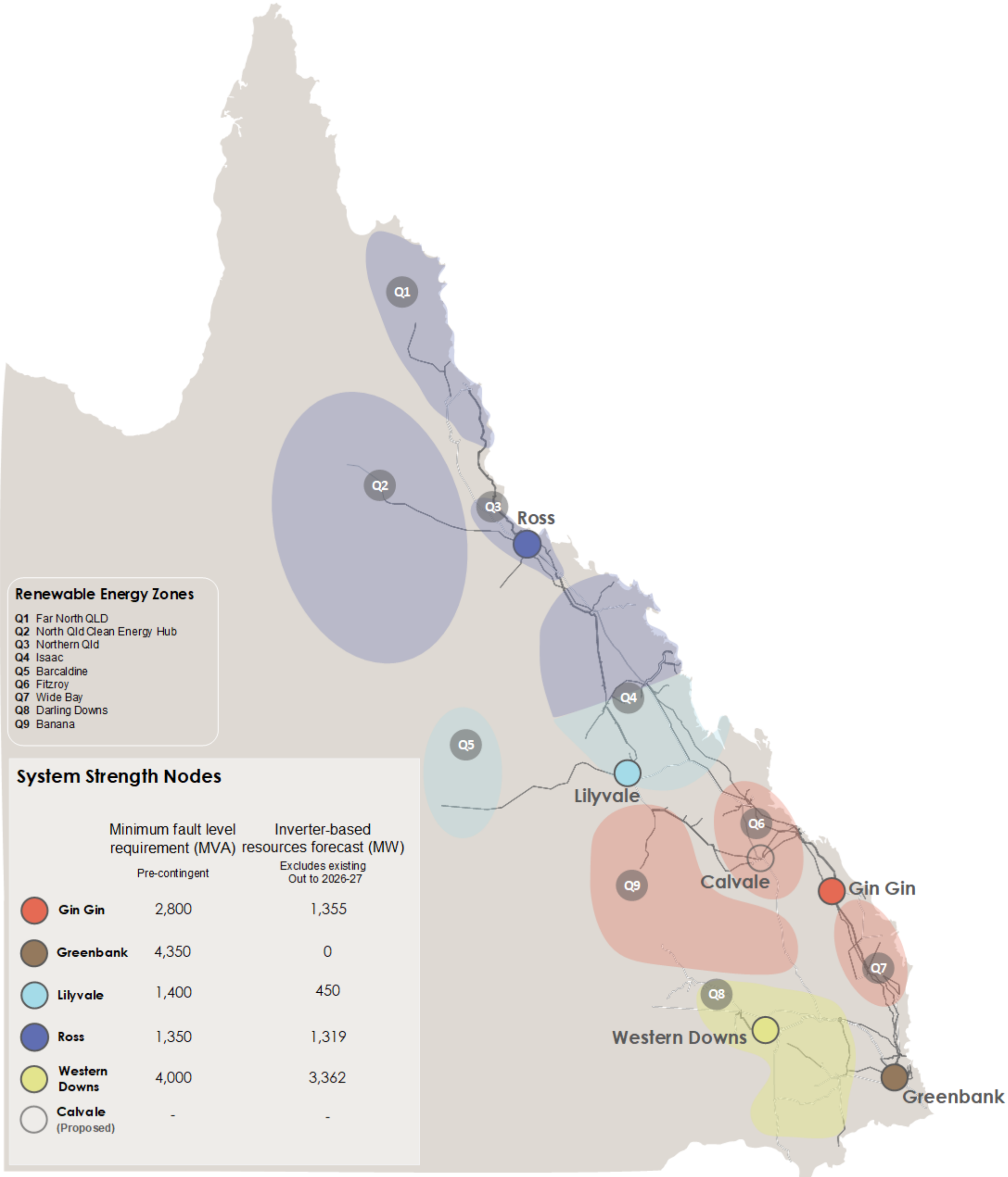
Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly-committed IBR and MNSFs.

2.2 Queensland

AEMO has not identified any new system strength shortfalls in Queensland, and the previously declared shortfall of 64 MVA at Gin Gin remains unchanged. Powerlink is progressing remediation activities which are expected to apply from 1 July 2025. Operational processes are in place to manage system security in the interim period.

Figure 11 provides a summary of the system strength specification for Queensland, including the location of system strength nodes, and the minimum fault level requirements and forecast IBR projections for each.

Figure 11 System strength node location and system strength standard in Queensland



	Minimum fault level requirement (MVA) Pre-contingent	Inverter-based resources forecast (MW) Excludes existing Out to 2026-27
Gin Gin	2,800	1,355
Greenbank	4,350	0
Lilyvale	1,400	450
Ross	1,350	1,319
Western Downs	4,000	3,362
Calvale (Proposed)	-	-

Note: REZs are mapped to show where the majority of forecast IBR are expected, consistent with the ISP. Several possible future notes are also being considered in Central, Northern and Southern Queensland, see Table 18 for detail.

Scope of assessment

AEMO has assessed fault level shortfalls in Queensland until 1 December 2025, and in parallel has specified a set of minimum fault level requirements and projected IBR levels over a 10-year period. These outcomes form the basis of SSSP remediation obligations under the system strength framework[15].

As part of the 2023 assessment, AEMO has considered if any material system changes have occurred that would warrant reassessment of the current system strength nodes, or a recalculation of their associated minimum fault levels requirements. No changes were subsequently made to these values, however recent REZ policy announcements, generator connections, and network modelling may justify including additional nodes in Queensland to maximise the effectiveness of system strength investments. AEMO has identified these potential nodes in the following section and welcomes stakeholder feedback on the utility of these (or other) locations.

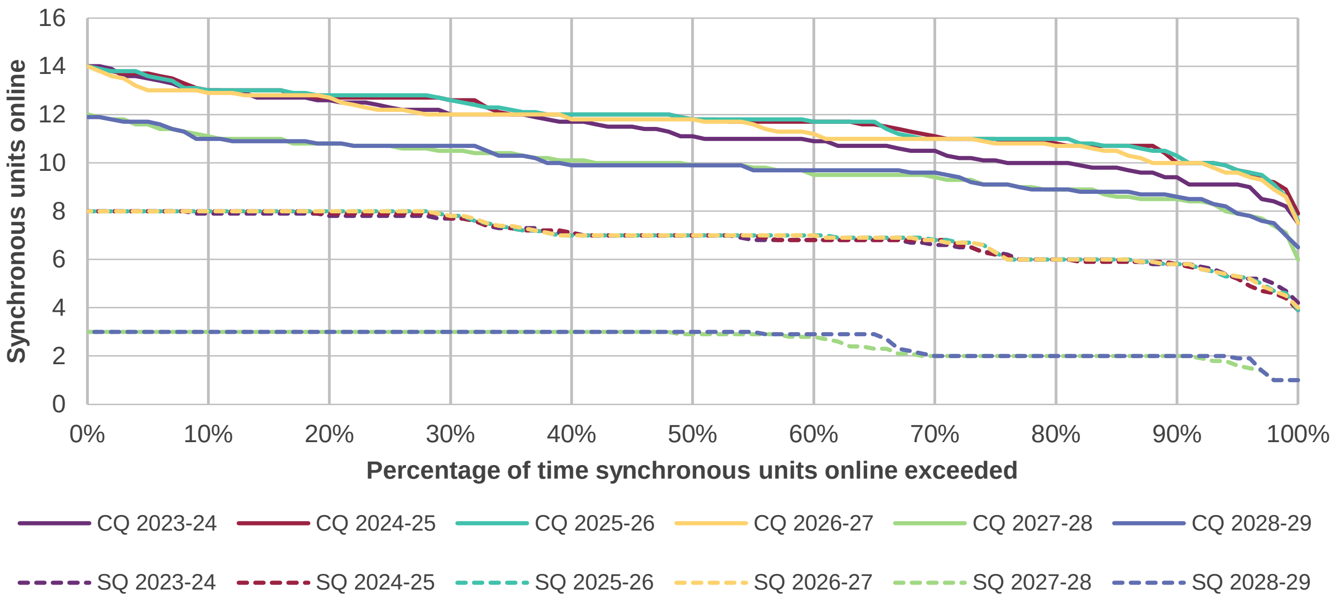
All modelling and analysis in this report is based on the latest inputs and results from the Draft 2024 ISP *Step Change* scenario. Appendix A1 provides further detail on the inputs and methodology used in this analysis.

Projected reduction in available fault current from synchronous generation

Figure 12 presents the modelled number of large synchronous generating units online in Queensland over a five-year outlook period[16]. This highlights a significant reduction over time, as falling levels of operational demand and increasing penetration of IBR act to reduce the utilisation of these units. These curves consider changes in dispatch patterns, and the announced withdrawal of existing generating units. The modelling does not enforce existing operational unit commitment requirements, and instead reflects the full need for system strength investment in the absence of operational interventions that would otherwise be required.

The dispatch patterns associated with the first three years of these results are also used to inform the shortfall assessments presented in the following section.

Figure 12 Synchronous units projected online under *Step Change* scenario, Central and Southern Queensland



15 Under NER 11.143.15 for the system strength transition period, and NER 5.2.3(b)/S5.1.14 for ongoing planning and remediation.

16 Refers to five calendar years noting that six financial years have been modelled.

Fault current requirements and shortfalls

AEMO has previously declared five system strength nodes in Queensland effective from 1 December 2022. These nodes remain unchanged since the 2022 *System Strength Report*, however AEMO has identified several potential new nodes related to recent REZ policy announcements, generator connections, and investment modelling results. AEMO has also assessed whether any material system changes have occurred that would affect the associated minimum fault level requirements, and no adjustments were made in response.

To identify any potential system strength shortfalls, AEMO assessed forecast levels of available system strength against these requirements until 1 December 2025. The results of this assessment are presented in Table 17 alongside the definition of each node and its current fault level requirements.

The analysis confirms the size and timing of the previously declared shortfall at Gin Gin. Powerlink is progressing arrangements to remediate this need, in parallel with a RIT-T to deliver its longer-term system strength obligations. AEMO will work with Powerlink to adjust the shortfall as required once arrangements are finalised.

Table 17 Queensland system strength nodes, fault level requirements, and identified shortfalls

System strength node[A]	Effective date range	2023 Minimum fault level requirement (MVA)		Identified shortfall by financial year ending (MVA)		
		Pre-contingent	Post-contingent	2024	2025	2026
Gin Gin 275 kV	1 Dec 2022 onwards	2,800	2,250	60[B]	50	50[C]
Greenbank 275 kV	1 Dec 2022 onwards	4,350	3,750	0	0	0
Lilyvale 132 kV	1 Dec 2022 onwards	1,400	1,150	0	0	0
Ross 275 kV	1 Dec 2022 onwards	1,350	1,175	0	0	0
Western Downs 275 kV	1 Dec 2022 onwards	4,000	2,550	0	0	0

A. Bus 1 of each system strength node is selected by default. Alternative buses may be selected on a case-by-case basis.
B. Magnitude of the shortfall is to remain at 64 MVA, consistent with the 2022 *System Strength Report*.
C. Shortfall applies to 1 December 2025.

AEMO is also considering possible future system strength nodes in Queensland, as described in Table 18. These are based on an assessment of recent generation connections, investment modelling results, and the Queensland Energy and Jobs Plan (QEJP)[17]. In particular, the QEJP includes a REZ development roadmap[18] outlining three phases for REZ development across Southern, Central, and Northern Queensland. AEMO welcomes all stakeholder feedback on the need for these, or additional node locations.

Table 18 Possible future nodes in Queensland and closures of existing nodes

System strength node	Effective date range	Purpose of new node
Calvale 275 kV	On closure of Gin Gin node	The current Gin Gin node is particularly sensitive to local generator behaviour, which could be improved by moving this node to Calvale.
Southern Downs (SQ), Far North Queensland (NQ)	In-flight REZ	These locations are defined as in-flight in the QEJP draft REZ Roadmap, and could support local system strength assessment and investment.
Calliope (CQ), Callide (CQ), Flinders (NQ)	REZ could be declared by 2024	These locations are Phase 1 REZs in the QEJP draft REZ Roadmap, and could support local system strength assessment and investment.
Collinsville (NQ), Isaac (CQ), Capricorn (CQ), Woolooga (SQ), Darling Downs (SQ), Tarong (CQ)	REZ could be declared between 2024 and 2035	These locations are Phase 2 or Phase 3 REZs in the QEJP draft REZ Roadmap and could support local system strength assessment and investment.

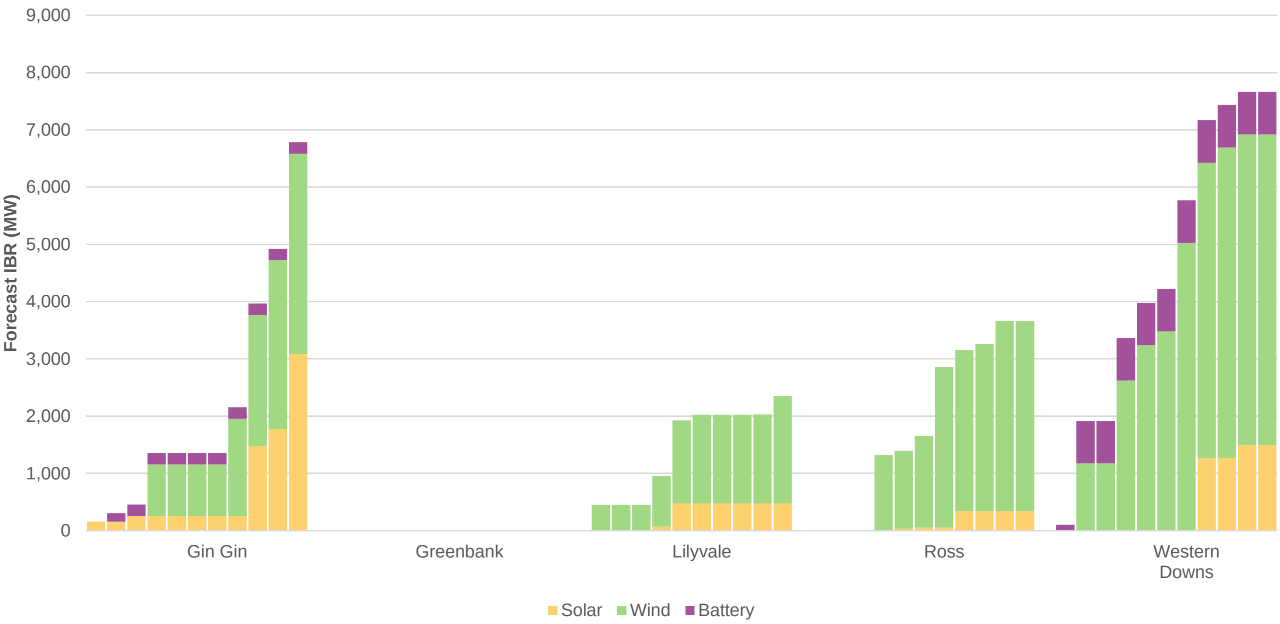
[17] See https://www.epw.qld.gov.au/__data/assets/pdf_file/0029/32987/queensland-energy-and-jobs-plan.pdf.

[18] Draft roadmap available at https://www.epw.qld.gov.au/__data/assets/pdf_file/0019/36037/draft-2023-queensland-rez-roadmap.pdf.

Summary of IBR projections for Queensland

AEMO's 10-year forecast of the quantity and technology of IBR investment in Queensland is summarised in Figure 13, with underlying datasets for each node provided in Section 2.2.1.

Figure 13 11-year forecast of IBR and MNSFs by system strength node from 2023-24, Queensland



Notes: the near-term years of the forecast may require adjustment by the SSSP as more information becomes available about committed plant, such as their technical characteristics or their elections under the system strength framework – for example to adjust requirements for projects connecting under the older framework. Further detail is provided in Appendix 1.1.

AEMO expects that Powerlink, as the SSSP in Queensland, may engage in joint planning with neighbouring SSSPs to identify any investment efficiencies in meeting these requirements. AEMO is supportive of SSSPs considering the latest available information and announcements to adjust these values for use in their system strength RIT-Ts between publications of the *System Strength Report*.

Critical planned outages

SSSPs are expected to consider critical planned outages into their proposed system strength solutions on a case-by-case basis[19]. AEMO has declared two critical planned outages as impactful for maintaining system strength in Queensland, and these are presented in Table 19.

Table 19 Critical planned outages in Queensland for each system strength node

Affected node	Network outage	Reason for consideration as a critical outage
Lilyvale 132 kV	Lilyvale to Broadsound 275 kV line Lilyvale 275/132 kV transformer	Lilyvale 132 kV bus below minimum fault level requirement for another contingency. The outage conditions require radialising the Lilyvale 132 kV network.
Lilyvale 132 kV	Stanwell to Broadsound 275 kV line	Loss of parallel feeder can result in significant system strength impact on IBR plants in North Queensland due to no direct 275 kV connection between Stanwell and Broadsound substations. Therefore all IBR in North Queensland can be curtailed pre-contingent during this outage.

[19] AEMC, 2021, Page 98, Efficient Management of System Strength on the Power System, at https://www.aemc.gov.au/rule-changes/efficient-management-system-strength-power-system.

2.2.1 Nodal assessment of minimum requirements, shortfalls, and IBR projections

Gin Gin 275 kV

Figure 14 presents the projected levels of available three phase fault current at the Gin Gin 275 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 20 summarises this assessment and identifies shortfalls. Table 21 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 14 Gin Gin node fault level duration curves and minimum requirement

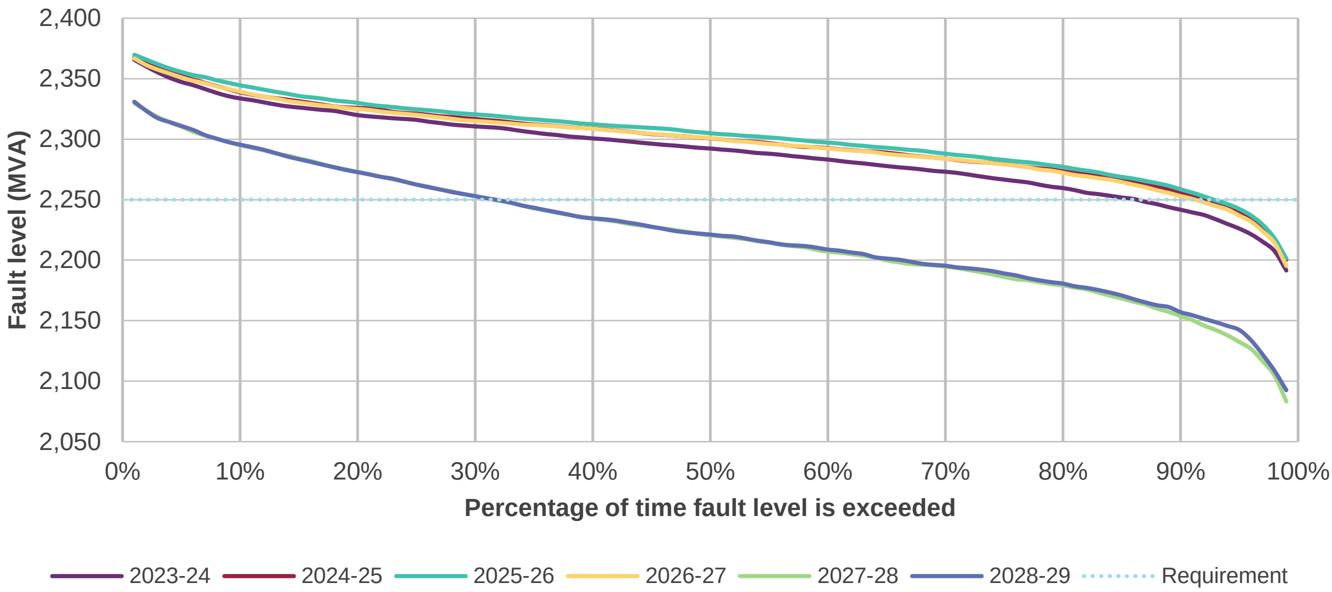


Table 20 Gin Gin node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Gin Gin 275 kV	Requirement (N)	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800
	Requirement (N-1)	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250
	Expected 99% of time	2,192	2,201	2,201	2,195	2,083	2,093					
	Declarable shortfall	**60[A]**	**50**	**50**								

A. 64 MVA shortfall declared consistent with the 2022 *System Strength Report*.

Table 21 Gin Gin node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Gin Gin 275 kV	Solar	471	154	154	255	255	255	255	255	255	1,477	1,774	3,086
	Wind	0	0	0	0	900	900	900	900	1,696	2,291	2,951	3,500
	Battery	0	0	150	200	200	200	200	200	200	200	200	200
	Total IBR	**471**	**154**	**304**	**455**	**1,355**	**1,355**	**1,355**	**1,355**	**2,151**	**3,968**	**4,925**	**6,786**

Note: Forecasts may require adjustment by the SSSP with new information on newly-committed IBR and MNSF.

Greenbank 275 kV

Figure 15 presents the projected levels of available three phase fault current at the Greenbank 275 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 22 summarises this assessment and does not identify any shortfalls. Table 23 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 15 Greenbank node fault level duration curves and minimum requirement

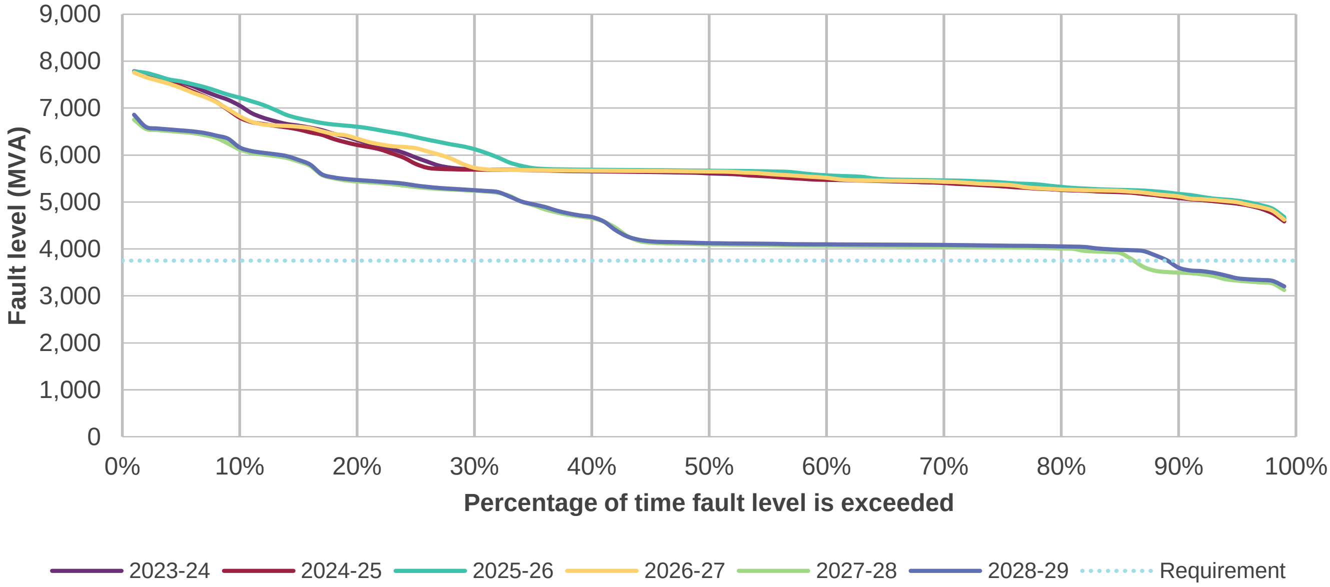


Table 22 Greenbank node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Greenbank 275 kV	Requirement (N)	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350
	Requirement (N-1)	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750
	Expected 99% of time	4,642	4,590	4,679	4,626	3,126	3,205					
	Declarable shortfall	**0**	**0**	**0**								

Table 23 Greenbank node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Greenbank 275 kV	Solar	0	0	0	0	0	0	0	0	0	0	0	0
	Wind	0	0	0	0	0	0	0	0	0	0	0	0
	Battery	0	0	0	0	0	0	0	0	0	0	0	0
	Total IBR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly-committed IBR and MNSFs.

Lilyvale 132 kV

Figure 16 presents the projected levels of available three phase fault current at the Lilyvale 132 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 24 summarises this assessment and does not identify any shortfalls. Table 25 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 16 Lilyvale node fault level duration curves and minimum requirement

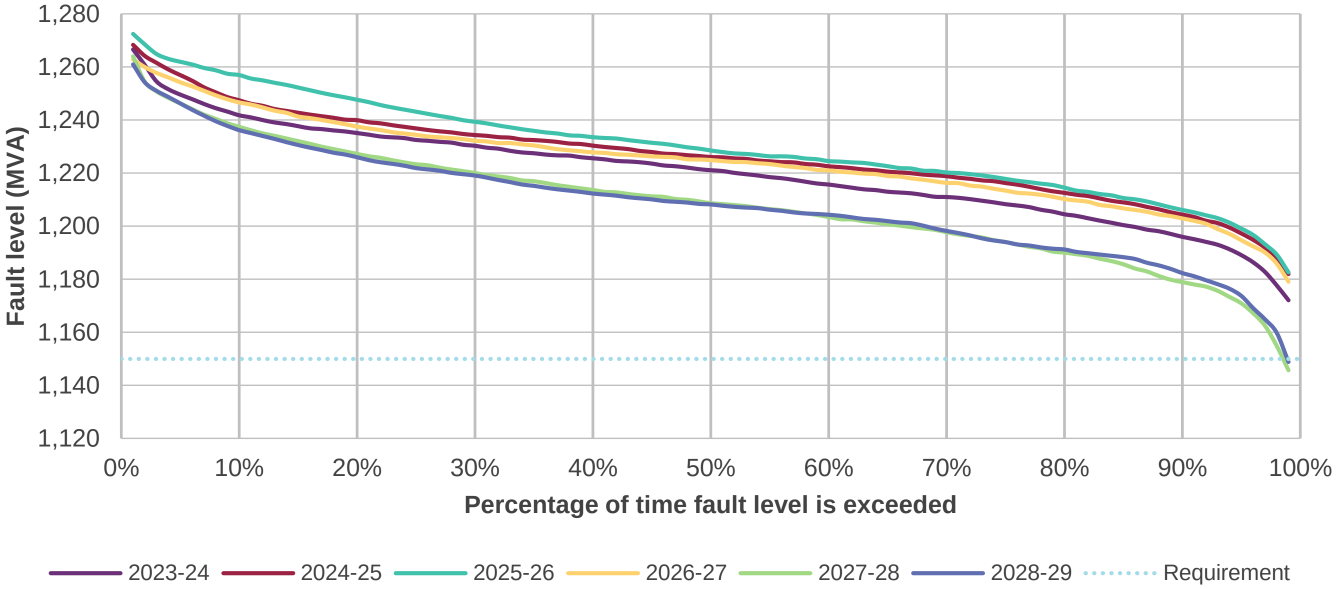


Table 24 Lilyvale node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Lilyvale 132 kV	Requirement (N)	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
	Requirement (N-1)	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150
	Expected 99% of time	1,172	1,182	1,183	1,179	1,146	1,149					
	Declarable shortfall	**0**	**0**	**0**								

A. Minimum fault current requirements at Lilyvale may be impacted by network impedance changes following the Lilyvale transformer replacement.

Table 25 Lilyvale node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Lilyvale 132 kV	Solar	388	0	0	0	0	68	474	474	474	474	474	474
	Wind	0	0	450	450	450	887	1,450	1,548	1,548	1,548	1,555	1,879
	Battery	0	0	0	0	0	0	0	0	0	0	0	0
	Total IBR	**388**	**0**	**450**	**450**	**450**	**955**	**1,924**	**2,022**	**2,022**	**2,022**	**2,029**	**2,353**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.

Ross 275 kV

Figure 17 presents the projected levels of available three phase fault current at the Ross 275 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 26 summarises this assessment and does not identify any shortfalls. Table 27 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 17 Ross node fault level duration curves and minimum requirement

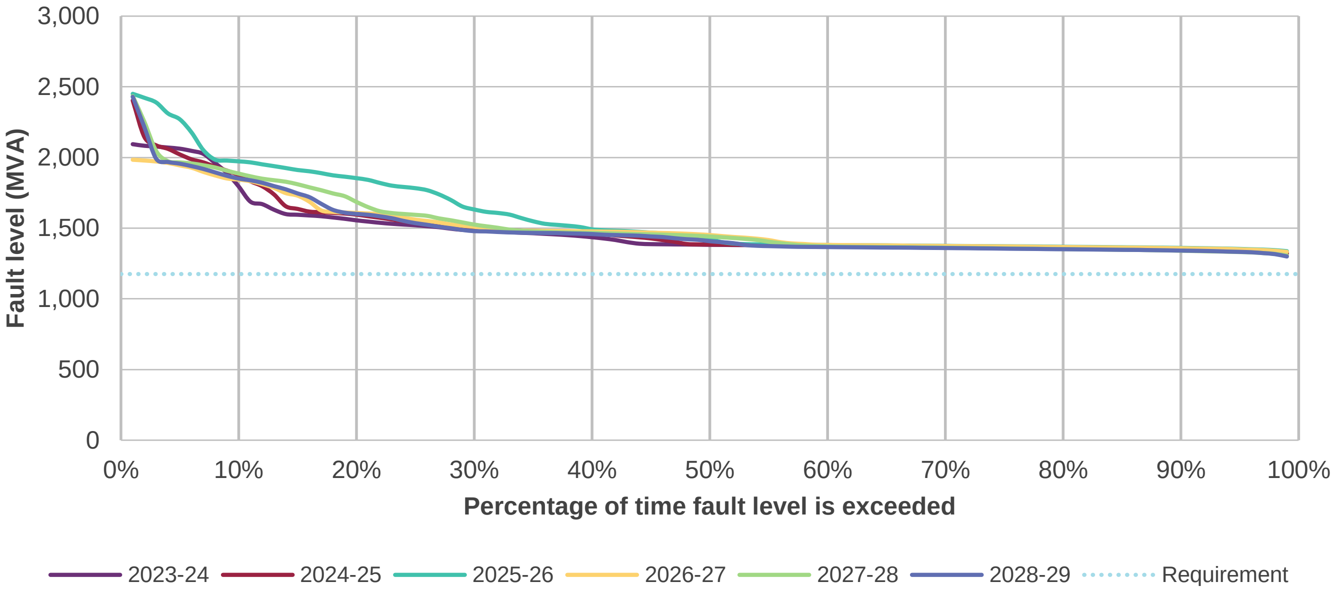


Table 26 Ross node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Ross 275 kV	Requirement (N)	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350
	Requirement (N-1)	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175	1,175
	Expected 99% of time	1,327	1,321	1,336	1,332	1,306	1,300					
	Declarable shortfall	**0**	**0**	**0**								

Table 27 Ross node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Ross 275 kV	Solar	983	0	0	0	0	32	53	53	343	343	343	343
	Wind	381	0	0	0	1,319	1,362	1,605	2,803	2,809	2,918	3,316	3,316
	Battery	0	0	0	0	0	0	0	0	0	0	0	0
	Total IBR	**1,364**	**0**	**0**	**0**	**1,319**	**1,394**	**1,658**	**2,856**	**3,152**	**3,261**	**3,659**	**3,659**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.

Western Downs 275 kV

Figure 18 presents the projected levels of available three phase fault current at the Western Downs 275 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 28 summarises this assessment and does not identify any shortfalls. Table 29 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 18 Western Downs node fault level duration curves and minimum

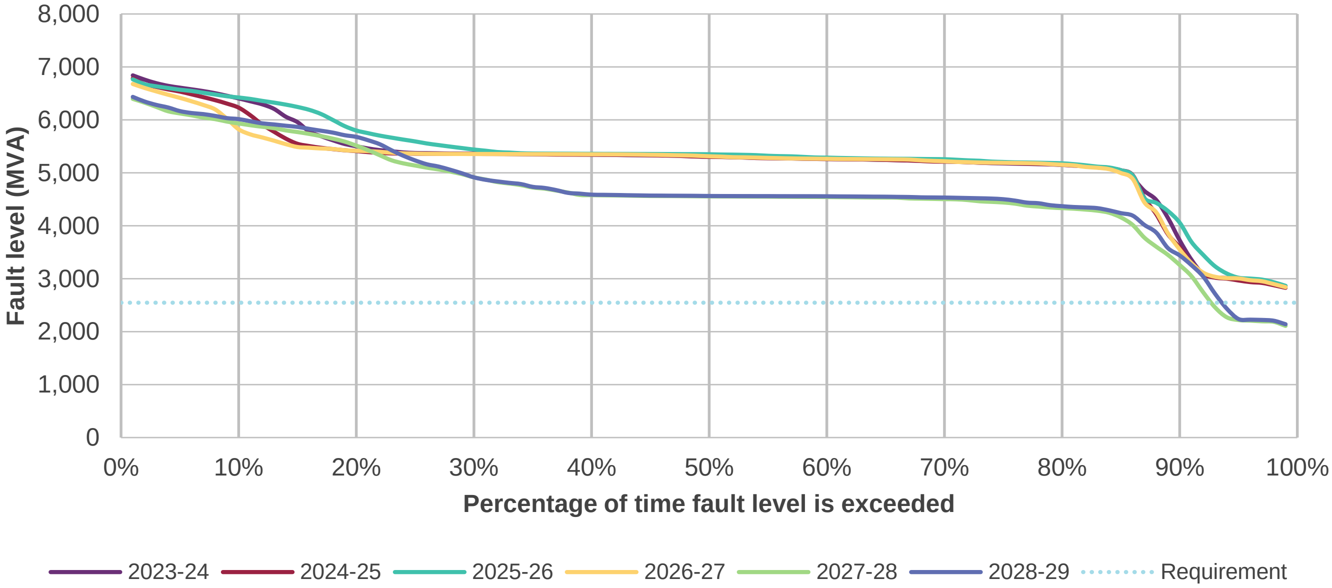


Table 28 Western Downs node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Western Downs 275 kV	Requirement (N)	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
	Requirement (N-1)	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550
	Expected 99% of time	2,858	2,830	2,863	2,843	2,112	2,144					
	Declarable shortfall	**0**	**0**	**0**								

Table 29 Western Downs node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Western Downs 275 kV	Solar	1,671	0	0	0	0	0	0	0	1,266	1,266	1,496	1,496
	Wind	626	0	1,175	1,175	2,621	3,238	3,478	5,027	5,164	5,427	5,427	5,427
	Battery	100	100	741	741	741	741	741	741	741	741	741	741
	Total IBR	**2,397**	**100**	**1,916**	**1,916**	**3,362**	**3,979**	**4,219**	**5,768**	**7,171**	**7,434**	**7,664**	**7,664**

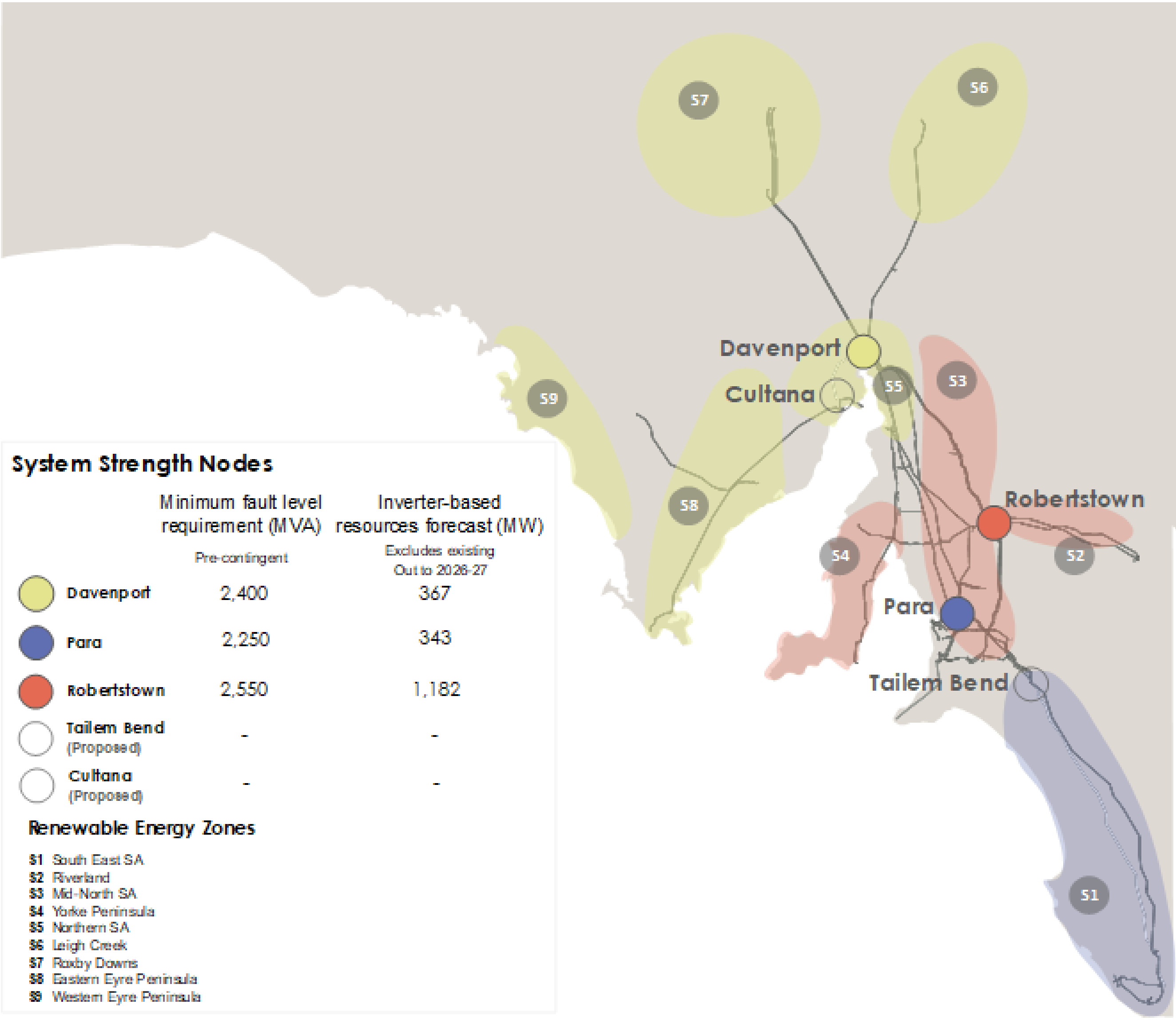
Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.

2.3 South Australia

AEMO has not identified any system strength shortfalls in South Australia, for the period to 1 December 2025.

Figure 19 provides a summary of the system strength specification for South Australia, including the location of system strength nodes, and the minimum fault level requirements and forecast IBR projections for each.

Figure 19 System strength node location and system strength standard in South Australia



Note: REZs are mapped to show where the majority of forecast IBR are expected, consistent with the ISP.

Scope of assessment

AEMO has assessed fault level shortfalls in South Australia until 1 December 2025, and in parallel has specified a set of minimum fault level requirements and projected IBR levels over a 10-year period. These outcomes form the basis of SSSP remediation obligations under the system strength framework[20].

As part of the 2023 assessment, AEMO has considered if any material system changes have occurred that would warrant reassessment of the current system strength nodes, or a recalculation of their associated minimum fault levels requirements. No changes were subsequently made to these values.

All modelling and analysis in this report is based on the latest inputs and results from the Draft 2024 ISP *Step Change* scenario[21]. Appendix A1 provides further detail on the inputs and assumptions used in this analysis.

Fault current requirements and shortfalls

AEMO has previously declared three system strength nodes in South Australia effective from 1 December 2022; these nodes remain unchanged since the 2022 *System Strength Report*. AEMO has also assessed whether any material system changes have occurred that would affect the associated minimum fault level requirements, and no adjustments were made in response.

To identify any potential system strength shortfalls, AEMO assessed forecast levels of available system strength against these requirements until 1 December 2025. The results of this assessment are presented in Table 30 alongside the definition of each node and its current fault level requirements.

This analysis does not identify any projected system strength shortfalls in South Australia by 1 December 2025. ElectraNet is currently progressing a RIT-T to deliver its longer-term system strength obligations.

Table 30 South Australia system strength nodes, fault level requirements, and identified shortfalls

System strength node[A]	Effective date range	2023 Minimum fault level requirement (MVA)		Identified shortfall by financial year ending (MVA)		
		Pre-contingent	Post-contingent	2024	2025	2026
Davenport 275 kV	1 Dec 2022 onwards	2,400	1,800	0	0	0
Para 257 kV	1 Dec 2022 onwards	2,250	2,000	0	0	0
Robertstown 275 kV	1 Dec 2022 onwards	2,550	2,000	0	0	0

A. Bus 1 of each system strength node is selected by default. Alternative buses may be selected on a case-by-case basis.

AEMO has also considered two possible future system strength nodes in South Australia, as described in Table 31. These nodes may be declared in future, subject to the changing needs of the power system.

Table 31 Possible future nodes in South Australia and closures of existing nodes

System strength node	Effective date range	Purpose of new node
Tailem Bend 275 kV	On connection of significant IBR in South East South Australia REZ	This node may provide better locations for forecast IBR in the South East South Australia REZ as it connects.
Cultana 275 kV	On connection of significant IBR near Cultana	This node may provide better locations for forecast IBR on the upper Eyre Peninsula as it connects.

[20] Under NER 11.143.15 for the system strength transition period, and NER 5.2.3(b)/S5.1.14 for ongoing planning and remediation.

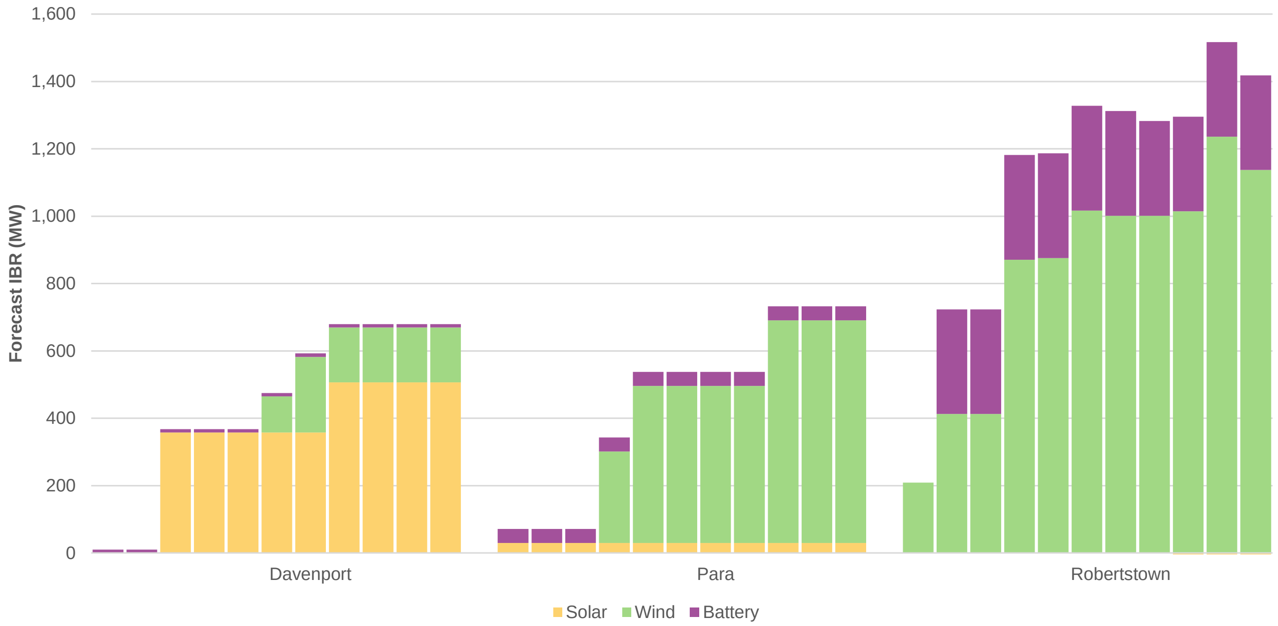
[21] Final revisions ahead of Draft 2024 ISP publication may result in minor changes compared with the modelling inputs used in this report.

Summary of IBR projections for South Australia

AEMO's 10-year forecast of the quantity and technology of IBR investment in South Australia is shown in Figure 20, with underlying datasets for each node provided in Section 2.3.1. While these are based on Draft 2024 ISP results, AEMO has applied minor adjustments in allocating these forecasts to specific nodes based on local network knowledge and engineering judgement.

AEMO expects that ElectraNet, as the SSSP in South Australia, will engage in joint planning with neighbouring SSSPs to identify any investment efficiencies when assessing the nature of solutions required to meet these requirements. AEMO is supportive of SSSPs considering the latest available information and announcements to adjust these values for use in their system strength RIT-Ts between publications of the *System Strength Report*.

Figure 20 11-year forecast of IBR and MNSFs by system strength node from 2023-24, South Australia



Notes: the near-term years of the forecast may require adjustment by the SSSP as more information becomes available about committed plant, such as their technical characteristics or their elections under the system strength framework – for example to adjust requirements for projects connecting under the older framework. Further detail is provided in Appendix 1.1. The nodal assessment section below provides further detail on the IBR and MNSF projections.

Critical planned outages

SSSPs are expected to consider critical planned outages into their proposed system strength solutions on a case-by-case basis[22]. AEMO has declared several critical planned outages as impactful for maintaining system strength in South Australia, and these are presented in Table 32.

Table 32 Critical planned outages in South Australia for each system strength node

Affected system strength node	Network outage	Reason for consideration as a critical outage
All nodes in South Australia	One synchronous condenser (post-Project EnergyConnect, including a Buronga synchronous condenser in New South Wales)	Significant system strength impact in South Australia for another contingency
	One South East to Heywood 275 kV line	
	One South East to Tailem Bend 275 kV line	
	Davenport to Mt Lock 275 kV line	
	Robertstown to Mokota 275 kV line	
	One Robertstown to Tungkillo 275 kV line	
	Robertstown to Canowie 275 kV line	
	Mokota to Willalo 275 kV line	
	Belalie to Willalo 275 kV line	
	Blyth West to Munno Para 275 kV line	

[22] AEMC, 2021, Page 98, Efficient Management of System Strength on the Power System, at https://www.aemc.gov.au/rule-changes/efficient-management-system-strength-power-system.

2.3.1 Nodal assessment of minimum requirements, shortfalls, and IBR projections

Davenport 275 kV

Figure 21 presents the projected levels of available three phase fault current at the Davenport 275 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 33 summarises this assessment and does not identify any shortfalls. Table 34 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 21 Davenport node fault level duration curves and minimum requirement

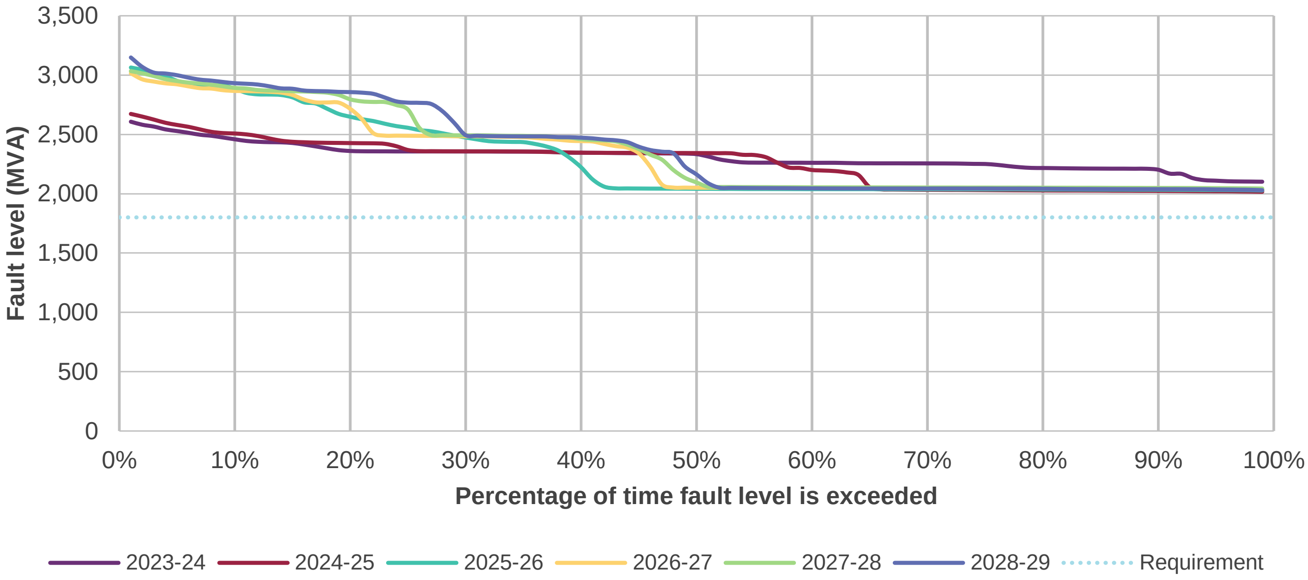


Table 33 Davenport node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Davenport 275 kV	Requirement (N)	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400
	Requirement (N-1)	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800
	Expected 99% of time	2,103	2,016	2,028	2,037	2,044	2,031					
	Declarable shortfall	**0**	**0**	**0**								

Table 34 Davenport node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Davenport 275 kV	Solar	349	0	0	357	357	357	357	357	507	507	507	507
	Wind	557	0	0	0	0	0	108	225	163	163	163	163
	Battery	0	10	10	10	10	10	10	10	10	10	10	10
	Total IBR	**906**	**10**	**10**	**367**	**367**	**367**	**475**	**592**	**680**	**680**	**680**	**680**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.

Para 275 kV

Figure 22 presents the projected levels of available three phase fault current at the Para 275 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 35 summarises this assessment and does not identify any shortfalls. Table 36 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 22 Para node fault level duration curves and minimum requirement

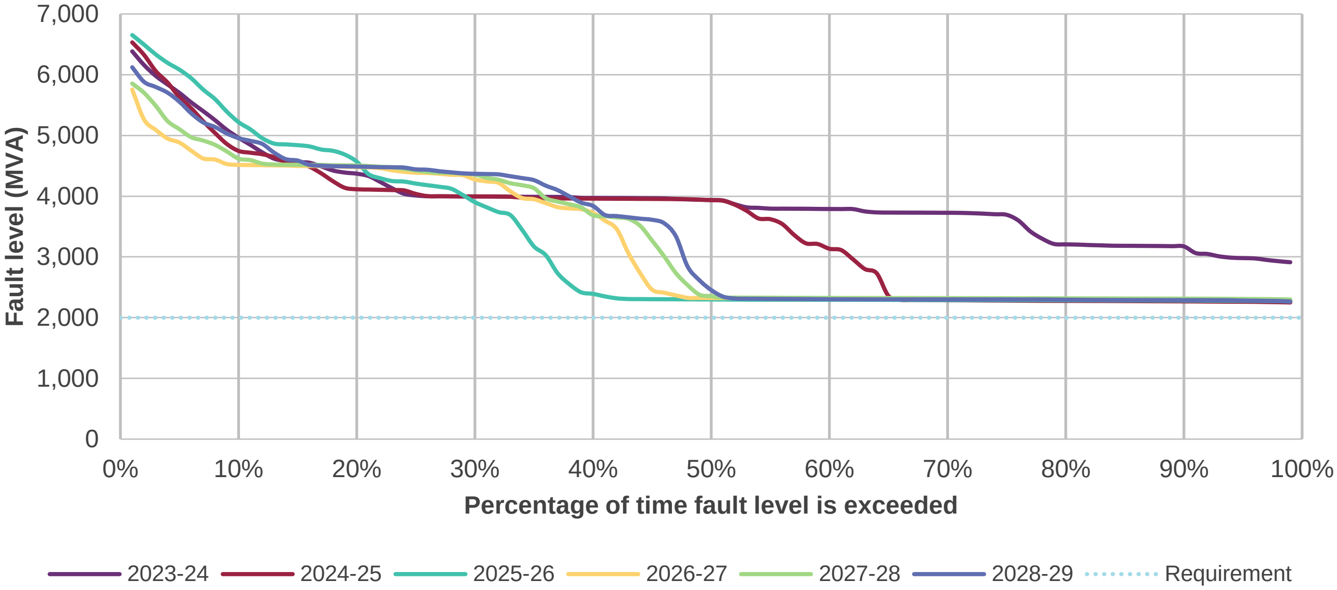


Table 35 Para node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Para 275 kV	Requirement (N)	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250
	Requirement (N-1)	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
	Expected 99% of time	2,914	2,249	2,268	2,287	2,299	2,267					
	Declarable shortfall	**0**	**0**	**0**								

Table 36 Para node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Para 275 kV	Solar	286	30	30	30	30	30	30	30	30	30	30	30
	Wind	358	0	0	0	271	466	466	466	466	661	661	661
	Battery	282	42	42	42	42	42	42	42	42	42	42	42
	Total IBR	**926**	**72**	**72**	**72**	**343**	**538**	**538**	**538**	**538**	**733**	**733**	**733**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly-committed IBR and MNSFs.

Robertstown 275 kV

Figure 23 presents the projected levels of available three phase fault current at the Robertstown 275 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 37 summarises this assessment and does not identify any shortfalls. Table 38 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 23 Robertstown node fault level duration curves and minimum requirement

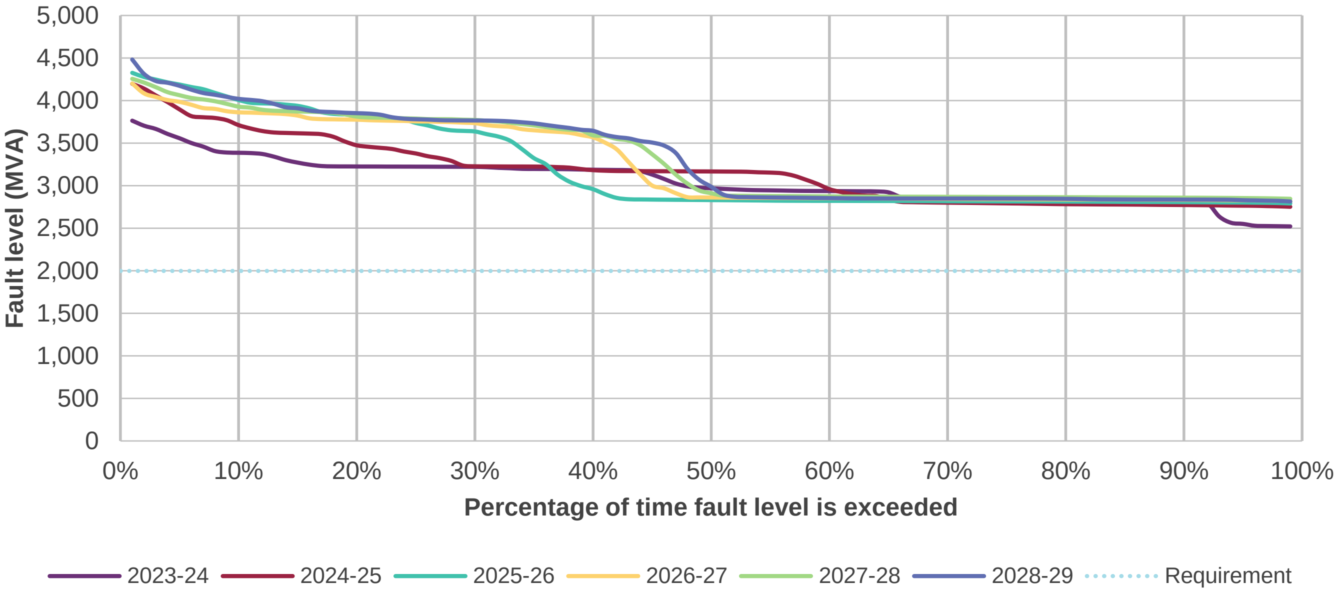


Table 37 Robertstown node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Robertstown 275 kV	Requirement (N)	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550
	Requirement (N-1)	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
	Expected 99% of time	2,522	2,750	2,792	2,819	2,846	2,814					
	Declarable shortfall	**0**	**0**	**0**								

A. Minimum fault current requirements at Robertstown may be impacted by network impedance changes following commissioning of Project EnergyConnect.

Table 38 Robertstown node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Robertstown 275 kV	Solar	25	0	0	0	0	0	0	0	0	-6	-6	-6
	Wind	1,434	209	413	413	871	876	1,017	1,001	1,001	1,015	1,236	1,137
	Battery	180	0	311	311	311	311	311	311	281	281	281	281
	Total IBR	**1,639**	**209**	**724**	**724**	**1,182**	**1,187**	**1,328**	**1,312**	**1,282**	**1,290**	**1,511**	**1,412**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.

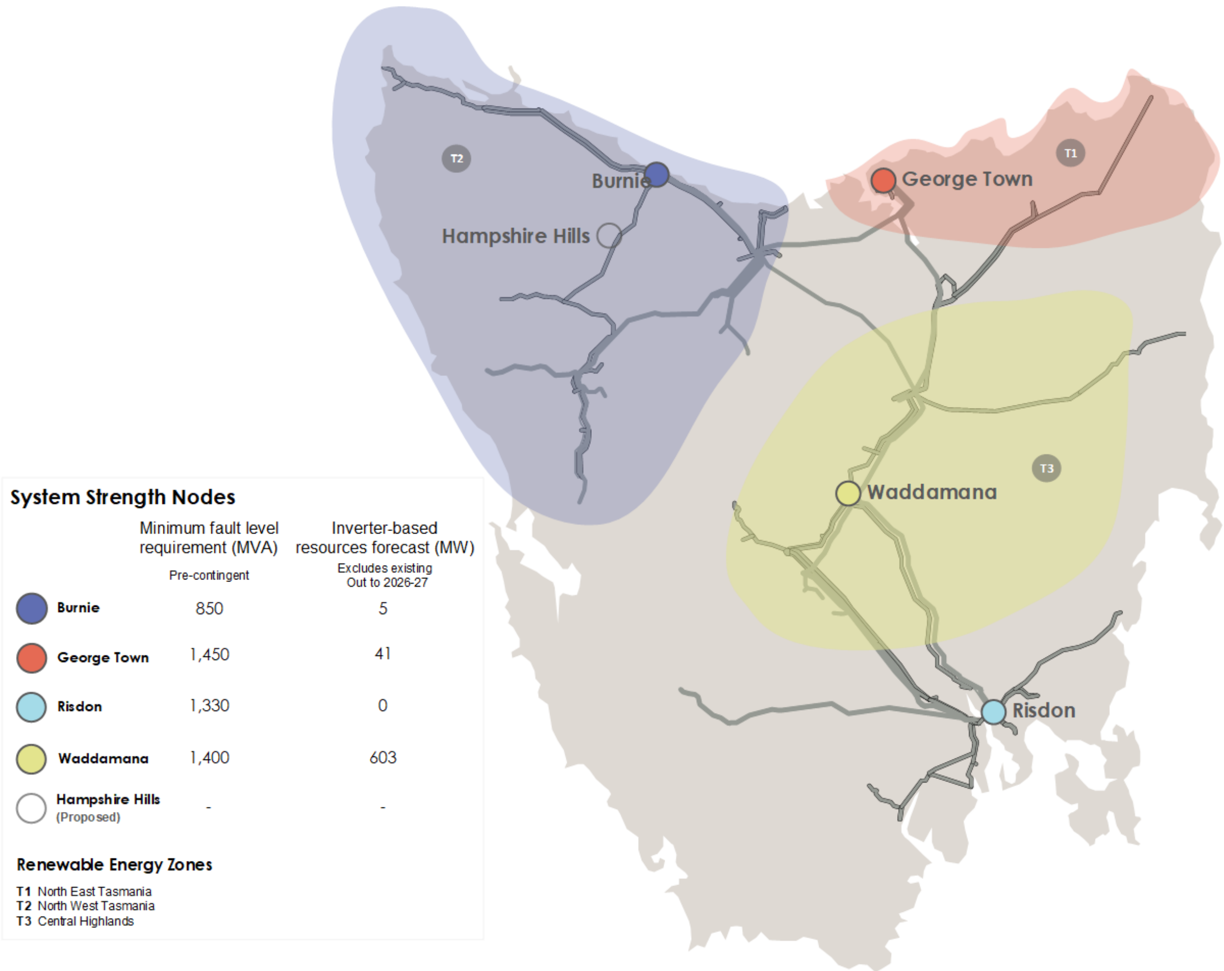
2.4 Tasmania

AEMO has not identified any new system strength shortfalls in Tasmania, and previously declared shortfalls at all nodes have reduced in magnitude. The reductions are linked with updated timing for several projects on the mainland that act to increase the levels of energy exported from Tasmania in the short term.

TasNetworks has sufficient network support agreements in place to remediate these shortfalls until 15 April 2024, beyond which time these shortfalls will reopen. TasNetworks is progressing additional arrangements to provide coverage until December 2025.

Figure 24 provides a summary of the system strength specification for Tasmania, including the location of system strength nodes, and the minimum fault level requirements and forecast IBR projections for each.

Figure 24 System strength node location and system strength standard in Tasmania



Note: REZs are mapped to show where the majority of forecast IBR are expected, consistent with the ISP

Scope of assessment

AEMO has assessed fault level shortfalls in Tasmania until 1 December 2025, and in parallel has specified a set of minimum fault level requirements and projected IBR levels over a 10-year period. These outcomes form the basis of SSSP remediation obligations under the system strength framework[23].

System strength outcomes in Tasmania are assessed against their pre-contingent levels due to specific local requirements including those for maintaining Basslink operation, switching for local reactive plant, and some power quality requirements for metropolitan load centres.

All modelling and analysis in this report is based on the latest inputs and results from the Draft 2024 ISP *Step Change* scenario[24]. Appendix A1 provides further detail on the inputs and assumptions used in this analysis.

Fault current requirements and shortfalls

AEMO has previously declared four system strength nodes in Tasmania effective from 1 December 2022; these nodes remain unchanged since the 2022 *System Strength Report*. AEMO has also assessed the associated minimum fault level requirements, and no adjustments were made in response.

To identify any potential system strength shortfalls, AEMO assessed forecast levels of available system strength against these requirements until 1 December 2025. The results of this assessment are presented in Table 39 alongside the definition of each node and its current fault level requirements.

The analysis confirms the quantity and timing of previously declared system strength shortfalls at all Tasmanian nodes within the horizon. TasNetworks is currently addressing these through commercial arrangements for system strength and inertia services. This arrangement expires in April 2024, and TasNetworks is progressing an extension until at least 1 December 2025.

Table 39 Tasmania system strength nodes, fault level requirements, and identified shortfalls

System strength node[A]	Effective date range	2023 Minimum fault level requirement (MVA)		Identified shortfall by financial year ending (MVA)		
		Pre-contingent	Post-contingent	2024	2025	2026[B]
Burnie 110 kV	1 Dec 2022 onwards	850	560	355	350	355
George Town 220 kV	1 Dec 2022 onwards	1,450	-	665	655	675
Risdon 110 kV	1 Dec 2022 onwards	1,330	-	360	350	355
Waddamana 220 kV	1 Dec 2022 onwards	1,400	-	375	360	380

A. Bus 1 of each system strength node is selected by default. Alternative buses may be selected on a case-by-case basis.
B. Shortfall applies to 1 December 2025.

AEMO has also considered a possible future system strength node at Hampshire Hills, as described in Table 40.

Table 40 Possible future nodes in Tasmania and closures of existing nodes

System strength node	Voltage and busbar	Effective date range	Purpose of new node
Hampshire Hills	220 kV Bus 1	On connection of significant IBR in Tasmania	This node may provide better locations for forecast IBR in Western Tasmania as it connects.

[23] Under NER 11.143.15 for the system strength transition period, and NER 5.2.3(b)/S5.1.14 for ongoing planning and remediation.

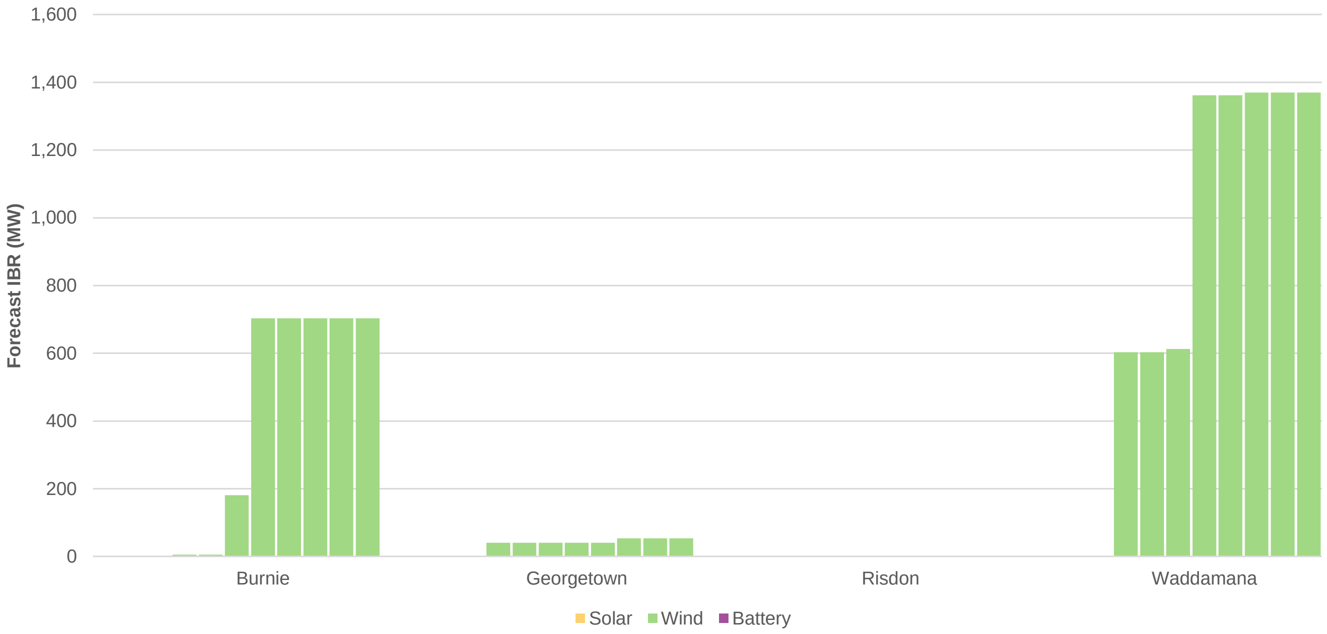
[24] Final revisions ahead of Draft 2024 ISP publication may result in minor changes compared with the modelling inputs used in this report.

Summary of IBR projections for Tasmania

AEMO's 10-year forecast of the quantity and technology of IBR investment in Tasmania is shown in Figure 25, with underlying datasets for each node provided in Section 2.4.1. While these are based on Draft 2024 ISP results, AEMO has applied minor adjustments in allocating these forecasts to specific nodes based on local network knowledge and engineering judgement.

AEMO expects that TasNetworks, as the SSSP in Tasmania, will engage in joint planning with neighbouring SSSPs to identify any investment efficiencies when assessing the nature of solutions required to meet these requirements. AEMO is supportive of SSSPs considering the latest available information and announcements to adjust these values for use in their system strength RIT-Ts between publications of the *System Strength Report*.

Figure 25 11-year forecast of IBR and MNSFs by system strength node from 2023-24, Tasmania



Notes: the near-term years of the forecast may require adjustment by the SSSP as more information becomes available about committed plant, such as their technical characteristics or their elections under the system strength framework – for example to adjust requirements for projects connecting under the older framework. Further detail is provided in Appendix 1.1. The forecast IBR at Burnie may be split with a new node Hampshire Hills if formally declared. MarinusLink has not been included in these forecasts as it is not considered as market service facility for the purposes of NER clause S5.1.14(b)(2).

Critical planned outages

AEMO has not currently declared any critical planned outages for maintaining system strength in Tasmania.

2.4.1 Nodal assessment of minimum requirements, shortfalls, and IBR projections

Burnie 110 kV

Figure 26 presents the projected levels of available three phase fault current at the Burnie 110 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum pre-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 41 summarises this assessment and identifies shortfalls. Table 42 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 26 Burnie node fault level duration curves and minimum requirement

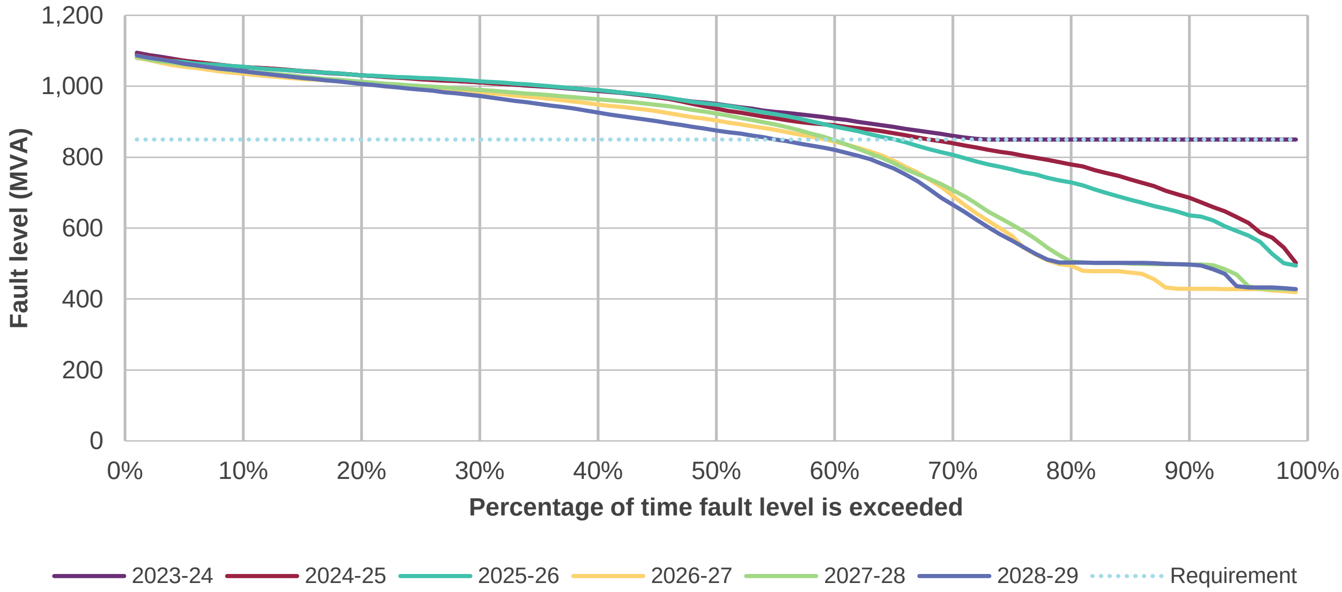


Table 41 Burnie node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)A										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Burnie 110 kV	Requirement (N)	850	850	850	850	850	850	850	850	850	850	850
	Requirement (N-1)	560	560	560	560	560	560	560	560	560	560	560
	Expected 99% of time	850	502	495	419	427	428					
	Declarable shortfall	**0**	**350**	**355**								

A. Minimum fault current requirements at Burnie may be impacted by commissioning of MarinusLink Stage 1.and MarinusLink Stage 2.

Table 42 Burnie node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Burnie 110 kV	Solar	0	0	0	0	0	0	0	0	0	0	0	0
	Wind	251	0	0	0	5	5	181	703	703	703	703	703
	Battery	0	0	0	0	0	0	0	0	0	0	0	0
	Total IBR	**251**	**0**	**0**	**0**	**5**	**5**	**181**	**703**	**703**	**703**	**703**	**703**

Note: because Hampshire Hills is not yet a declared node, IBR in that area are assigned to the Burnie node.

George Town 220 kV

Figure 27 presents the projected levels of available three phase fault current at the George Town 220 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum pre-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 43 summarises this assessment and identifies shortfalls. Table 44 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 27 George Town node fault level duration curves and minimum requirement

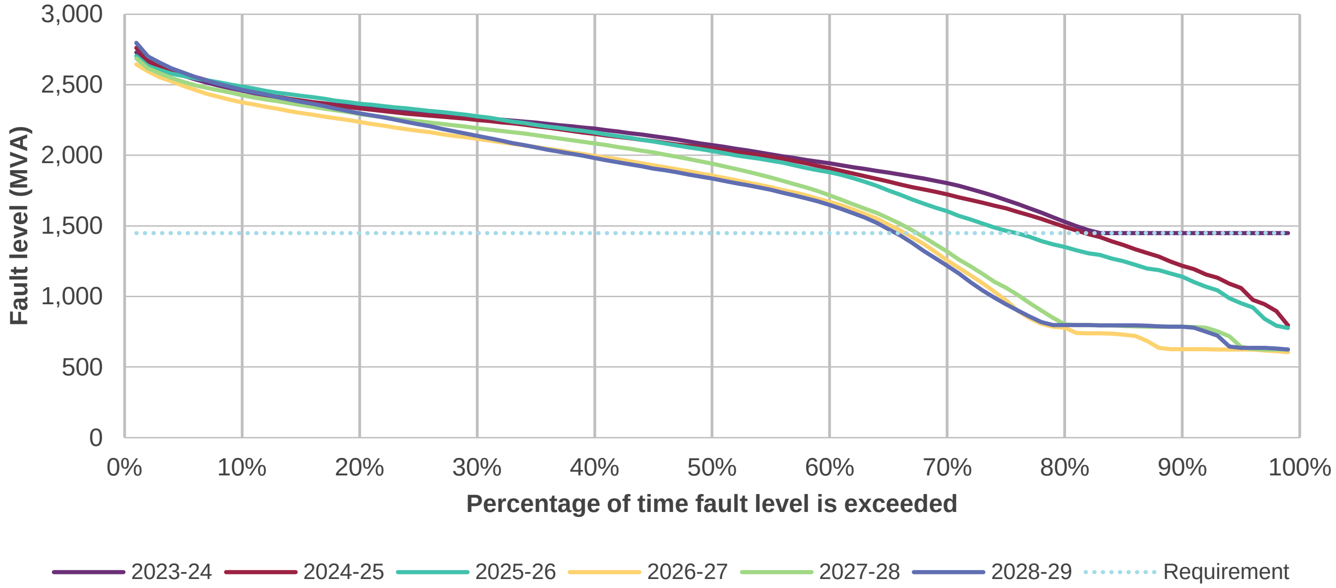


Table 43 George Town node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
George Town 220 kV	Requirement (N)	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450	1,450
	Requirement (N-1)	-	-	-	-	-	-	-	-	-	-	-
	Expected 99% of time	1,450	795	776	605	623	624					
	Declarable shortfall	**0**	**655**	**675**								

Table 44 George Town node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
George Town 220 kV	Solar	0	0	0	0	0	0	0	0	0	0	0	0
	Wind	168	0	0	0	41	41	41	41	41	53	53	53
	Battery	0	0	0	0	0	0	0	0	0	0	0	0
	Total IBR	**168**	**0**	**0**	**0**	**41**	**41**	**41**	**41**	**41**	**53**	**53**	**53**

A. Forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.

Risdon 110 kV

Figure 28 presents the projected levels of available three phase fault current at the Risdon 110 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum pre-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 45 summarises this assessment and identifies shortfalls. Table 46 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 28 Risdon node fault level duration curves and minimum requirement

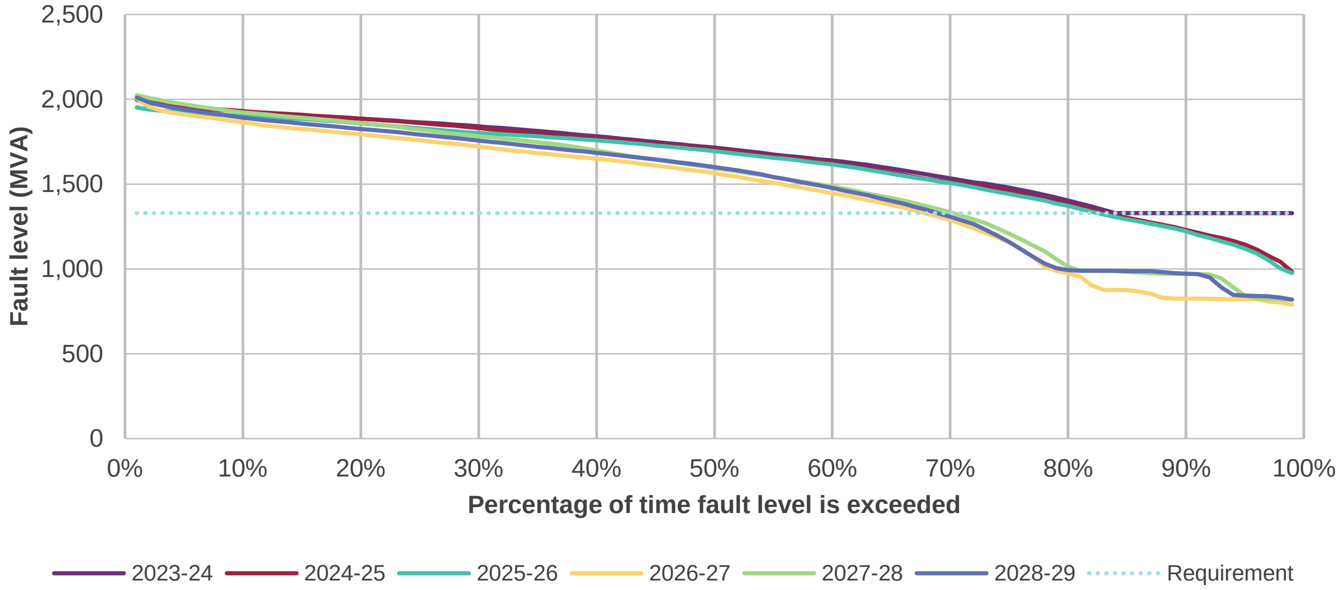


Table 45 Risdon node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Risdon 110 kV	Requirement (N)	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330	1,330
	Requirement (N-1)	-	-	-	-	-	-	-	-	-	-	-
	Expected 99% of time	1,330	984	975	791	819	820					
	Declarable shortfall	**0**	**350**	**355**								

Table 46 Risdon node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Risdon 110 kV	Solar	0	0	0	0	0	0	0	0	0	0	0	0
	Wind	0	0	0	0	0	0	0	0	0	0	0	0
	Battery	0	0	0	0	0	0	0	0	0	0	0	0
	Total IBR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

A. Forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.

Waddamana 220 kV

Figure 29 presents the projected levels of available three phase fault current at the Waddamana 220 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum pre-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 47 summarises this assessment and identifies shortfalls. Table 48 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 29 Waddamana node fault level duration curves and minimum

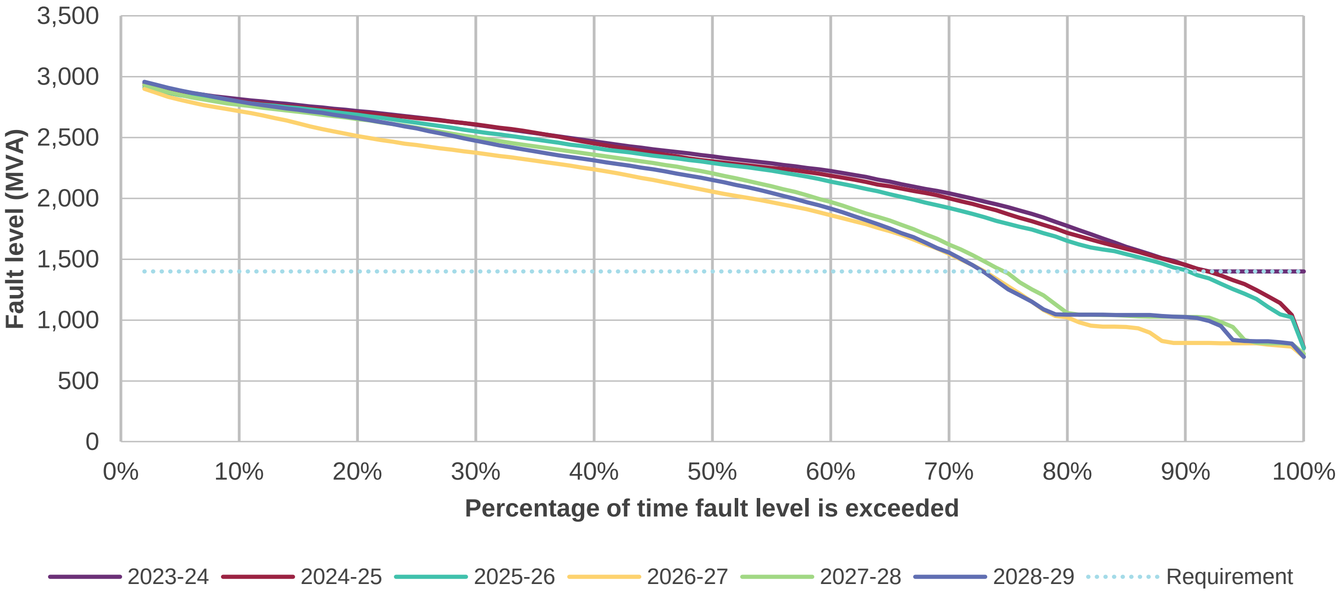


Table 47 Waddamana node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Waddamana 220 kV	Requirement (N)	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
	Requirement (N-1)	-	-	-	-	-	-	-	-	-	-	-
	Expected 99% of time	1,400	1,041	1,022	781	806	807					
	Declarable shortfall	0	**360**	**380**								

Table 48 Waddamana node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Waddamana 220 kV	Solar	0	0	0	0	0	0	0	0	0	0	0	0
	Wind	144	0	0	0	603	603	612	1,362	1,362	1,370	1,370	1,370
	Battery	0	0	0	0	0	0	0	0	0	0	0	0
	Total IBR	**144**	**0**	**0**	**0**	**603**	**603**	**612**	**1,362**	**1,362**	**1,370**	**1,370**	**1,370**

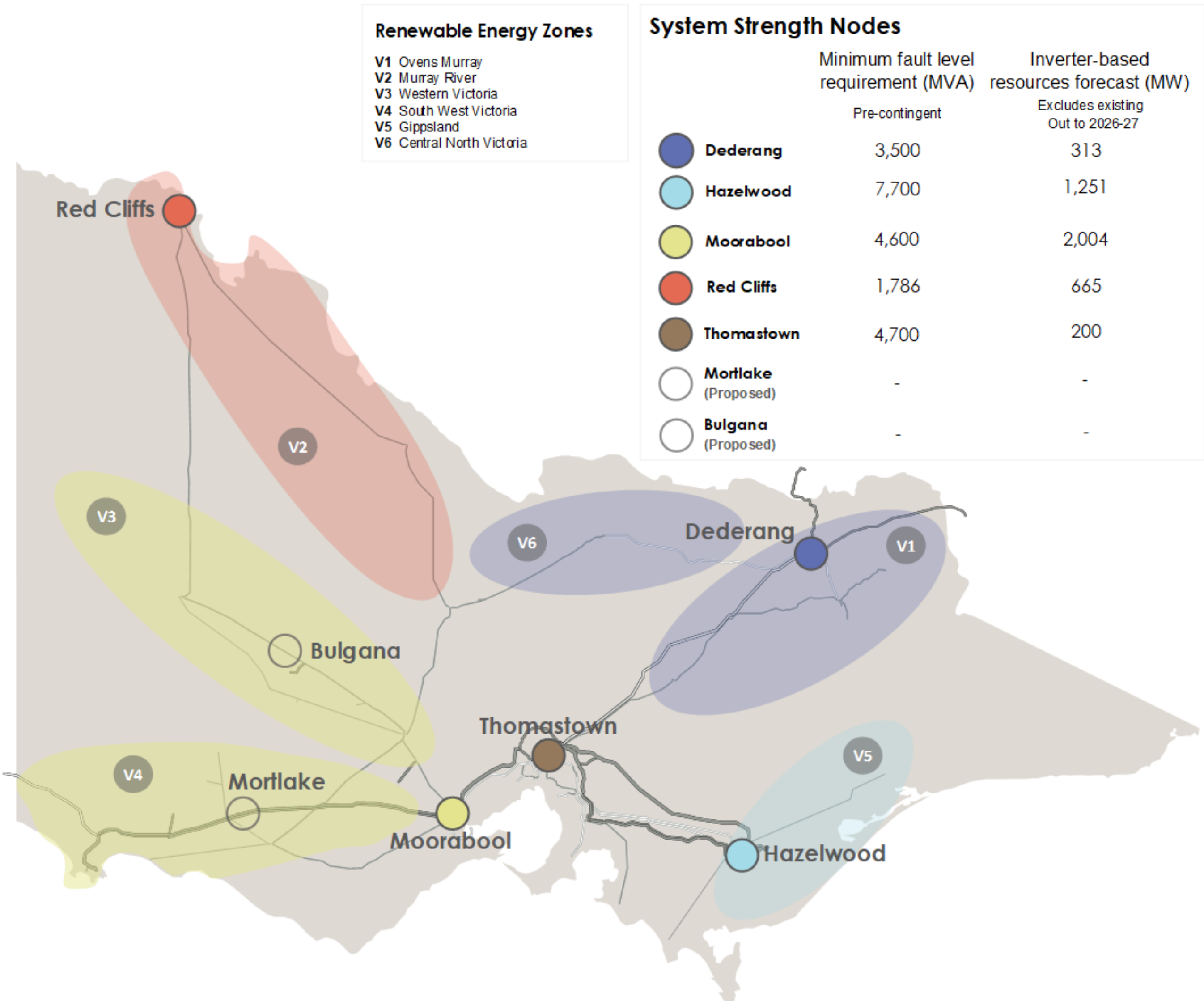
A. Forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.

2.5 Victoria

AEMO has not identified any system strength shortfalls in Victoria for the period to 1 December 2025.

Figure 30 provides a summary of the system strength specification for Victoria, including the location of system strength nodes, and the minimum fault level requirements and forecast IBR projections for each.

Figure 30 System strength node location and system strength standard in Victoria



Note: REZs are mapped to show where the majority of forecast IBR are expected, consistent with the ISP.

Scope of assessment

AEMO has assessed fault level shortfalls in Victoria until 1 December 2025, and in parallel has specified a set of minimum fault level requirements and projected IBR levels over a 10-year period. These outcomes form the basis of SSSP remediation obligations under the system strength framework[25].

As part of the 2023 assessment, AEMO has considered if any material system changes have occurred that would warrant reassessment of the current system strength nodes, or a recalculation of their associated minimum fault levels requirements. No changes were subsequently made to these values.

To assess shortfalls, time-sequential market modelling studies were used to estimate the typical levels of system strength available at each node across a five-year study horizon. While shortfalls can only be declared until 1 December 2025, AEMO has included the full five-year availability assessment for information purposes.

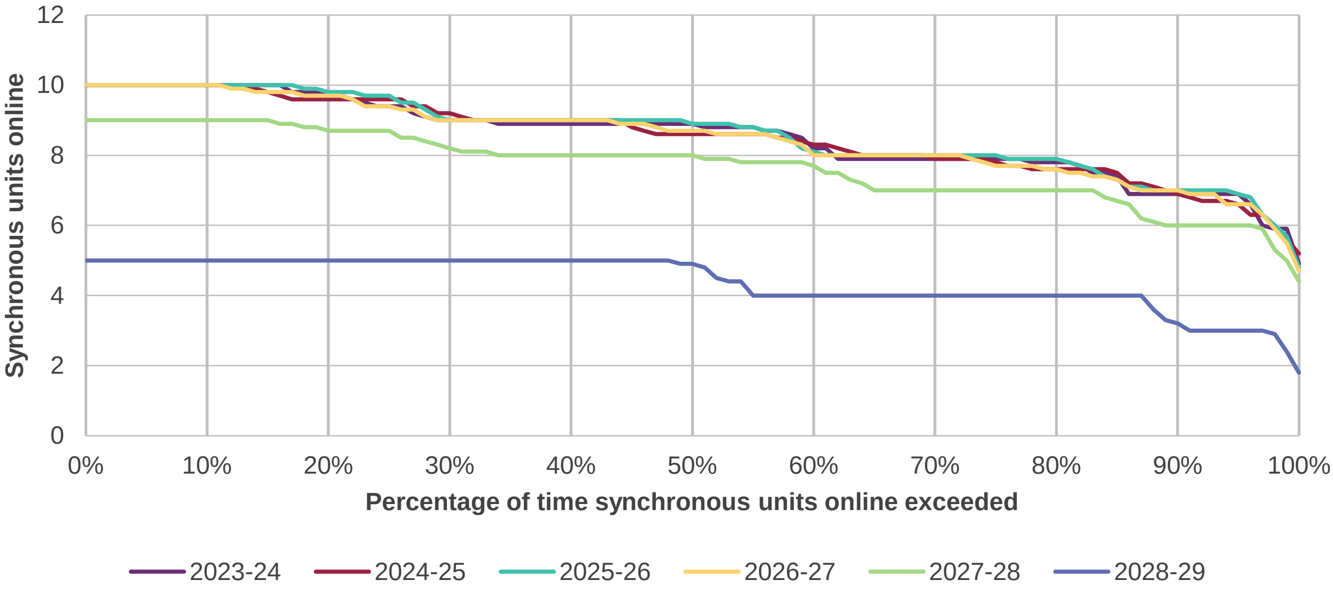
Appendix A1 provides further detail on the inputs, assumptions, and methodology used in this analysis.

Projected reduction in available fault current from synchronous generation

Figure 31 presents the modelled number of large synchronous generating units online in Victoria over a five-year outlook period[26]. This highlights a significant reduction over time, as falling levels of operational demand and increasing penetration of IBR act to reduce the utilisation of these units. These curves consider changes in dispatch patterns, and the announced withdrawal of existing generating units. The modelling does not enforce existing operational unit commitment requirements, and instead reflects the full need for system strength investment in the absence of operational interventions that would otherwise be required.

The dispatch patterns associated with the first three years of these results are also used to inform the shortfall assessments presented in the following section.

Figure 31 Synchronous units projected online under *Step Change* scenario, Victoria



[25] Under NER 11.143.15 for the system strength transition period, and NER 5.2.3(b)/S5.1.14 for ongoing planning and remediation.

[26] Refers to five calendar years noting that six financial years have been modelled.

Fault current requirements and shortfalls

AEMO has previously declared five system strength nodes in Victoria effective from 1 December 2022. These nodes remain unchanged since the 2022 *System Strength Report*. AEMO has also assessed whether any material system changes have occurred that would affect the associated minimum fault level requirements, and no adjustments were made in response.

To identify any potential system strength shortfalls, AEMO assessed forecast levels of available system strength against these requirements until 1 December 2025. The results of this assessment are presented in Table 49, alongside the definition of each node and its current fault level requirements.

The analysis does not identify any system strength shortfalls in the period to 1 December 2025, and AEMO Victorian Planning (AVP) is progressing a RIT-T to deliver its longer-term system strength obligations.

Table 49 Victoria system strength nodes, fault level requirements, and identified shortfalls

System strength node[A]	Effective date range	2023 Minimum fault level requirement (MVA)		Identified shortfall by financial year ending (MVA)		
		Pre-contingent	Post-contingent	2024	2025	2026
Dederang 220 kV	1 Dec 2022 onwards	3,500	3,300	0	0	0
Hazelwood 500 kV	1 Dec 2022 onwards	7,700	7,150	0	0	0
Moorabool 220 kV	1 Dec 2022 onwards	4,600	4,050	0	0	0
Red Cliffs 220 kV	1 Dec 2022 onwards	1,786	1,036	0	0	0
Thomastown 220 kV	1 Dec 2022 onwards	4,700	4,500	0	0	0

A. Bus 1 of each system strength node is selected by default. Alternative buses may be selected on a case-by-case basis.

AEMO has also considered possible future system strength nodes in Victoria, as described in Table 50. These nodes may be declared in a future *System Strength Report*, subject to the changing needs of the power system.

Table 50 Possible future nodes in Victoria region and closures of existing nodes

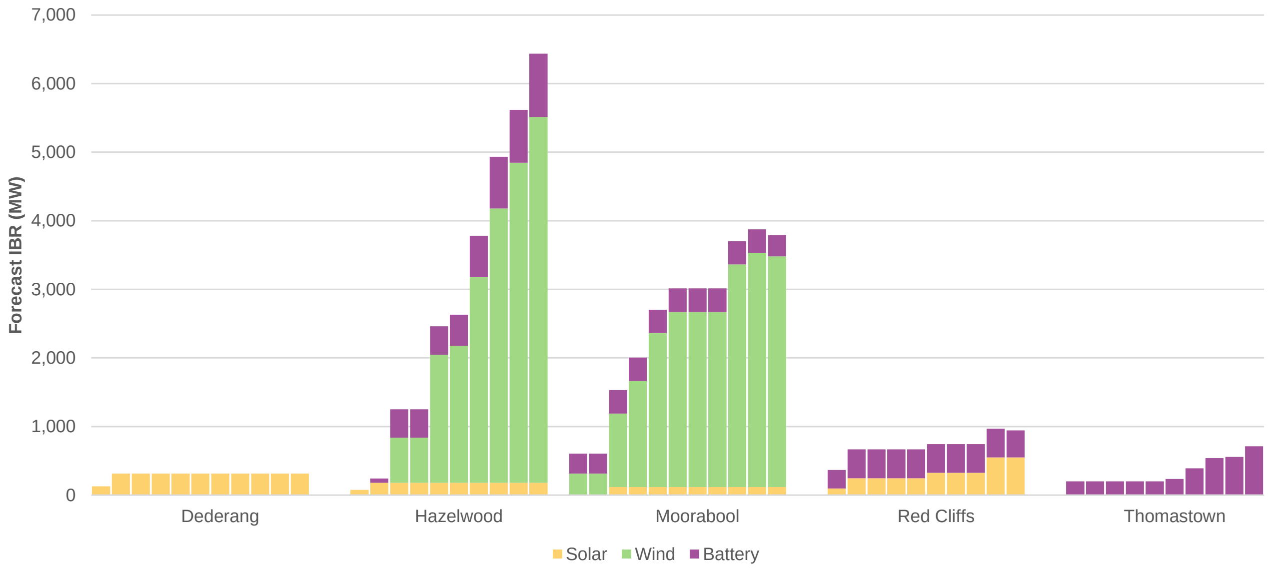
System strength node	Voltage and busbar	Effective date range	Purpose of new node
Mortlake	500 kV Bus 1	On connection of significant IBR in Victoria	This node is located within the South West REZ, where large amounts of future IBR may connect. It may also provide a node suitable for assessing critical planned outages on the interconnector with other regions.
Bulgana	220 kV Bus 1	On connection of significant IBR in Victoria	This node is located within the Western Victorian REZ, where future transmission augmentation projects will unlock network capacity to connect new IBR generation.

Summary of IBR projections for Victoria

AEMO's 10-year forecast of the quantity and technology of IBR investment in Victoria is shown in Figure 32, with underlying datasets for each node provided in Section 2.5.1. While these are based on Draft 2024 ISP results, AEMO has applied minor adjustments in allocating these forecasts to specific nodes based on local network knowledge and engineering judgement.

AEMO expects that AVP, as the SSSP in Victoria, may engage in joint planning with neighbouring SSSPs to identify any investment efficiencies when assessing the nature of solutions required to meet these requirements. AEMO is supportive of SSSPs considering the latest available information and announcements to adjust these values for use in their system strength RIT-Ts between publications of the *System Strength Report*.

Figure 32 11-year forecast of IBR and MNSFs by system strength node from 2023-24, Victoria



Notes: the near-term years of the forecast may require adjustment by the SSSP as more information becomes available about committed plant, such as their technical characteristics or their elections under the system strength framework – for example to adjust requirements for projects connecting under the older framework. Further detail is provided in Appendix 1.1. MarinusLink has not been included as it is not considered as market service facility for the purposes of NER clause S5.1.14(b)(2).

Critical planned outages

SSSPs are expected to consider critical planned outages on a case-by-case basis[27]. AEMO has declared several critical planned outages for system strength in Victoria, presented in Table 51.

Table 51 Critical planned outages in Victoria for each system strength node

Affected node	Network outage	Reason for consideration as a critical outage
Dederang (Darlington Point in New South Wales)	Dederang to Wodonga 330 kV line	Fault level at Darlington Point node in New South Wales drops below requirement for another contingency.
Moorabool **Thomastown**	Hazelwood to Loy Yang 1 or 2 or 3 500 kV line	One of the specified minimum synchronous unit combinations must be dispatched [A].
	Moorabool to Sydenham 1 or 2 500 kV line	
	South Morang to Rowville 500 kV line	
Moorabool	500/220 kV Transformer at Moorabool	Low fault level at Moorabool.
	Mortlake to Moorabool 500 kV line	Significant system strength impact along Victoria to South Australia corridor for another contingency.
	Heywood to Mortlake 500 kV line	
	Moorabool to Haunted Gully 500 kV line	
	Haunted Gully to Tarrone 500 kV line	
	Tarrone to Heywood 500 kV line	

A. See https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/congestion-information/victorian-transfer-limit-advice-outages.pdf?la=en.

[27] AEMC, 2021, Page 98, Efficient Management of System Strength on the Power System, at https://www.aemc.gov.au/rule-changes/efficient-management-system-strength-power-system.

2.5.1 Assessment of minimum requirements, shortfalls, and IBR projections

Dederang 220 kV

Figure 33 presents the projected levels of available three phase fault current at the Dederang 220 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 52 summarises this assessment and does not identify any shortfalls. Table 53 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 33 Dederang node fault level duration curves and minimum requirement

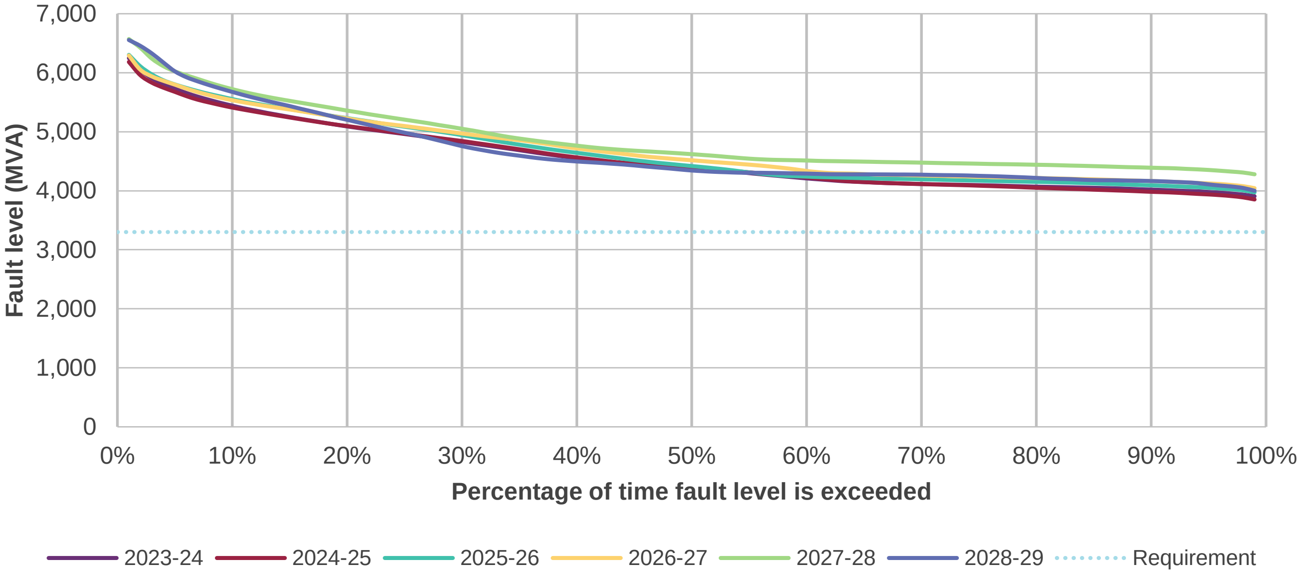


Table 52 Dederang node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Dederang 220 kV	Requirement (N)	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
	Requirement (N-1)	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300
	Expected 99% of time	3,907	3,851	3,971	4,043	4,280	4,001					
	Declarable shortfall	**0**	**0**	**0**								

A. Minimum fault current requirements at Dederang may be impacted following retirement of synchronous generation in the Latrobe Valley.

Table 53 Dederang node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Dederang 220 kV	Solar	327	127	313	313	313	313	313	313	313	313	313	313
	Wind	0	0	0	0	0	0	0	0	0	0	0	0
	Battery	0	0	0	0	0	0	0	0	0	0	0	0
	Total IBR	**327**	**127**	**313**	**313**	**313**	**313**	**313**	**313**	**313**	**313**	**313**	**313**

Note: forecasts may require adjustment by the SSSP for new information on newly committed IBR and MNSFs.

Hazelwood 500 kV

Figure 34 presents the projected levels of available three phase fault current at the Hazelwood 500 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 54 summarises this assessment and does not identify any shortfalls. Table 55 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 34 Hazelwood node fault level duration curves and minimum requirement

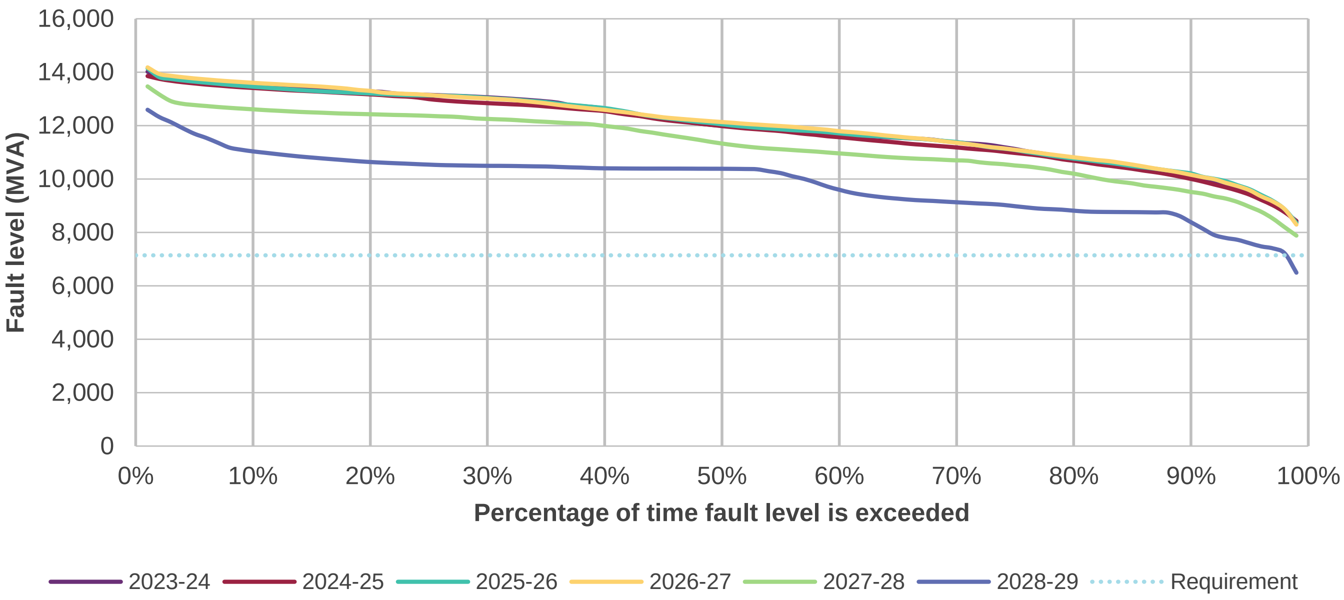


Table 54 Hazelwood node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Hazelwood 500 kV	Requirement (N)	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700	7,700
	Requirement (N-1)	7,150	7,150	7,150	7,150	7,150	7,150	7,150	7,150	7,150	7,150	7,150
	Expected 99% of time	8,385	8,433	8,354	8,294	7,878	6,496					
	Declarable shortfall	**0**	**0**	**0**								

A. Minimum fault current requirements at Hazelwood may be impacted following retirement of synchronous generation in the Latrobe Valley.

Table 55 Hazelwood node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Hazelwood 500 kV	Solar	0	0	77	178	178	178	178	178	178	178	178	178
	Wind	107	0	0	0	658	658	1,866	2,000	3,000	4,000	4,667	5,333
	Battery	200	0	0	65	415	415	415	451	603	754	772	925
	Total IBR	**307**	**0**	**77**	**243**	**1,251**	**1,251**	**2,459**	**2,629**	**3,781**	**4,932**	**5,617**	**6,436**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.

Moorabool 220 kV

Figure 35 presents the projected levels of available three phase fault current at the Moorabool 220 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 56 summarises this assessment and does not identify any shortfalls. Table 57 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 35 Moorabool node fault level duration curves and minimum requirement

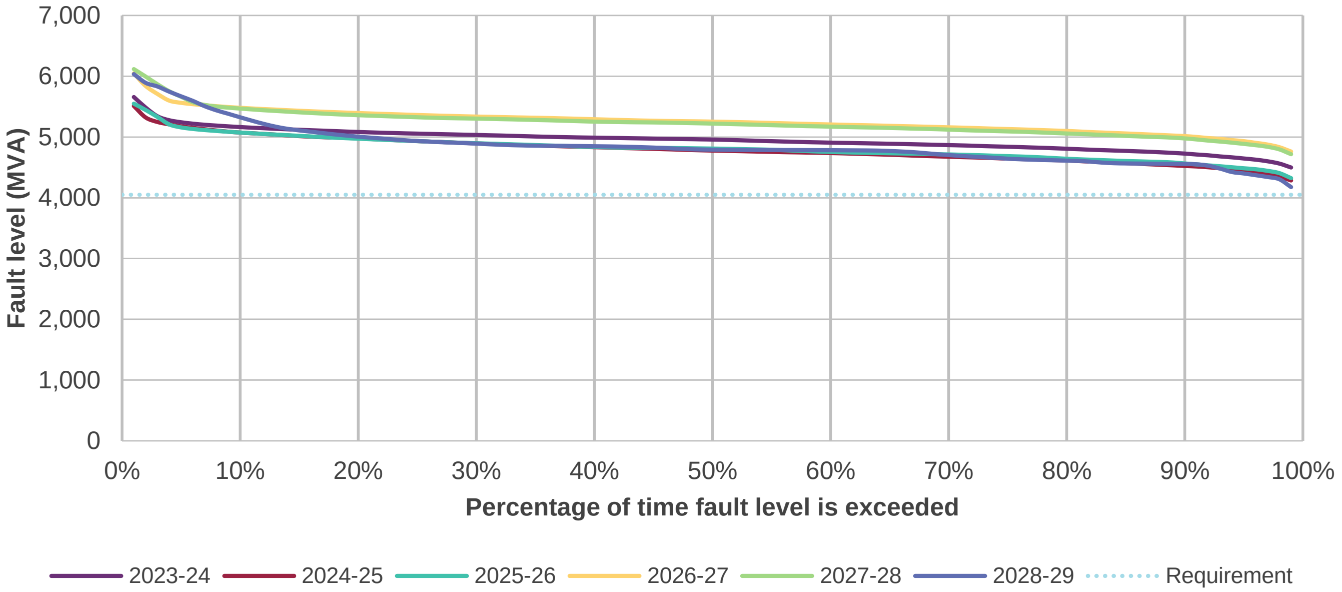


Table 56 Moorabool node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Moorabool 220 kV	Requirement (N)	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600
	Requirement (N-1)	4,050	4,050	4,050	4,050	4,050	4,050	4,050	4,050	4,050	4,050	4,050
	Expected 99% of time	4,499	4,283	4,321	4,762	4,718	4,175					
	Declarable shortfall	**0**	**0**	**0**								

A. Minimum fault current requirements at Moorabool may be impacted following retirement of synchronous generation in the Latrobe Valley.

Table 57 Moorabool node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Moorabool 220 kV	Solar	0	0	0	119	119	119	119	119	119	119	119	119
	Wind	4,126	315	315	1,071	1,545	2,245	2,553	2,553	2,553	3,243	3,414	3,362
	Battery	350	290	290	340	340	340	340	340	340	340	340	310
	Total IBR	**4,476**	**605**	**605**	**1,530**	**2,004**	**2,704**	**3,012**	**3,012**	**3,012**	**3,702**	**3,873**	**3,791**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.

Red Cliffs 220 kV

Figure 36 presents the projected levels of available three phase fault current at the Red Cliffs 220 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 58 summarises this assessment and does not identify any shortfalls. Table 59 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 36 Red Cliffs node fault level duration curves and minimum requirement

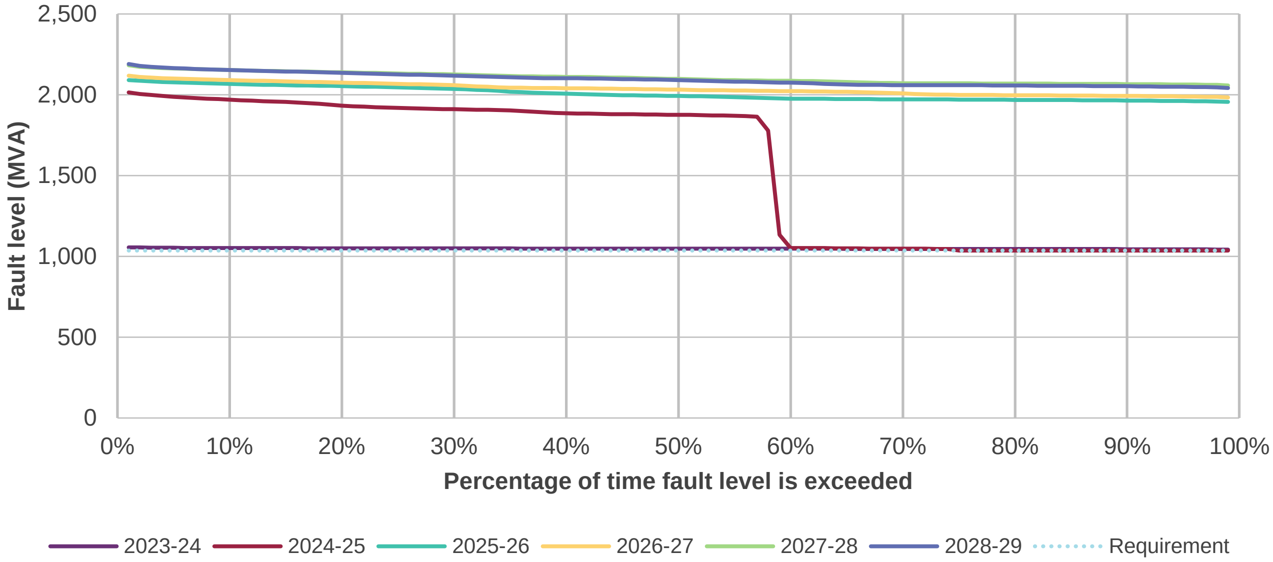


Table 58 Red Cliffs node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)[A,B]										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Red Cliffs 220 kV	Requirement (N)	1,786	1,786	1,786	1,786	1,786	1,786	1,786	1,786	1,786	1,786	1,786
	Requirement (N-1)	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036	1,036
	Expected 99% of time	1,042	1,036	1,955	1,984	2,058	2,041					
	Declarable shortfall	**0**	**0**	**0**								

A. Minimum fault current requirements at Red Cliffs may be impacted by network impedance changes following commissioning of Project EnergyConnect and VNI West and following retirement of synchronous generation in the Latrobe Valley.
B. This assessment assumes existing remediation arrangements at Red cliffs will continue until commissioning of the Project EnergyConnect synchronous condensers.

Table 59 Red Cliffs node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Red Cliffs 220 kV	Solar	682	0	95	245	245	245	245	323	323	323	548	548
	Wind	0	0	0	0	0	0	0	0	0	0	0	0
	Battery	25	0	270	420	420	420	420	420	420	420	420	395
	Total IBR	**707**	**0**	**365**	**665**	**665**	**665**	**665**	**743**	**743**	**743**	**968**	**943**

Note: forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.

Thomastown 220 kV

Figure 37 presents the projected levels of available three phase fault current at the Thomastown 220 kV node over a five-year outlook period. AEMO compares the 99th percentile values from this chart against the minimum post-contingent fault level requirements for the node to identify any declarable system strength shortfalls. Table 60 summarises this assessment and does not identify any shortfalls. Table 61 provides an overview of projected IBR by technology and year, which forms the basis of the efficient level requirement for system strength at this node.

Figure 37 Thomastown node fault level duration curves and minimum requirement

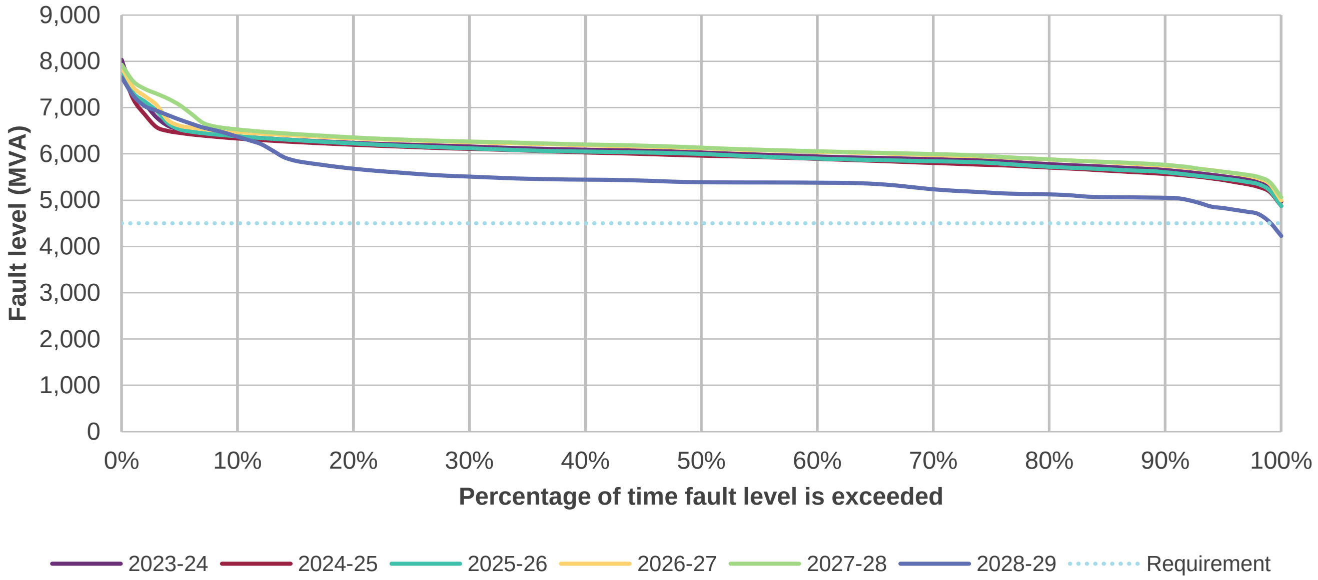


Table 60 Thomastown node minimum three phase fault current requirements and shortfalls

Node	Parameter	Minimum three phase fault current by financial year ending (MVA)										
		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Thomastown 220 kV	Requirement (N)	4,700	4,700	4,700	4,700	4,700	4,700	4,700	4,700	4,700	4,700	4,700
	Requirement (N-1)	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
	Expected 99% of time	5,294	5,173	5,215	5,355	5,414	4,525					
	Declarable shortfall	**0**	**0**	**0**								

A. Minimum fault current requirements at Thomastown may be impacted following retirement of synchronous generation in the Latrobe Valley.

Table 61 Thomastown node utility-scale IBR projections

Node	Technology type	Existing (MW)	Projected IBR by financial year ending (MW)[A]										
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Thomastown 220 kV	Solar	0	0	0	0	0	0	0	0	0	0	0	0
	Wind	58	0	0	0	0	0	0	0	0	0	0	0
	Battery[B]	5	0	200	200	200	200	200	236	389	540	557	710
	Total IBR	**63**	**0**	**200**	**200**	**200**	**200**	**200**	**236**	**389**	**540**	**557**	**710**

A. Forecasts may require adjustment by the SSSP when preparing system strength services, with new information on newly committed IBR and MNSFs.
B. ISP results do not allocate battery technology to specific REZs but rather to the region as a whole. Allocating this battery capacity to Thomastown node was performed in post-processing.

3 Next steps

AEMO has revised its 10-year specification of system strength requirements as a result of this 2023 assessment and has identified seven system strength shortfalls in the period until 1 December 2025. Table 62 summarises these findings. AEMO will work closely with all SSSPs in 2024 to deliver remediation for each gap, and to facilitate long-term investment planning activities associated with the future system strength needs.

AEMO welcomes any comments, questions, or suggestions on this report via planning@aemo.com.au.

Table 62 Summary of new and existing system strength shortfalls

Region	System strength shortfalls
New South Wales 	**AEMO notes revised shortfalls of 1,420 MVA and 1,165 MVA at Newcastle and Sydney West respectively.** Both shortfalls apply from 1 July 2025 until 1 December 2025, and Transgrid is progressing remediation as part of its longer-term system strength RIT-T.
Queensland 	**AEMO confirms the declared shortfall of 64 MVA at Gin Gin until 1 December 2025.** This remains unchanged from the previous report, and Powerlink is progressing commercial arrangements to remediate this need from 1 July 2025. Operational processes have been agreed to manage local system security in the interim period.
Tasmania 	**AEMO has confirmed an ongoing shortfall at all four nodes in Tasmania.** TasNetworks has sufficient network support agreements in place to provide system strength and inertia services until 15 April 2024, beyond which time these shortfalls will reopen. TasNetworks is progressing additional service arrangements to provide coverage until December 2025.

Note: AEMO has not identified any system strength shortfalls for South Australia or Victoria.

A1. Methodology and inputs

This section details the method applied to perform the analysis for the 2023 *System Strength Report*. It also provides the key inputs and assumptions applied, such as ISP scenario selection, committed and anticipated projects, and period of declarations.

AEMO has prepared this report consistent with the System Strength Requirements Methodology v2.0 (SSRM). This current version of the SSRM was finalised in September 2022, with an effective date of 1 December 2022. This followed extensive consultation with stakeholders and incorporates the requirements of the new system strength framework[28].

A1.1 Method

System strength node selection

This report maintains the existing system strength nodes, consistent with the 2022 *System Strength Report*.

AEMO is seeking feedback from all stakeholders on possible declarations of future nodes as detailed in the body of this report. These nodes are suggested by the SSSPs for better application of the system strength standard set out in the 2022 SSRM.

The system strength standard is applied to each system strength node. Minimum fault level requirements are to be determined and projected as well as forecast IBR associated with each node for a 10-year horizon. Additionally, fault level shortfalls may be declared until 1 December 2025.

Minimum fault level requirement projections

AEMO has maintained existing minimum fault level requirements across the NEM. AEMO has considered the material changes that may impact the requirements in future, and has indicated these as footnotes to the 'minimum three phase fault current requirements and shortfalls' table for each node. The timing of these changes is linked to the approval, delivery, and commissioning of major network projects, and AEMO will assess these impacts as the project scopes and commitments solidify.

Additional information – such as protection scheme operation and design, requirements for voltage control equipment operation, and power system analysis – will be required before adjusting existing minimum fault level requirements.

IBR forecast

AEMO projects the forecast IBR associated with each node (electrically closest) for the 10-year horizon to allow the SSSP to plan for delivering the efficient level of system strength required to host this IBR. The forecast is broken down into technology types. The forecast is consistent with the 2024 Draft ISP *Step Change* scenario results. Consistent with the ISP, the IBR forecast includes the majority of new generation being forecast to

[28] Version 2.0 of the SSRM is available on AEMO's website at https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/system-security-planning. The consultation materials for the amendments made to incorporate the new system strength framework are at https://aemo.com.au/consultations/current-and-closed-consultations/ssrmiag.

connect in designated REZs across the NEM. In some cases, post-model adjustments have been made to incorporate information provided by the relevant SSSP.

The IBR forecasts presented in this report may include projects that have elected to be part of the old system strength framework, those which have chosen to self-remediate, or those which have not yet made a declaration as part of their connection process.

The intent of the efficient levels is to represent AEMO's best view of the future IBR projects that will (or could) benefit from the centralised system strength services offered through SSSP investment.

AEMO considers that the default assumption should be for all future projects to leverage central remediation under the new framework, *unless project proponents*:

- have elected to self-remediate through their connection application.
- have elected to apply the old framework if eligible to do so.
- are part of an REZ development project that has committed to self-remediation.

This means any project which has not yet decided or declared a pathway should remain part of the efficient level IBR forecasts. This is consistent with paragraph 30 of the AEMC determination[29], which indicates a slight over-procurement is preferred to under procurement.

When a project has formally elected to self-remediate or apply the old framework, those projects should no longer be considered part of the efficient level to be remediated by the SSSPs. This reflects that building additional central remediation for these projects is unnecessary.

AEMO considers that SSSPs are likely better placed to determine the status of these decisions throughout the year, and between annual updates to the efficient levels. As such, AEMO encourages SSSPs to apply their local knowledge in adjusting the efficient levels for application in their planning processes. Table 63 provides an example of how SSSPs may need to modify these IBR projections to account known project decisions.

Table 63 Adjusting the forecast IBR

<table>
<tr><td colspan="4">Projected IBR for FY25 at Node A
332 MW</td></tr>
<tr><td rowspan="2">Elected to apply old framework
100 MW</td><td colspan="3">Undecided or elected to apply the new framework
232 MW</td></tr>
<tr><td>Elected to self-remediate
50 MW</td><td>Subject to other remediation
60 MW</td><td>Undecided or elected to centrally remediate
122 MW</td></tr>
<tr><td colspan="4">Efficient level requiring SSSP Investment
122 MW</td></tr>
</table>

[29] AEMC. Efficient management of System Strength, at https://www.aemc.gov.au/sites/default/files/2021-10/ERC0300%20-%20Final%20determination_for%20publication.pdf.

Shortfall declarations to December 2025

As part of the transition to the new rules framework, AEMO must continue to project fault levels for each system strength node and declare any shortfalls out to 1 December 2025[30]. To determine if a fault level shortfall is present, AEMO forecasts the fault level typically available at each system strength node of the NEM against the nodes respective requirements for every 30-minute dispatch interval. AEMO has assessed shortfalls based on the 99th percentile results of the selected market modelling projection.

Although only required to project shortfalls until 1 December 2025, AEMO has presented expected fault level availabilities until 2028-29. Availability data from 2 December 2025 is provided for informational purposes only.

Generation outlook

Building on the Draft 2024 ISP outcomes, the projected generation dispatch in this report follows the *Step Change* scenario and is the basis for projections of minimum fault level requirements, IBR forecasts and shortfall declarations. The majority of new generation is forecast to connect in REZs across the NEM. In addition to this assessment, AEMO has conducted a 100% renewable energy sensitivity for a minimum demand snapshot of the system, the results of which are used to highlight potential system security issues in the event the NEM transitions faster towards 100% instantaneous renewable energy penetration.

Table 64 summarises the use of key inputs for market modelling projections prepared for this report. Appendix A2 has further details.

Table 64 Key inputs for market modelling projections

Input	***Step Change* assessment for this report**
Generator withdrawal and operation	Generator withdrawal consistent with the Draft 2024 ISP *Step Change* scenario results.
New generation connections	Committed and anticipated generation from the latest NEM Generation Information[A]. IBR projections from *Step Change* results were added into the time-sequential modelling used to project fault levels for the five-year horizon and the 10-year forecasts.
Transmission network projects	Committed, anticipated and actionable ISP transmission network augmentation projects were included consistent with the Draft 2024 ISP.
Minimum unit requirements for system security	All minimum unit requirements were removed, to allow the projections to be assessed (except for the South Australia assumption that two units will be kept on until Project EnergyConnect is commissioned, or additional voltage control measures are in place[B], and adequate grid reference testing has been conducted).
Demand forecast	Apply 2023 *Electricity Statement of Opportunities* (ESOO) Central projection.

A. See https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information.
B. See https://www.electranet.com.au/projects/south-australian-transmission-network-voltage-control/

[30] AEMC. National Electricity Amendment (Efficient management of system strength on the power system) Rule 2021 No.11, including clause 11.143.14 outlining the transitional arrangements for declaration of shortfalls before December 2025.

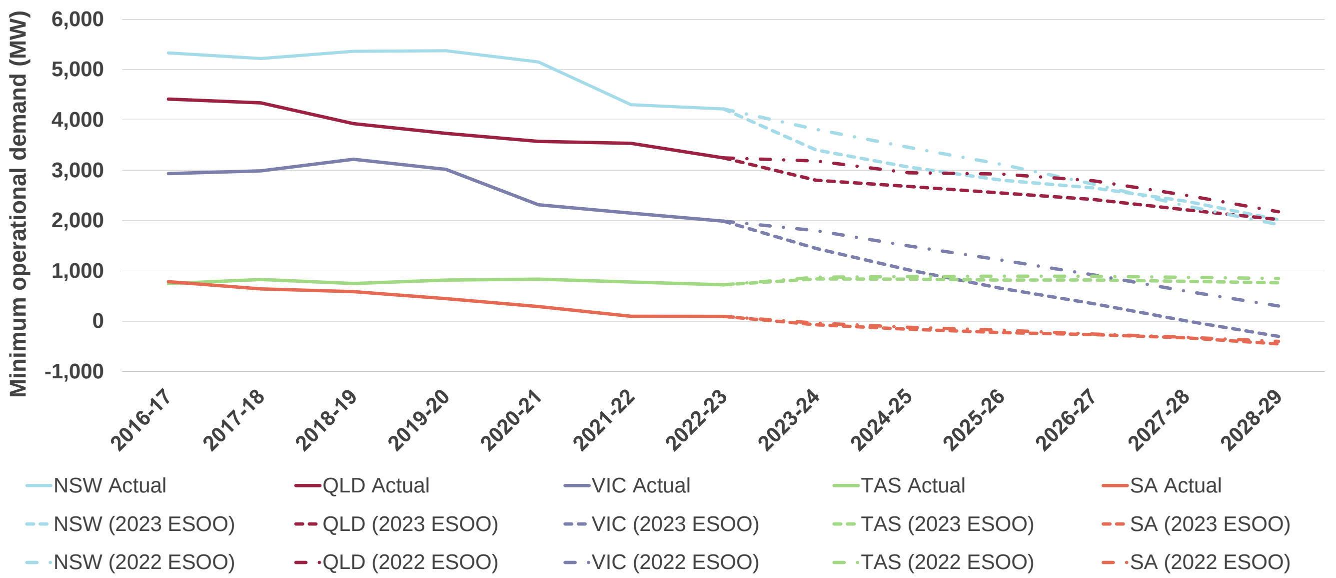
A2. Generator, network and market modelling assumptions

A2.1 Key inputs and assumptions

The system strength assessments have been prepared using the latest 2023 *Electricity Statement of Opportunities* (ESOO) Central scenario 50% probability of exceedance (POE) minimum demand projections[31].

The 2023 ESOO projects declining minimum demand values for many regions of the NEM. However, the 2023 Central scenario has a higher underlying demand across many regions when compared with the previous year's forecast. Figure 38 below shows the differences in the minimum demand projections used in the 2022 and 2023 system strength assessments.

Figure 38 Regional minimum demands based on the 2022 and 2023 ESOO *Central* projections



A2.2 Generator assumptions

Committed and anticipated generation projects

The system strength forecasts provided in this report consider existing generators already in service as well as any committed and committed* scheduled and semi scheduled generation projects. These projections for 2023-24 to 2028-29 incorporate projects from the September 2023 NEM Generation Information[32].

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[31] AEMO National Electricity and Gas Forecasting portal at http://forecasting.aemo.com.au/Electricity/MinimumDemand/Operational.

[32] AEMO. September 2023 NEM Generation Information is available under the Archive section of AEMO's Generation information webpage, at https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/forecasting-and-planning-data/generation-information. Criteria for committed and committed* and anticipated are explained in the Background Information tab of the spreadsheet.

The system strength forecasts also consider anticipated projects captured in the September 2023 NEM Generation Information consistent with the references in the paragraph above, as well as any new generation forecasted to be built under the market modelling results for the *Step Change* scenario prepared for the Draft 2024 ISP[33,34].

Appendix A2.4 has more details about how projects have been incorporated in the market modelling results used in this report.

Generation withdrawal and operation

The system strength forecasts in this report are aligned with the generator withdrawals and operation in the *Step Change* scenario of the Draft 2024 ISP[33].

A2.3 Transmission network augmentations

Table 65 provides the details and modelling date for the large committed, anticipated and actionable ISP transmission network augmentation projects included in the system strength forecasts in this report. These projects are modelled consistent with the latest information provided by transmission network service providers (TNSPs), where timing permitted.

Table 65 Large transmission network upgrades included in each assessment

	Augmentation detail	Project Status	Modelling date (calendar year)
Project EnergyConnect	**Stage 1:** • A new Robertstown to Bundey 275 kV double circuit line. • A new Bundey to Buronga 330 kV double circuit line with one circuit connected initially. • A new 330/275 kV substation and 3x400 MVA 275/330 kV transformers at Bundey. • A new 330/220 kV substation, 1x200 MVA 330/220 kV transformer and 1x200 MVA 330 kV phase shifting transformer at Buronga. • 1x60 megavolt amperes reactive (MVAr) 330 kV line reactor at Bundey. • 1x60 MVAr 330 kV bus connected reactor at Bundey. • 1x100 MVAr 275 kV bus connected capacitor at Bundey. • 1x50 MVAr 330 kV line reactor at Buronga. • 2x52 MVAr 330 kV capacitors at Buronga. • 1x100 MVA 330 kV connected synchronous condenser at Buronga. • An inter-trip protection scheme to trip the Project EnergyConnect interconnector if South Australia becomes separated from Victoria via the Heywood Interconnector. **Stage 2:** • Second 330 kV circuit closed on the Bundey–Buronga 330 kV double circuit line (including 1 x 60 MVAr line reactor at Bundey and 1 x 50 MVAr line reactor at Buronga of each circuit). • A new Buronga to Red Cliffs 220 kV double circuit line. • A new 330 kV double-circuit line from Dinawan to Buronga (including 50 MVAr line reactors at both ends of each circuit).	Committed	Stage 1 2024 Stage 2 2025

[33] Final revisions ahead of publishing the Draft 2024 ISP in may result in minor changes compared with the modelling inputs used in this report.

[34] Aligned with the Draft 2024 ISP modelling assumptions, additional generation projects are included where policy frameworks include them.

	Augmentation detail	Project Status	Modelling date (calendar year)
	• A new 500 kV double-circuit line from Dinawan to Wagga Wagga operating at 330 kV (including 50 MVAr line reactors at the Dinawan end on each circuit). • A new 330 kV switching station at Dinawan. • Additional 4x200 MVA 330 kV phase shifting transformers at Buronga. • Additional 2x200 MVA 330/220 kV transformers at Buronga. • An additional 1x100 MVA 330 kV connected synchronous condenser at Buronga. • New 2x100 MVA 330 kV connected synchronous condenser at Dinawan. • New 2x52 MVAr 330 kV capacitor banks at Dinawan. • Turning the existing 275 kV line between Para and Robertstown into Tungkillo. • A special protection scheme to detect and manage the loss of either of the AC interconnectors connecting to South Australia.		
Waratah Super Battery project A	• Uprate of Bannaby – Sydney West 330 kV transmission lines. • Substation works at Bannaby, Sydney West, Newcastle, Tomago, Liddell, Muswellbrook, Tamworth, Armidale, Dumaresq and Sapphire substations. • Link tendered paired generation to Waratah Super Battery with Special Integrity Protection Scheme (SIPS) control scheme. • SIPS control delivered by Transgrid. • Uprate of Yass – Collector, Collector – Marulan and Yass – Marulan 330 kV transmission lines. • Substation works at Upper Tumut, Lower Tumut, Yass, Collector, Marulan and Macarthur substations.	Committed	2025
Mortlake Turn-in	• Installing four new 500 kV circuit breakers and associated equipment to fully populate one the existing 500 kV bays and establish a new additional 500 kV bay at Mortlake Power Station. • Connecting the existing Haunted Gully to Tarrone 500 kV circuit, of the Moorabool – Heywood 500 kV double circuit line, into Mortlake Terminal Station to establish a Haunted Gully – Mortlake 500 kV circuit and a Mortlake to Tarrone 500 kV circuit.	Anticipated	2025
Victorian REZ Development Plan – Western REZ project	A 250 MVA (1,000 MWs) synchronous condenser next to the Ararat Terminal Station.	Anticipated	2025
Koorangie Energy Storage System (KESS)	• Establishing a new 220 kV terminal station, located approximately 15 km north-west of the existing Kerang Terminal Station, connecting into the existing Kerang – Wemen 220 kV line. • A 185 MW big battery and grid forming inverter technology near Kerang to provide system strength services.	Anticipated	2025
Western Renewables Link	• A new 500 kV double circuit transmission line from Sydenham Terminal Station to Bulgana Terminal Station with switched shunt line reactors at the end of each circuit (approximately 70 MVAr). • Extension of the 500 kV Sydenham Terminal Station by two breaker and a half switched bays. • Additional 100 MVAr at 500 kV switched bus reactor at Sydenham Terminal Station. • Rerouting of the existing No. 1 Sydenham to South Morang and Sydenham to Keilor 500 kV transmission lines to terminate into new bays. • Construction of new 220 kV circuit breakers and a second 220 kV bus at Bulgana Terminal Station. • A new 500 kV switchyard at Bulgana Terminal Station with two new 500/220 kV 1,000 MVA transformers, transmission line realignment, site provisioning and line cut in works for the existing Bulgana to Horsham 220 kV transmission line and Crowlands to Bulgana 220kV transmission line. • Cut-in, termination and switching of the existing Ballarat to Moorabool No.2 220 kV transmission line at Elaine Terminal Station, forming Ballarat to Elaine No.2 line and Elaine to Moorabool No.2 line.	Anticipated	2027

	Augmentation detail	Project Status	Modelling date (calendar year)
	• Re-alignment and switching of the existing Ballarat to Elaine transmission line and Elaine to Moorabool transmission lines at Elaine Terminal Station and renaming them to Ballarat to Elaine No.3 line and Elaine to Moorabool No.3 line. • Implement new Special Control Schemes and/or amend some existing ones at multiple stations. • Validation of the capabilities of the existing earthing systems at multiple stations and the connected 220 kV transmission lines optic ground wire and/or earth wire.		
Central-West Orana REZ Transmission Link [B]	The Central West Orana REZ link includes extension of the 500 kV and 330 kV network in the Central-West Orana region of New South Wales. This REZ will also include some system strength remediation as part of the build.	Anticipated	2027
HumeLink	A 500 kV transmission upgrade connecting Project EnergyConnect and the Snowy Mountains Hydroelectric Scheme to Bannaby.	Actionable ISP	2027
New England REZ	The New England REZ augmentations include additional 330 kV and 500 kV transmission network cutting in between Armidale and Tamworth, connecting renewable generation to Sydney.	Actionable NSW	2028
Sydney Ring Northern Loop	New 500 kV loop: • A new 500 kV substation near Eraring. • A new 500 kV double circuit line between substation near Eraring and Bayswater substation. Two 500/330 kV 1,500 MVA transformers either at Eraring substation or new substation near Eraring.	Actionable NSW	2028

A. As per New South Wales Government announcement, at https://www.energyco.nsw.gov.au/waratah-super-battery-munmorah-site.
B. EnergyCo will build system strength remediation in some form for the Central West Orana REZ. AEMO has included latest information on this remediation.

A2.4 Market modelling of generator dispatch method

AEMO undertakes integrated energy market modelling to forecast future investment in and operation of electricity generation, storage and transmission in the NEM[35].

Projected generation and storage investment and dispatch from the *Step Change* scenario results for the early results in the Draft 2024 ISP have been used for system strength forecasts in this report, with some updates to reflect the latest information. These market modelling results:

- Cover the financial years from 2023-24 to 2028-29.
- Are based on the *Step Change* scenario generator, storage and transmission build outcomes for the Draft 2024 ISP[36].
- Include generator dispatch projections from a time-sequential model using the ‘bidding behaviour model’ for realistic generator dispatch results given the generation and build outcomes. The bidding behaviour model uses historical analysis of actual generator bidding data and back-cast approaches for the purposes of calibrating projected dispatch[37].
- Apply the *Step Change* scenario 50% POE demand projection from the 2023 ESOO.
- Apply multiple projections of generation outages.

[35] Information about AEMO’s energy market modelling can be found in the 2021 ISP Methodology, at https://aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2022-integrated-system-plan-isp/isp-methodology respectively.

[36] Final revisions ahead of publishing the Draft 2024 ISP in may result in minor changes compared with this report.

[37] AEMO, Market Modelling Methodologies, July 2020, at https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/inputs-assumptionsmethodologies/2020/market-modelling-methodology-paper-jul-20.pdf?la=en.

- Apply projections of planned maintenance. Maintenance events are assumed to be distributed throughout the year such that they minimise planned outages at times when it is most required when consumer demand is high, to avoid exacerbating reliability risks.
- Incorporate a range of market modelling iterations for each year of the study period, capturing multiple generator outage patterns. This better captures the variability in generator outage patterns, and hence gives better regard of typical dispatch patterns.

When applying the market modelling results to assess the inertia projections, some post model adjustments were made where necessary based on industry knowledge and known operational practices.

A3. Translation of minimum fault level requirements to real-time operations

AEMO is required to publish minimum fault level requirements for each system strength node applicable for the following year under NER 5.20C.1. Maintaining the system strength requirements at each node forms part of the general power system principles to operate a secure network as per NER 4.2.6(g).

The following table lists the pre-contingent minimum fault level requirements for each system strength node.

Table 66 Pre-contingent minimum fault level requirements as at 1 December 2023

System strength node	Minimum fault level requirement (pre-contingency) (MVA[A])
New South Wales	
Armidale 330 kV	3,300
Buronga 220 kV (from December 2025)	1,755 (from December 2025)
Darlington Point 330 kV	1,500
Newcastle 330 kV	8,150
Sydney West 330 kV	8,450
Wellington 330 kV	2,900
Queensland	
Gin Gin 275 kV	2,800
Greenbank 275 kV	4,350
Lilyvale 132 kV	1,400
Ross 275 kV	1,350
Western Downs 275 kV	4,000
South Australia	
Davenport 275 kV	2,400
Para 275 kV	2,250
Robertstown 275 kV	2,550
Tasmania	
Burnie 110 kV	850
George Town 220 kV	1,450
Risdon 110 kV	1,330
Waddamana 220 kV	1,400
Victoria	
Dederang 220 kV	3,500
Hazelwood 500 kV	7,700
Moorabool 220 kV	4,600
Red Cliffs 220 kV	1,786
Thomastown 220 kV	4,700

A. These requirements are calculated to ensure system security for the 'worst credible contingency'. Non-credible events like the inability of synchronous generators to ride through a circuit breaker fail event have not been considered. Events like this and the resulting loss of resilience of the system should be taken into consideration by the SSSP when meeting the system strength standard.