Department of
Energy and Economic Diversification

GOVERNMENT OF WESTERN AUSTRALIA

Transformation Design and Operation Working Group Meeting 59

Power System Security and Reliability Standards Review – Exposure Draft

10 September 2026

Acknowledgement of Country

The Government of Western Australia acknowledges the traditional custodians throughout Western Australia and their continuing connection to the land, waters and community.

We pay our respects to all members of the Aboriginal and Torres Strait Islander communities and their cultures, and to Elders past and present.

Agenda

Item		Presented by
1. Welcome	2 min	Chair
2. PSSR Standards Review overview	3 min	DEED
3. Review process and timeline	3 min	DEED
3. SWIS System Strength framework	10 min	DEED
4. Technical Requirements for GFL and GFM IBRs	90 min	Western Power/AEMO
4.1 Transitional Arrangements	10 min	DEED
5. Next Steps	2 min	DEED

The PSSR Standards Review

Reason and objective of the review

The Department of Energy and Economic Diversification (DEED), in consultation with AEMO, Western Power and a Market Advisory Committee Working Group has been progressing the PSSR Standards Review.

The purpose of this review is to implement the Energy Transformation Taskforce's recommendation to introduce a consistent, single end-to-end PSSR standard with a centralised governance framework in the ESM Rules.

The objective of the review is to ensure that the standards are effective as the energy transition continues, while having regard to all limbs of the State Electricity Objective.

Review process and timeline

1. June 2025 Consultation Paper

20 proposals including:

- Technical Requirements for new technologies; and
- A framework to identify and manage current and emerging system strength risks.

2. December 2025 Western Power Technical Paper

Following stakeholder feedback and developments in the National Electricity Market revised Technical Requirements for GFL and GFM IBRs were proposed.

3. August 2026 Information Paper and Exposure Draft

Final review outcomes to establish a SWIS System Strength framework and updated Technical Requirements for GFL and GFM IBRs.

4. August 2026 Consultation Paper

Additional proposals that are required to complement the review outcomes in the Information Paper including a proposed regulatory incentives framework to minimise system strength shortfalls and reduce the requirement and cost of any procurement of solutions by Western Power.

SWIS System Strength framework

Key review outcomes: Roles and responsibilities

20 August 2026 Information Paper and Exposure Draft

As per current framework

Revised System Strength definition and new definition of System Strength Shortfall

Forecasting Planning and Coordination Group (Coordinator, AEMO and Western Power) to align forecasting and planning approaches and methodologies.

AEMO publishes System Strength Shortfalls and outlook in a System Strength Report every two years*.

Where non-network solutions are most efficient, Western Power to submit NCESS Trigger submission to alleviate shortfalls.

NCESS costs are recovered through network tariffs.

Question for discussion

Do the TDOWG members have any specific input on the the drafting of review outcomes in the Exposure Draft?

* FPCG can require a targeted System Strength Report in intervening years when deemed necessary

Technical Requirements for Grid-following and Grid-forming inverter-based technologies

Overview of draft ESM Amending Rules

Terminology and definitions

ESM Rules amended to implement new 'Access Standard' terminology:

- Chapter 1
- Chapter 3A
- Chapter 11 (Glossary)
- Appendix 12

Appendix 12 amended to support the implementation of GFM/GFL requirements via:

- new definitions
- new supporting / amended definitions
- consequential amendments

Technical Requirements

Appendix 12 amended to implement GFL and 'interim' GFM requirements via:

- New A12.9A Withstand Short Circuit Ratio
- New A12.9B Voltage Phase Angle Jump
- Other required amendments to Appendix 12

Clarifications also made throughout Appendix 12 to improve descriptive accuracy

Transitional arrangements

ESM Rules amended to clarify how Proposed GPS are to be assessed if amendments to the Technical Requirements are made.

- Technical Requirements change after submission of Proposed GPS (new clause **3A.5.1A**)
- Proposed GPS must be submitted for a Relevant Generator Modification (new clause **3A.5.1B)**

‘Interim’ Access Standards for GFM (inverter-based) technology

Interim GFM requirements aim to:

Define clear, behaviour-based definition of GFM (inverter-based) technology for the SWIS that behaves as a controlled voltage source behind an effective, controllable impedance while providing a stable sub-cycle response within its current and energy limits

Build on AEMO’s ongoing work on GFM Access Standards in the National Electricity Market (NEM) and emerging international guidance

Introduce a focused set of GFM Access Standards, with MAS limited to essential capabilities needed for power system security and efficient SWIS operation

“No regrets capabilities”

AAS and higher-end GFM functions intentionally deferred to later phases, once national and international practice is more mature

Refinements since December 2025 consultation - Terminology updated

Generator Performance Standards

- Ideal Generator Performance Standard
- Minimum Generator Performance Standard
- Negotiated Generator Performance Standard
- Proposed Negotiated Generator Performance Standard

Generator Performance Standards

- Automatic Access Standard (AAS)
- Minimum Access Standard (MAS)
- Negotiated Access Standard
- Proposed Negotiated Access Standard

Alignment to new ‘Access Standards’ terminology:

- supports the transition of Existing Transmission Connected Generating Systems to the new arrangements
- creates consistency across jurisdictions (i.e. National Electricity Market)

Refinements since December 2025 consultation - new definitions to support GFM/GFL requirements

New term	Review outcome	Rationale
Grid-Forming Capability	*The capability of a Generating Unit or Generating System, as applicable, to:* *(a) behave as a controlled voltage source behind an **effective impedance**; and* *(b) autonomously deliver a stable sub-cycle response to rapid changes in voltage magnitude, frequency, and phase angle, within its current and energy limits,* *such that the relevant Generating Unit or Generating System does not primarily rely on an externally measured voltage phase angle or frequency reference to determine its response.*	Provide guidance on when a Generating Unit or Generating System (as relevant) should be assessed against GFM specific technical requirements, while providing greater clarity for new connections. Reflects stakeholder feedback. ~~Note~~ In response to stakeholder feedback: 'effective impedance' is used instead of 'controllable impedance' to improve clarity and flexibility, avoid prescribing internal design or implementation choices, and preserve the required terminal behaviour and performance outcome at the agreed Measurement Location
Grid-Following Capability	*The capability of a Generating Unit or Generating System, as applicable, that does not have Grid-Forming Capability.*	
Short Circuit Ratio	*The ratio of the three-phase fault level (MVA) at the Connection Point, calculated excluding the contribution of all Asynchronous Generating Systems, to the **Maximum Apparent Power** (MVA) of the relevant Asynchronous Generating System.*	SCR of ≤3 is an appropriate and achievable minimum threshold for the SWIS. Setting a more stringent minimum requirement would likely require additional equipment (i.e. synchronous condensers) or prevent connection at otherwise viable locations
Withstand Short Circuit Ratio	*The lowest Short Circuit Ratio at the **Measurement Location** at which an Asynchronous Generating Unit or Generating System, as applicable, is demonstrated to be Adequately Controlled, while remaining in **Continuous Uninterrupted Operation**, for the purposes of the withstand SCR assessment under Part A12.9A.*	Only applies for the application of Part A12.9A, and not more generally as part of System Strength reporting. Note consequential changes made to the existing definitions of 'Measurement Location' and 'Continuous Uninterrupted Operation'

New term	Review outcome	Rationale
Adequately Controlled (new)	*The response of an Asynchronous Generating Unit or Asynchronous Generating System, as applicable, to temporary over-voltage or temporary under-voltage achieves the agreed level of reactive current injection or absorption within the duration of the relevant Disturbance, considering:* *(a) expected positive and negative sequence reactive current response;* *(b) expected active current response; and* *(c) stable control when operating at and transitioning into and out of limits, and does not cause or exacerbate:* *(d) over-voltages, exceeding levels and durations agreed under Part A12.8;* *(e) under-voltages, below levels and durations agreed under Part A12.8; and* *(f) voltage transients or oscillations that could adversely affect the ability of other* *Equipment to remain in operation during the Disturbance*	Describes the acceptable response of IBR. Broadly consistent with the NEM approach.
Adequately Damped	~~*As described in the Technical Rules.*~~ *The response of a Generating Unit, Generating System or power system, as applicable, following an oscillation triggered by any Disturbance must conform to the following criteria:* *(a) the damping ratio of the oscillation must be at least 0.1;* *(b) the halving time of any oscillation is not to exceed 5 seconds; and* *(c) allow other Generating Systems or Generating Units, as applicable to maintain Continuous Uninterrupted Operation.*	Describes the acceptable response of synchronous generating systems

Refinements since December 2025 consultation - amended definitions to support GFM/GFL requirements

Term	Review outcome	Rationale
Continuous Uninterrupted Operation	*In respect of a Generating System or operating Generating Unit within a Transmission Connected Generating System that is operating immediately prior to a ~~power system disturbance~~ Disturbance, means:* *(a) not disconnecting from the SWIS except ~~in accordance with~~ as required or permitted under its Registered Generator Performance Standard;* *(b) during the ~~disturbance~~ Disturbance, contributing active and reactive current or Active Power and Reactive Power as required or permitted by its Registered Generator Performance Standard;* *(c) after clearance of any electrical fault that caused the ~~disturbance~~ Disturbance, only ~~substantially~~ varying its Active Power and Reactive Power as required or permitted by its Registered Generator Performance Standard; and* *(d) not exacerbating or prolonging the ~~disturbance~~ Disturbance or causing a subsequent ~~disturbance~~ Disturbance for other connected Equipment, except as required or permitted by its Registered Generator Performance Standard,* *with all essential auxiliary and reactive Equipment remaining in service and accounting for, where applicable:* *(e) inherent or programmed responses, in accordance with good electricity industry practice, opposing RoCoF or opposing voltage phase angle jumps; and* *(f) responses consistent with the operation of the Generating Unit or Generating System, as applicable, in accordance with Part A12.6*	Relates to 'SCR boundaries when the Generating System or Generating Unit is expected to remain stable' Amended to support the definition of 'Withstand Short Circuit Ratio', clarifying that Continuous Uninterrupted Operation is not required where the actual system impedance at the connection point exceeds the nominated withstand system impedance (i.e. does not constitute a non-compliance)
Measurement Location	*The Connection Point, or another measurement location agreed by AEMO and the Network Operator, as specified for the relevant Technical Requirement. The process for agreeing an alternate measurement location is documented in the guidelines published by the Network Operator under clause 3A.4.4.*	Amended to support the definition of 'Withstand Short Circuit Ratio'. Note supporting processes to be developed with a subordinate instrument

Refinements since December 2025 consultation - new supporting definitions

New term	Review outcome	Rationale
Commencement Time	*In relation to a voltage Disturbance, the time measured from the commencement of the voltage deviation until the first clearly identifiable point at which the reactive current response begins to act in a direction that opposes the voltage deviation, based on the relevant fundamental-frequency reactive current component.*	Described the clear and measurable point at which the reactive current response is taken to have commenced for the purposes of the Technical Requirements
Control System Bandwidth	*For a relevant Control System, the upper frequency limit, expressed as an absolute frequency in Hertz, up to which the closed-loop Control System can provide its intended response for the applicable Technical Requirement at the relevant operating point. This limit is assessed by considering the response of the Control System to time-varying changes, in a relevant command or input signal, or a measured quantity used by the Control System, or a Disturbance. For the avoidance of doubt, Control System Bandwidth is not the power system fundamental frequency, switching frequency components of semiconducting devices, sampling frequency, communication update rate, measurement filter cut-off frequency, or harmonic frequency.*	Required to support the interpretation of the Minimum Access Standard for Voltage and Reactive Power Control
Disturbance	*Any large disturbance or small disturbance as described in the Technical Rules.*	Supports the operation of new or amended definitions (i.e. 'Continuous Uninterrupted Operation', 'Adequately Controlled' and 'Adequately Damped') and relevant Technical Requirements, and clarifies the application of existing definitions that that refer to a 'Disturbance' (i.e. 'Maximum Continuous Current 'and 'Rise Time')

New term	Review outcome	Rationale
End of Disturbance	*Following a Disturbance, the time at which the RMS magnitude of the voltage at the Connection Point recovers to within 90% and 110% of the nominal voltage and remains within this range for at least 20 ms.*	Establishes a consistent reference point for assessing active power recovery following a contingency event, and that recovery obligations commence once the voltage at the Connection Point has recovered to the specified range post-Disturbance
Maximum Active Power	*The maximum Active Power level that a Generating Unit or Generating System, as applicable, can inject or withdraw, as specified in the Temperature Dependency Data provided under Part A12.2.*	Inserted to differentiate between 'Maximum Active Power' and 'Rated Maximum Active Power', where the latter is a derated value
Maximum Apparent Power	*The maximum Apparent Power level that a Generating Unit or Generating System, as applicable, can inject or withdraw, including as calculated from the Generator Performance Chart provided under Part A12.3.*	Required to support 'Short Circuit Ratio' definition
Total Current	*The root mean square magnitude of the fundamental-frequency current injected or absorbed by a Generating System or Generating Unit, as applicable, at the Measurement Location, determined as the root-sum-square of the active and reactive current components of both positive-sequence and negative-sequence current, including any overload capability (if available). Total Current excludes zero-sequence current, harmonic, inter-harmonic, direct current offset and switching-frequency components of semiconducting devices, unless expressly stated otherwise.*	Describes the reference quantity during contingencies in a way that better reflects the actual operational characteristics and short-term capability of IBR to ensure a simple and technology-neutral measure of fault support, and that existing overcurrent capability built into modern GFL and GFM IBRs can be fully utilised during faults (without requiring additional equipment or design changes)

Details of refined A12 Technical Requirements for ‘interim’ GFM and GFL Access Standards

Details of refined A12 Technical Requirements

Item	December 2025 recommendation	September 2026	

2.1 Withstand Short Circuit Ratio (SCR) capability	• Minimum Generator Performance Standard of withstand SCR 2.0 (GFM) and 3.0 (GFL)
	• Automatic Generator Performance Standard of Withstand SCR 1.2 (GFM)
	• No Automatic Generator Performance Standard (GFL)
		MAS modified / AAS deferred	• A single Minimum Access Standard of ≤3 adopted for GFM and GFL to:
			  • avoid favouring one technology pathway over another
			  • ensure all IBRs contribute appropriately to system security
			• Defer Automatic Access Standard pending further development of the WA system strength framework

2.2 Settings used to demonstrate Withstand SCR	• Require settings used to demonstrate Withstand SCR not to differ from settings required for other Technical Requirements, unless agreed with AEMO and the Network Operator	Retained-for further consider-ation	• Retain the principle that the settings used to demonstrate compliance should, by default, be the same settings used in operation • Proposal to enable changes to control settings if determined necessary by Western Power i.e. where a single set of settings is impractical due to a particularly wide system strength operating envelope

3.1, 3.2 Voltage Phase Angle Jump	• Minimum Generator Performance Standard of:
	  • ±25° withstand + fast opposition with response initiation ≤20 ms (GFM)
	  • ±25° phase angle jump withstand (GFL)
	• Remain in operation for phase angle changes during faults (within positive-sequence criterion)
		Retained and clarified	• Retain the revised proposal: ±25° withstand plus response initiation within 20 ms (GFM) and ±25° withstand (GFL)
			• Automatic Access Standard same as the Minimum Access Standard
			• Retain the requirement to remain in ‘Continuous Uninterrupted Operation’ during fault-related phase angle changes within the positive-sequence criterion, and for GFM or GFL capability to be ‘Adequately Controlled’
			• Further clarification on testing and assessment arrangements via subordinate instrument

Item	December 2025 recommendation	September 2026	

4.1 Reactive current commencement time during contingencies	• Minimum Generator Performance Standard:
	  • ≤ 20 ms (GFM)
	  • ≤ 40 ms (GFL)
	• Automatic Generator Performance Standard:
	  • not proposed (GFM)
	  • ≤ 20 ms (GFL)
		AAS retained / MAS modified	• Modified Minimum Access Standard to apply:
			  • 30 ms for GFM
			  • 40 ms for GFL
			• Default assessment for 'Commencement Time' is the connection point unless an alternative 'Measurement Location' is agreed

4.2 Reactive current rise time during contingencies	• Minimum Generator Performance Standard:
	  • ≤ 80 ms (GFM)
	  • ≤ 80 ms (GFL)
	• Automatic Generator Performance Standard:
	  • not proposed (GFM)
	  • ≤ 40 ms (GFL)
		MAS retained / AAS modified / Clarifications made	• Retain Minimum Access Standard for GFL and GFM
			• Retain Automatic Access Standard for GFL
			• Set Automatic Access Standard at Minimum Access Standard for GFM
			• A longer rise time may be agreed where appropriate
			• Default assessment for 'Rise Time' is the connection point unless an alternative 'Measurement Location' is agreed
			• Negotiated flexibility in A12

4.3 Negative-sequence control during contingencies	• Minimum Generator Performance Standard:
	  • not proposed (GFM)
	  • negative sequence current leading negative sequence voltage by about 90°, with clear prioritisation (GFL)
	• Automatic Generator Performance Standard:
	  • not proposed (GFM)
		MAS retained / GFM requirements deferred	• Retain the GFL requirements, aligned with IEEE 2800-style intent
			• Defer any GFM requirements for future consideration
			• For GFM and GFL, require prioritisation between positive- and negative-sequence current components when current limits are reached

Item	December 2025 recommendation	September 2026	

4.5 Behaviour at current limitation during contingencies	• Requirement for GFM operating at or above their maximum continuous current to:
	  • remain compliant with withstand obligations;
	  • provide a predictable combination of active and reactive current that is consistent with the total current level;
	  • maintain stable control through transitions into and out of current limiting; and
	  • avoid behaviour that degrades system security, system strength or quality of supply.
	• Separate Minimum Generator Performance Standard (GFL) not required
		Retained	• Retain [‘Common Requirements’ under A12.9.1.6 amended and applies the requirement consistently to both GFL and GFM technologies to ensure stable and predictable behaviour during current-limited operation.]

4.6 Frequency of current injection during contingencies	• Requirement for GFM or GFL that, during the fault, active and reactive current injection must have a fundamental frequency component that is same as the fundamental frequency of the terminal voltage	Retained	• Retain [‘Common Requirements’ under A12.9.1.6 amended]

Item	December 2025 recommendation	September 2026	

4.7 Fast opposition of voltage magnitude changes	• Minimum Generator Performance Standard:
	  • reduce the sensitivity of voltage magnitude to a given change in current within 20 ms after the disturbance, compared to when the facility was not connected (GFM)
	  • not applicable (GFL)
		Retained	• Retained on the basis that opposition of voltage magnitude changes is a distinct performance requirement and addresses a separate dimension of Disturbance behaviour

4.8 Fault ride-through activation thresholds	• Minimum Generator Performance Standard:
	  • 80% and 120% (GFM and GFL)
	• Automatic Generator Performance Standard:
	  • not proposed (GFM)
	  • 85% and 115% (GFL)
		Retained and clarified	• Retain Minimum Access Standard of 80% (under-voltage threshold) and 120% (over-voltage threshold) for GFM and GFL - noting the under-voltage threshold is a relaxation from existing WEM settings
			• New ‘End of Disturbance’ reference point

4.9 Use of total current during contingencies	• Minimum Generator Performance Standard:
	  • total current will replace the maximum continuous current (GFM)
	  • total current will replace the maximum continuous current (GFL)
		Retained and clarified	• Retain total current as the reference approach during contingencies via ‘Total Current’ definition

4.10 Active power recovery following contingencies	• Minimum Generator Performance Standard:
	  • return to at least 95% of pre-disturbance Active Power output within a period of time agreed by AEMO and the Network Operator (GFM and GFL)
	• Automatic Generator Performance Standard:
	  • not proposed (GFM)
	  • return to at least 95% of pre-disturbance Active Power output within ≤ 100 ms (GFL)
		Retained	• Retain GFM and GFL requirements
			• New ‘End of Disturbance’ reference point

Item	December 2025 recommendation	September 2026	
4.11 Reactive current sustainment time during contingencies	Create a new definition for Sustainment Time to specify that GFL and GFM must 'substantially maintain' the required reactive current response until the 'End of the Disturbance	Modified and clarified	• Sustainment time concept implemented without specifically implementing a new definition • Further clarification via subordinate instrument
4.12 Reactive current injection ratio during contingencies	Minimum Generator Performance Standard: • 0% reactive current injection per 1% reduction in positive sequence voltage (GFM and GFL)	Modified	• Revised requirement for a reactive current injection ratio greater than 0% per 1% reduction in positive-sequence voltage • Applicable ratio of positive to negative sequence reactive current to be determined through the Generator Performance Standard process

4.13 Long duration faults	• Minimum Generator Performance Standard:
	  • reduce 2 seconds to 450 ms and replace 'Adequately Damped' with 'Adequately Controlled' (GFM and GFL)
	• Automatic Generator Performance Standard:
	  • not applicable (GFM and GFL)
		Retained	• Retain
			• Requirement for GFM or GFL capability to be 'Adequately Controlled'

5.1 Disturbance ride-through for multiple disturbances	• Facilities must maintain continuous uninterrupted operation through sequences of multiple disturbances, subject to defined disturbance sequencing criteria (GFM and GFL)	Retained and clarified	• Retain with clarifications the combinations of Disturbances for which a Generating System and each operating Generating Unit must remain in Continuous Uninterrupted Operation • New 'End of Disturbance' reference point • Retain the requirement to remain in 'Continuous Uninterrupted Operation' • Further clarification via subordinate instrument

Item	December 2025 recommendation	September 2026	

6. Damping of power system oscillations	• Minimum Generator Performance Standard:
	  • "oscillation neutral" in 0.1–100 Hz band (GFM)
	  • no direct requirement, covered by new definition 'Adequately Controlled' (GFL)
	• Automatic Generator Performance Standard:
	  • not applicable (GFM)
	  • no direct requirement (GFL)
		Retained and clarified	• Retain 'oscillation-neutral formulation' i.e. facilities should not degrade damping or introduce new instability, without prescribing internal control design
			• Requirement for GFM or GFL capability to be 'Adequately Controlled' and 'Adequately Damped'
			• New 'Control System Bandwidth' definition to support application of Minimum Access Standard for Voltage and Reactive Power Control

7. Partial load rejection	• Modify the definition of 'Continuous Uninterrupted Operation' and clause A12.6.1.5 of the ESM Rules to recognise beneficial responses: active power opposing phase-angle jumps and primary frequency/inertial response opposing frequency changes	Retained and clarified	• Retain - definition of 'Continuous Uninterrupted Operation' amended
8. Instability detection mechanism	Instability detection mechanism to address a genuine system security risk, for GLF only: • to be consistent with NER S5.2.5.10 (post NER version 234) • not proposed for GFM	Retained	• Retain to provide AEMO and Western Power with a practical mechanism to identify and contain unstable behaviour before it propagates more broadly through the power system • Further clarification via subordinate instrument

Key A12 Technical Requirements and Access Standards to support GFM capability

Withstand Short Circuit Ratio (SCR)
Voltage Phase Angle Jump

Withstand Short Circuit Ratio (SCR)

DEED June 2025 Consultation Paper

- Proposed Minimum User Performance Standard (UPS):
  - GFL: withstand SCR 3.0
  - GFM: withstand SCR of 2.0
- Proposed Automatic User Performance Standard:
  - GFL: not applicable
  - GFM: withstand SCR 1.2
- Clarification on ‘continuous uninterrupted operation’
- Settings must not differ to those for compliance with other Technical Requirements, unless otherwise agreed with AEMO and Western Power
- Allow connection of GFL not capable of meeting Minimum UPS if firm investment commitment to remedy capability shortfall

Key stakeholder feedback

Broad agreement :

- Support for improving weak-grid performance.
- Support for differentiating between GFL and GFM

Main concerns

- Considered SCR 1.2 particularly challenging and not representative of realistic operation
- facilities should be tuned for actual grid conditions, not extreme future scenarios

(Revised) December 2025 position

- Proposed Minimum Access Standard (MAS):
  - GFL: capable of continuous uninterrupted operation down to an agreed withstand SCR of 3.0
  - GFM: capable of continuous uninterrupted operation down to an agreed withstand SCR of 2.0
- Defer proposed Automatic Access Standard (AAS)

Key stakeholder feedback

- A main area of stakeholder concern
- Several stakeholders argued that fixed SCR thresholds are overly prescriptive or simplistic, and that a higher GFL MAS should apply in strong parts of the network
- Other stakeholders raised technology-neutrality and incentive concerns for GFM

New Technical Requirement
A12.9A Withstand Short Circuit Ratio (SCR)

- Minimum Access Standard (GFL and GFM)
  - SCR of ≤3
- Automatic Access Standard same as Minimum Access Standard at this stage
- No Negotiation Criteria for Withstand SCR
- ‘Continuous Uninterrupted Operation’ – definition amended

Rationale for August 2026 outcome

Single Minimum Access Standard for Withstand SCR of ≤3 (GFM and GFL):

- is appropriate and achievable minimum threshold for the SWIS
- avoids favouring one technology pathway over another while ensuring all IBRs contribute appropriately to system security
- supports connection at otherwise viable locations
- consistent with AEMO’s 2025 WEM ESOO preliminary system strength analysis and aligned with National Electricity Market requirements

Voltage Phase Angle Jump

DEED June 2025 position

- Proposed Minimum User Performance Standard (UPS):
  - GFL: withstand an angle jump of less than 25 degrees
  - GFM: withstand an angle jump of less than 60 degrees and supress the phase angle jump with a response time of 20ms or lower
- Requirement to remain in operation for any change in the phase angle of individual phases caused by occurrence and clearance of balanced and unbalanced faults, provided that the positive sequence angle change does not exceed the Minimum UPS

Key stakeholder feedback

- Supported for preventing nuisance tripping and limiting vector-shift protection operation
- However, many stakeholders viewed the proposed 60° GFM phase-angle jump and 20 ms suppression requirements as overly onerous, difficult to validate, and potentially detrimental to overall GFM performance

(Revised) December 2025 position

- Proposed Minimum Access Standard (MAS):
  - GFL: withstand ±25°
  - GFM: withstand ±25° and provide fast opposition with sub-cycle (≤20 ms) initiation
- Automatic Access Standard:
  - Not applicable for GFL
  - Not proposed for GFM at this stage
- Requirement to remain in operation for fault-induced phase angle changes up to the specified positive-sequence angle criterion

Key stakeholder feedback

- Stakeholders questioned whether explicit phase-angle requirements duplicate fault ride-through obligations and if the GFM 20 ms response requirement is too prescriptive
- Some suggested vector shift protection settings could be a more practical alternative

New Technical Requirement

A12.9B Voltage Phase Angle Jump

- **Minimum Access Standard (GFL)**
  - be ‘Adequately Controlled’ and remain in ‘Continuous Uninterrupted Operation’ for a positive-sequence phase angle jump of ±25°
- **Minimum Access Standard (GFM)**
  - be ‘Adequately Controlled’ and remain in ‘Continuous Uninterrupted Operation’ for a positive-sequence phase angle jump of ±25°; and
  - initiate a response to oppose the positive-sequence phase angle jump within 20 ms
- Detailed testing and assessment arrangements to be specified in a WEM Procedure
- Automatic Access Standard same as Minimum Access Standard at this stage
- No Negotiation Criteria for Voltage Phase Angle Jump

Rationale for August 2026 outcome

- **Voltage phase angle jump** requirement:
  - is consistent with international practice, including IEEE Std 2800, and appropriately expresses the fault ride-through obligation as it applies to phase angle events
  - is not an additional requirement on top of fault ride-through obligations but instead it ensures consistency between voltage-magnitude and phase-angle requirements during faults
  - reflects the demonstrated capability of modern IBRs, and is intended to reduce nuisance tripping from vector shift protection and support continued operation during credible disturbances
  - relates to maintaining stability and voltage angle coherence during rapid phase-angle disturbances – without this capability, Western Power and AEMO would likely need to rely more heavily on synchronous machines and additional system strength and inertia services, increasing overall system costs
- The additional expectation on GFM is to actively opposes the phase angle jump to support restoration of the system voltage angle:
  - response initiation within one cycle (≤20ms) is intended to define the fast voltage angle support capability characteristic of GFM operation and is not a requirement to fully suppress the disturbance within one cycle

Other Critical Technical Requirements

New Technical Requirement

A12.8.3.4 – Fast Opposition of Voltage Magnitude Changes

- **Minimum Access Standard (GFM)**
  - initiate a response to oppose a positive-sequence voltage magnitude jump within **20 ms**
- Applies during voltage disturbances as part of GFM voltage support capability
- Automatic Access Standard same as Minimum Access Standard at this stage
- No Negotiation Criteria specified
- Detailed testing and assessment arrangements to be specified in a WEM Procedure

New GFM-Specific Access Standard

A12.9.3.7A – Reactive Current Response During Contingencies

- **Minimum Access Standard (GFM)**
  - **Commencement Time ≤ 30 ms**
  - **Rise Time ≤ 80 ms** (or longer if agreed by AEMO and the Network Operator)
  - response must be **Adequately Controlled**
- Applies where AEMO and the Network Operator require a response duration of **450 ms or less**
- Forms part of the disturbance ride-through and contingency response framework for inverter-based resources
- Automatic Access Standard currently deferred, with the corresponding Minimum Access Standard applying

Other Critical Technical Requirements

New Technical Requirement

A12.4.3.9–A12.4.3.10 – Oscillation Damping and Control System Bandwidth

Minimum Access Standard (GFM)

- operation of the Generating System must **not degrade the damping of power system oscillations**
- operation of the Generating System must be **Adequately Controlled**
- the relevant **Control System Bandwidth** must be documented as part of the Registered Generator Performance Standard

- Evidence of converter control bandwidth must be provided by the Market Participant
- AEMO and the Network Operator may assume a default bandwidth limit of **100 Hz** if sufficient evidence is not provided
- Automatic Access Standard same as Minimum Access Standard at this stage
- Detailed assessment methodology to be specified through supporting guidelines and procedures

Accompanying Publications

Western Power intends to publish the following supporting documents, following public consultation and **prior to the commencement of the amended ESM Rules**:

- **GPS Technical Requirements Guideline** (required under clause 3A.4.4), providing guidance, interpretation and worked examples for the new technical requirements and access standards*.
- **GPS Submission Template** to support the consistent preparation and submission of Generator Performance Standards.
- **GPS Report Template** to standardise the assessment and documentation of compliance with Generator Performance Standards.

* Over time, the content of the guidelines will be formalised through a WEM Procedure.

Transitional Arrangements for proponents with an Arrangement for Access or by agreement

New proposed clause 3A.5.1A

Clarifies how Proposed GPS are to be assessed if amendments to the Technical Requirements are made.

An exception has been applied if an ***Arrangement for Access*** has been executed before the amended Technical Requirements commence.

In those circumstances:

• the Proposed GPS will continue to be assessed against the version of the Technical Requirements that applied before the amendments commenced, or

• ***if the Market Participant and the Network Operator agree*** that the amended Technical Requirements should apply, the Network Operator must assess the Proposed GPS under clause 3A.5 using the Technical Requirements that are in force at the time of the assessment.

Rationale

- Avoids reassessment of projects that have materially progressed through the connection process
- Minimises rework by retaining completed technical assessments
- Allows amended Technical Requirements to be adopted by agreement, supporting project-specific and locational needs

Technical Requirements for Relevant Generator Modification

New proposed clause 3A.5.1B

Clarifies that where a Market Participant is required to submit a Proposed GPS for a Relevant Generator Modification, the Proposed GPS will be assessed against the Technical Requirements that applied when the Network Operator declared the modification to be a Relevant Generator Modification.

Rationale

Ensures assessment certainty by applying the Technical Requirements in force at the time a modification is declared.

Next Steps

Consultation Open

Submissions on the **Exposure Draft close at 5:00 pm (AWST) on 21 September 2026**, while submissions on the **Consultation Paper close at 5:00 pm (AWST) on 29 September 2026.**

Stakeholder submissions should be sent to **energymarkets@deed.wa.gov.au**

Following Consultation

Consultation Paper: Stakeholder feedback will inform the drafting of an Information Paper and Exposure Draft

Exposure Draft: The final ESM Amending Rules, considering stakeholder feedback will be submitted to the Minister for Energy for approval

Appendix

Summary of deferred Automatic Access Standards for GFM

Technical Requirement	GFM - Automatic Access Standard	Reason (if applicable)
Withstand Short Circuit Ratio (SCR)	Not proposed	Defer pending further development of the WA system strength framework
Voltage Phase Angle Jump	Same as MAS	Consistent with the broader interim approach adopted for the current GFM framework, the MAS is being clarified first, with any higher-tier GFM requirements to identified and developed (where necessary)
Reactive current commencement time during contingencies	Same as MAS	
Reactive current rise time during contingencies	Same as MAS	
Negative-sequence control during contingencies	Not proposed	Defer AAS (and MAS) for future consideration
Fault ride-through activation thresholds	Not proposed	A well-designed GFM inverter operating as a voltage source would generally produce a sub-cycle response before voltage reaches the 80% threshold
Active power recovery following contingencies	Not proposed	Deferred pending further development and experience
Damping of power system oscillations	Not applicable	Requirement around oscillation-neutral behaviour instead, to allows compliant behaviour to be achieved through appropriate control-system design and tuning without imposing disproportionate costs

Summary of refined A12 Technical Requirements

Technical Requirement	Dec 2025 feedback	Change on Dec 2025
Withstand Short Circuit Ratio (SCR) capability	Concerns over approach	MAS modified / AAS deferred
Settings used to demonstrate Withstand SCR	Concerns over approach	Retained - for further consideration
Voltage Phase Angle Jump	Concerns over duplication of requirements	Retained and clarified
Reactive current commencement time during contingencies	Flexibility requested; concerns over over-prescription	AAS retained / MAS modified
Reactive current rise time during contingencies	Flexibility requested	MAS retained / AAS modified / clarifications made
Negative-sequence control during contingencies	Generally supported; cautioned against making early prescription for GFM	MAS retained / GFM requirements deferred
Behaviour at current limitation during contingencies	Stakeholder feedback on this item was generally limited and largely supportive	Retained
Frequency of current injection during contingencies	Concerns over a strict requirement for injected current frequency to always match terminal voltage frequency to be inappropriate for GFM technologies	Retained
Fast opposition of voltage magnitude changes	Concerns that it be difficult to objectively assess and may duplicate capabilities already inherent to GFM	Retained
Fault ride-through activation thresholds	Concerns over fixed thresholds	Retained and clarified

Technical Requirement	Dec 2025 feedback	Change on Dec 2025
Use of total current during contingencies	Generally supported; more clarification requested	Retained and clarified
Active power recovery following contingencies	Little substantive comment received	Retained
Reactive current sustainment time during contingencies	Generally supported; more clarity requested	Modified and clarified
Reactive current injection ratio during contingencies	Supportive of moving away from the existing fixed reactive current injection ratio requirement	Modified
Long duration faults	Generally supportive; more clarity was requested	Retained
Disturbance ride-through for multiple disturbances	Generally supported; more clarity requested	Retained and clarified
Damping of power system oscillations	Generally supported; some concerns over over-prescription	Retained and clarified
Partial load rejection	Generally supported; more clarity requested	Retained and clarified
Instability detection mechanism	Intent generally supported; some concern over approach	Retained

GOVERNMENT OF WESTERN AUSTRALIA

Department of
Energy and Economic Diversification

Thank you