Australian Energy Market Commission

RULE

Draft rule determination

National Electricity Amendment (Improving the NEM access standards – Package 2) Rule 2026

Proponents

AEMO

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About the AEMC
The AEMC reports to the energy ministers. We have two functions. We make and amend the national electricity, gas and energy retail rules and conduct independent reviews for the energy ministers.

Acknowledgement of Country
The AEMC acknowledges and shows respect for the traditional custodians of the many different lands across Australia on which we all live and work. We pay respect to all Elders past and present and the continuing connection of Aboriginal and Torres Strait Islander peoples to Country. The AEMC office is located on the land traditionally owned by the Gadigal people of the Eora nation.

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Summary

1 Australia is experiencing rapid growth in critical digital infrastructure, particularly data centres, driven by cloud computing, artificial intelligence (AI) and the expansion of digital services. Efficiently connecting these facilities to the NEM while maintaining power system security requires clear, pragmatic technical standards.

2 The National Electricity Rules (NER) access standards define the permissible range of technical performance requirements that connection applicants must meet before being allowed to connect to the National Electricity Market (NEM). By providing a clear, enforceable framework, access standards enable the timely connection of large loads such as data centres and the realisation of their economic benefits while maintaining power system security and stability.[1]

3 Data centres tend to be highly energy intensive, currently consuming approximately 3.9 terawatt hours (TWh) of energy annually, or 2 per cent of Australia's annual electricity consumption. Oxford Economics' projections, developed for AEMO, indicate this consumption is set to rise to approximately 32 TWh, or 12 per cent by 2050.[2] At the same time, data centres are expected to invest billions of dollars into grid infrastructure and renewable energy generation,[3] contributing to Australia's emissions reduction goals.[4]

4 Importantly, data centres are predominantly connected using inverter based technology, similar to that used by wind and solar generation, which introduces new challenges for power system security. They can place significant stress on local networks, and are often clustered around key distribution network nodes.

5 These risks cannot be adequately managed by the existing NER framework. This issue presents itself in two ways.

6 First, the NER framework for technical access standards was originally designed for a system dominated by conventional, synchronous generation and relatively passive load. Accordingly, the NER does not clearly distinguish between small or passive loads, and large inverter based loads (IBLs) that have asynchronous generator-like impacts on power system security. This creates uncertainty for proponents about the applicable access standards and can lead to inconsistent treatment of plant and technology connection requirements across network service providers (NSPs).

7 Moreover, there is an increased risk that technical requirements under the NER are being inconsistently or inappropriately applied. The Commission understands this can lead to misaligned incentives and unintended cost outcomes. For instance, NSPs are primarily incentivised to manage impacts within their own networks for which they are accountable. Where upstream transmission-level risks are not fully understood or assessed for a distribution connection, the burden of managing these risks may fall on an NSP that is not responsible for them. The Australian Energy Market Operator (AEMO) may need to manage these risks through operational interventions, such as constraints or the procurement of frequency control ancillary services (FCAS). Together, this can increase system costs which are ultimately borne by the

1 The Commission notes that the Australian federal government seeks to support the growth and connection of data centres, to ensure the secure, onshore storage of data, consistent with Australia's data sovereignty objectives. For more information, see: Australian Government Department of Industry, Science and Resources, National AI plan, 2025.

2 Oxford Economics, Data Centre Energy Demand, Final Report, July 2025, pp 3-4. Note, this report was developed for the Australian Energy Market Operator (AEMO) to inform the 2025 Electricity Statement of Opportunities and the 2026 Integrated System Plan.

3 Mandala Report, Data Centres as Enabling Infrastructure, November 2025, p 2.

4 To help drive the transition to net zero, the Australian Government has set a target to reduce emissions to 62-70% below 2005 levels by 2035. See DCCEEW, Net Zero, November 2025.

broader consumer base, rather than being efficiently allocated to the parties responsible for the harm.

8 Second, the emerging challenges to system security posed by large loads using inverter-based technology require new access standards that address them, similar to those that apply to generators. It is especially important for these loads to ride through credible grid disturbances to avoid cascading outages or even system black events, which can drive up costs for the broader consumer base.

9 We have already seen international examples of major disruption caused by data centres in jurisdictions such as Ireland, Virginia, and Texas, with some of these jurisdictions going so far as to place moratoriums on new data centre developments.[5]

10 As a result, data centres and other large IBLs cannot be treated as passive loads, and their potential impacts on power system stability and security must be considered when seeking connection to the NEM.

The Commission has made a draft rule that would address the risks posed by large IBL connections

11 To help manage these risks, the Australian Energy Market Commission (AEMC or Commission) has made a more preferable draft rule (hereinafter 'draft rule') that introduces new access standards and a clear regulatory framework for determining when and to whom they apply. This is in response to three consolidated rule change requests from the AEMO and Rod Hughes Consulting (hereinafter '*Improving the NEM access standards - Package 2*') that aim to ensure the NER access standards are appropriate for connecting participants and their evolving technologies.

12 Importantly, the draft rule prioritises the secure and reliable operation of the power system by recognising the technical impact of large IBLs and introducing new technical access standard requirements in Schedule 5.3 of the NER, which would ensure overall system costs from managing system security issues do not increase and are not passed onto consumers.

13 The draft rule also ensures a proportionate application of technical access standards, which means that technical and compliance costs would be commensurate with a load's interaction with and impact on power system security. This would be achieved through a tiered framework for classifying IBLs, including large IBLs, seeking to connect to a distribution network. The Commission has not proposed a new classification framework for large IBLs connecting at the transmission level, or to those that have opted to be registered under the NER, as all of the Schedule 5.3 access standards currently apply automatically.

14 The Commission has sought to align the new access standards in the draft rule with those in comparable international jurisdictions. If Australia's access standards align with practices in other mature markets, investors could reuse feasibility studies, grid-integration assumptions, and risk models developed for other jurisdictions, thereby reducing technical and regulatory incompatibilities that may deter investment in large loads for the NEM. Further, this approach would benefit connecting loads, such as large data centres, because original equipment manufacturers (OEMs) who supply standardised load equipment would be better able to do so in Australia. This would shorten procurement, reduce engineering hours, and lower equipment integration risk for the NEM. Those savings would flow directly into lower capex and faster commissioning for data centre developers, whilst ensuring system security is maintained.

5 For example, Ireland placed a three-year moratorium on new data centre developments. See Commission for Regulation of Utilities, Large Energy Users connection policy, Proposed Decision Paper CRU/202504, February 2025.

The Commission's draft rule would also make targeted reforms to the broader access standards framework

15 The Commission's draft rule also makes improvements to technical standards that apply to generating systems and integrated resource systems, high voltage direct current (HVDC) networks, and loads. This includes standards for:

- Power system stability and protection
- System strength
- Under frequency load shedding (UFLS)
- The scope of credible contingency events
- Plant testing, including as part of commissioning
- Compliance and enforcement.

16 For implementing the draft rule, the Commission proposes transitional arrangements for determining whether connection processes that are ongoing at rule commencement should use new or old access standards. We propose that the rule commence when the final rule is published so that connecting parties could immediately apply the improvements to the NER technical access standards and the accompanying regulatory framework.[6]

17 By providing a clear and robust regulatory framework with a practical implementation pathway, the draft rule would enhance transparency and certainty, helping maintain Australia's attractiveness as a destination for data centre investment and supporting the continued growth of the digital economy.

18 This is important because, without a clear and fit-for-purpose framework to classify large IBLs and determine how the technical access standards apply to each category, NSPs may interpret and apply those standards inconsistently. This uncertainty can lead to delays in the connection process and result in real cost impacts. The Commission, therefore, considers that the draft rule's new technical connection requirements for proponents and NSPs would streamline grid connections, as these requirements would introduce a consistent application of technical standards across NSPs.

The Commission is seeking stakeholder feedback on our draft rule

19 The AEMC has worked closely with stakeholders to develop the draft rule, and we seek ongoing engagement in this rule change process. Our draft rule is informed by submissions to our consultation paper, contributions to our technical working group (TWG) process, which rigorously analysed the technical characteristics of large IBLs, engagement with the market bodies, and discussions with interested stakeholders.[7]

20 It has also been informed by AEMO's R*eview of the technical requirements for connection to the NEM contained in Chapter 5 of the NER* (Access Standards Review) and the extensive stakeholder feedback received through that process. We have explicitly leveraged AEMO's prior technical analysis and consultation and built on it with our own analysis and consultation. In particular, we further developed the work AEMO commenced on defining and classifying 'large' loads, with the draft rule setting out a clear regulatory framework.

21 We are seeking feedback on our draft determination and rule by **7 May 2026**.

6 For more information, see Chapter 1 of this draft determination.

7 For more information on how stakeholder feedback has informed the draft rule, see Chapter 1 of this draft determination.

The draft rule would address the system security impacts of large IBL and improve the NEM access standards

The Commission's draft rule targets loads that are most likely to impact power system security

22 This rule change is primarily focused on large loads whose technical characteristics can materially impact system security and are not adequately addressed under the current NER framework.

23 Large IBLs, such as data centres , are connecting to the NEM at an unprecedented scale and pace. These facilities connect to the grid through actively controlled power electronic converters, meaning their behaviour during disturbances is shaped by software and control systems.

24 As a result, large IBLs can rapidly reduce or cease demand during voltage and frequency disturbances, interact dynamically with system strength, contribute limited fault current, and affect stability in weaker grid conditions. In aggregate, this behaviour can influence disturbance outcomes and, if not appropriately managed, increase the risk of cascading events.

25 By contrast, traditional non-IBL facilities such as mines, refineries and processing plants typically comprise heterogeneous motors and resistive processes that largely follow prevailing grid conditions and exhibit more predictable electrical behaviour. While these facilities may have significant aggregate demand, they do not generally present the same control-driven, grid-interactive characteristics.

26 The Commission has therefore targeted reform where the technical risk profile warrants it. This is a proportionate response that strengthens obligations for plant capable of materially affecting system security, while avoiding unnecessary regulatory burden on other load types.

The draft rule would promote efficient investment and regulatory certainty through a clear and transparent framework for classifying large IBL

27 The Commission's draft rule would establish a clear regulatory framework for classifying and applying the Schedule 5.3 access standards to large IBLs seeking to connect to distribution networks.

28 At present, the NER do not clearly distinguish between small or passive loads and large IBLs that may have grid-following generator-like impacts on system security. In practice, the 'large IBL' concept has been defined in AEMO's System Strength Impact Assessment Guidelines (SSIAG), which classifies IBLs as large if they are 5 MW or greater. While this concept was developed for the purposes of the system strength framework, it has increasingly been relied upon more broadly in connection processes to inform the application of access standards.

29 The Commission considers that this has led to uncertainty and inconsistent application of technical requirements across NSPs, with the SSIAG definition effectively shaping obligations beyond its original system strength context.

30 Under the draft rule, large IBL would no longer be defined or classified through the SSIAG. Instead, a clear and structured classification framework would be embedded directly within the NER to ensure Schedule 5.3 access standards are applied in a clear and consistent manner.

31 The classification framework would consist of three connection tiers for distribution-connected loads, as follows:

- Tier 1 connection: applies to IBL with a nameplate rating of up to 30 MW, and non-IBL regardless of its MW nameplate rating.

- Tier 2 connection: applies to IBL with a nameplate rating of at least 30 MW but less than 100 MW.
- Tier 3 connection: applies to IBL with a nameplate rating of 100 MW or greater.

32 Importantly, IBLs with a nameplate rating of 30 MW or greater would be classified as large IBL under the draft rule. This differs from the current threshold of 5 MW or greater, in AEMO's SSIAG.

33 The Schedule 5.3 access standards would apply to Tier 1 and Tier 2 connections at the discretion of NSPs, having regard to the expected impact of the connection on the quality and security of network services to other network users. For Tier 3 connections, the Schedule 5.3 access standards would automatically apply in their entirety, subject to the specific requirements in each access standard.

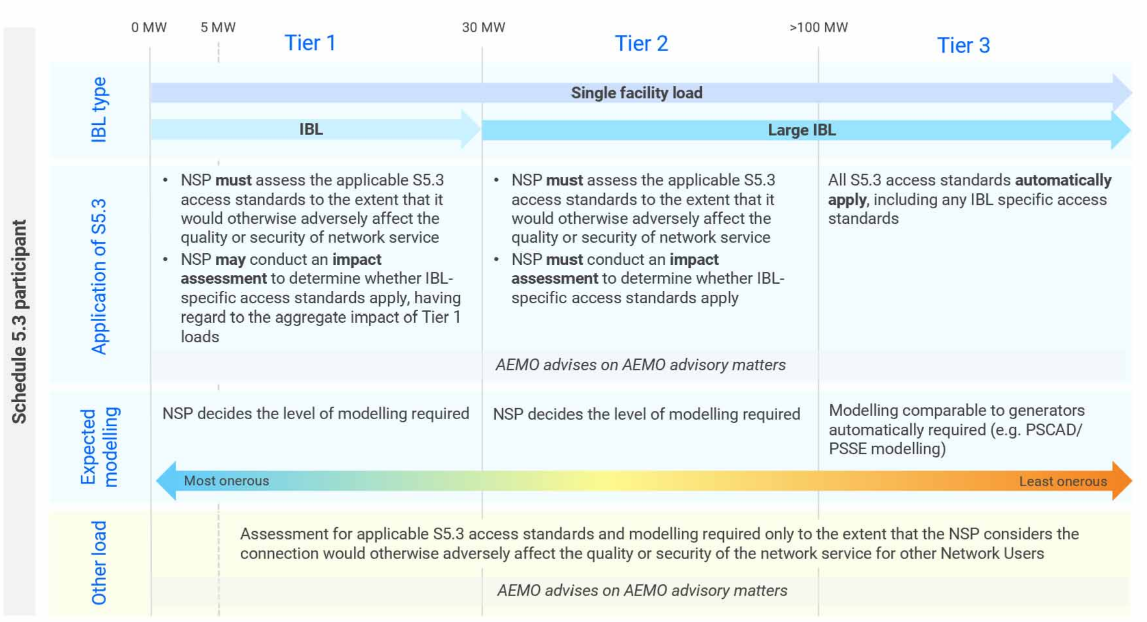
34 The Commission has not included a new classification framework for large IBLs connecting at the transmission level, or that have opted to be registered under the NER. This is because the Schedule 5.3 access standards currently apply automatically to all loads connecting to the transmission network and to registered participants.

35 The Commission carefully considered alternative approaches, including requiring all large IBLs to register with AEMO. We have not adopted that approach.

36 Mandating registration would represent a significant regulatory shift, with broader implications for compliance, governance and market participation. While it may have addressed certain visibility concerns, it would also impose substantial administrative and cost burdens on proponents, regardless of their actual system impact.

37 Instead, the Commission has prioritised a measured response that would target the technical risks identified, without unnecessarily expanding the registration regime.

Figure 1: Classification tiering structure for distribution connections under Schedule 5.3 of the NER



Source: AEMC

Note: The 5 MW dotted line is to recognise that standalone loads below 5 MW are unlikely to adversely affect power system quality or security for other network users.

38 Moreover, the draft rule would also strengthen the compliance framework for Schedule 5 plant to

ensure that negotiated performance standards are meaningful, enforceable and transparent. Specifically:

- under clause 4.14(n) of the NER, AEMO is required to establish and maintain a formal register of the performance standards applicable to Registered Participants' plant. The draft rule seeks to extend the application of this clause to all Schedule 5 Participants. It is a light-touch approach that would ensure AEMO and the Australian Energy Regulator (AER) have complete visibility over all performance standards made in accordance with Schedules 5.2, 5.3 and 5.3a, regardless of registration status
- the draft rule would require connection agreements with non-registered participants to include terms and conditions that provide reasonable assurance from the connection applicant of ongoing compliance with the performance standards, in a manner consistent with good electricity industry practice. This could materially improve compliance outcomes for unregistered Schedule 5 Participants by leveraging private contractual arrangements as a practical enforcement mechanism.

The draft rule would ensure system security and reliability by introducing new disturbance ride-through access standards

39 The Commission's draft rule introduces new access standards that would require large IBLs to ride through specified voltage and frequency disturbances, including post-fault active power recovery requirements.

40 This reform addresses a critical system security gap that is emerging in the NEM. Large loads that rapidly disconnect during disturbances can worsen system events and increase the likelihood of cascading outages or system black events, which would disrupt supply and increase costs for customers.

41 Requiring disturbance ride-through capability would therefore:

- strengthen power system resilience
- reduce reliance on costly operational interventions.

42 The standards are calibrated to be technically achievable and proportionate, and have been informed by international developments to promote investment certainty in Australia.

43 Under the draft rule, IBLs would also be required to provide information on their ride-through capability to the NSP and AEMO, at the NSP's request. Improving NSPs' and AEMO's visibility of this ride-through performance would enable them to better manage the system security impacts of large loads at a lower cost to consumers, as they would not need to rely on conservative assumptions.

44 Further, the draft rule would clarify and restrict the scope of credible contingency events that Schedule 5.2 plant must ride-through during a disturbance, improving transparency and predictability in performance standard negotiations.

The draft would support power system stability through strengthened access standards and clearer technical definitions

45 The draft rule would introduce a new access standard for large IBL to detect, respond to, and avoid causing instability. This would improve power system security by helping to manage the impacts that large IBL may have on system stability. This is important because if instability is not managed, it could lead to plant disconnections and potentially a system black, compromising the security and stability of the NEM.

46 The draft rule would also formally define primary and back-up protection systems in the NER to clarify protection requirements throughout the Chapter 5 schedules. Clear, simple definitions would support system security and an efficient connections process while maintaining flexibility for different plant types and sizes.

The draft rule would support efficient system strength outcomes by making requirements fit-for-purpose for IBLs and HVDC links

47 The Commission's draft rule would refine the application of system strength requirements to ensure they are proportionate and targeted.

48 First, the draft rule would limit the application of short circuit ratio requirements to large inverter based loads (greater than 30 MW), consistent with the tiering framework described above. This recognises that smaller loads are unlikely to have a material impact on system strength or voltage stability at a system level and aligns regulatory requirements with technical risk.

49 Second, the draft rule would enable HVDC link operators to procure system strength services from third parties. Under the current framework, HVDC proponents are required to develop their own dedicated system strength solutions, even where suitable strength services already exist or could be provided more efficiently by others. The draft rule allows HVDC operators to contract for system strength from existing providers, such as synchronous condensers or generators, where this meets the required performance standard.

50 This reform would encourage more efficient and cooperative outcomes. It reduces the risk of duplicative investment in system strength infrastructure, promotes the use of existing assets, and supports competitive provision of system strength services. It also facilitates more coordinated network development, particularly in regions where multiple parties are seeking to connect.

The Commission's draft rule would promote system security and regulatory clarity through targeted improvements to Chapter 5 of the NER

51 The Commission's draft rule would make targeted improvements to Chapter 5 of the NER, in support of the broader technical access standards framework. Specifically, the draft rule would:

- allow under-frequency load shedding through fast ramp-down, where technically feasible, rather than requiring disconnection in blocks
- enable all Schedule 5 plant to be subject to requests for testing or assessments, where there are reasonable grounds to suspect non-compliance with the NER or applicable performance standards, and allow all Schedule 5 Participants to be able to request testing or assessment of Schedule 5 plant (regardless of registration status)
- provide AEMO with flexibility to extend timeframes for future access standards reviews, subject to transparency guardrails.

52 Together, these reforms would improve system security oversight, support innovation, and reflect the increasing number of non-registered plant connecting to the NEM.

We assessed our more preferable draft rule against three assessment criteria using regulatory impact analysis and stakeholder feedback

53 The Commission has considered the National Electricity Objective (NEO),[8] and the issues raised in the rule change request and assessed the more preferable draft rule against three assessment

8 Section 7 of the NEL.

criteria outlined below. We gathered stakeholder feedback and undertook regulatory impact analysis in relation to these criteria.

54 The more preferable draft rule would contribute to achieving the NEO in the following ways:

- **Safety, security and reliability:** The draft rule would promote the safe, reliable, and secure operation of the power system at least cost. The operational security of the power system depends on whether the connecting plant and equipment can operate within the technical access standards contained in the NER and not present significant system security risks. Improving access standards would ensure alignment with safe, secure and reliable system performance and improve power system resilience.
- **Innovation and flexibility:** The draft rule would promote innovation and flexibility because it improves the NEM access standards from the perspective of process innovations and provides the right amount of flexibility for connection applicants, NSPs and AEMO to find solutions to system security issues.
- **Implementation considerations:** The draft rule takes a practical approach to implementation. This includes timing, interrelationships with other reforms and processes, and benefits or adverse consequences for industry and consumers. We have considered the cost and complexity of implementation, as well as the ongoing regulatory and administrative costs for all market bodies, participants, and consumers. The draft rule also provides clarity on the roles of market bodies and participants, supporting efficient investment and operational decisions, and promoting transparency and predictability.

How to make a submission

We encourage you to make a submission

Stakeholders can help shape the solution by participating in the rule change process. Engaging with stakeholders helps us understand the potential impacts of our decisions and contributes to well-informed, high quality rule changes.

How to make a written submission

Due date: Written submissions responding to this draft determination and rule must be lodged with Commission by **7 May 2026 (8 weeks)**.

How to make a submission: Go to the Commission's website, www.aemc.gov.au, find the "lodge a submission" function under the "Contact Us" tab, and select the project reference code **ERC0394**.[9]

Tips for making submissions on rule change requests are available on our website.[10]

Publication: The Commission publishes submissions on its website. However, we will not publish parts of a submission that we agree are confidential, or that we consider inappropriate (for example offensive or defamatory content, or content that is likely to infringe intellectual property rights).[11]

Next steps and opportunities for engagement

There are other opportunities for you to engage with us, such as one-on-one discussions or industry briefing sessions.

The final determination is due to be published by mid to late 2026.

You can also request the Commission to hold a public hearing in relation to this draft rule determination.[12]

Due date: Requests for a hearing must be lodged with the Commission by 19 March 2026.

How to request a hearing: Go to the Commission's website, www.aemc.gov.au, find the 'lodge a submission' function under the 'Contact Us' tab, and select the project reference code **ERC0394**. Specify in the comment field that you are requesting a hearing rather than making a submission.[13]

For more information, you can contact us

Please contact the project leader with questions or feedback at any stage via the form on our website.

9 If you are not able to lodge a submission online, please contact us and we will provide instructions for alternative methods to lodge the submission

10 See: https://www.aemc.gov.au/our-work/changing-energy-rules-unique-process/making-rule-change-request/our-work-3

11 Further information about publication of submissions and our privacy policy can be found here: https://www.aemc.gov.au/contact-us/lodge-submission

12 Section 101(1a) of the NEL.

13 If you are not able to lodge a request online, please contact us and we will provide instructions for alternative methods to lodge the request.

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Appendices

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1 The Commission has made a more preferable draft rule determination

This draft determination is to make a more preferable draft rule (hereinafter, draft rule) in response to three consolidated rule change requests from the Australian Energy Market Operator (AEMO) and Rod Hughes Consulting to improve the technical access standards in the National Electricity Rules (NER) for connection to the National Electricity Market (NEM).[14] The draft rule would improve the technical requirements for loads and other plant types connecting to the NEM (known as access standards) contained in Chapter 5 of the NER and its accompanying schedules. It also makes a series of corresponding changes to Chapter 10 of the NER (the Glossary) and consequential changes to a number of clauses throughout the NER. We are seeking feedback on this draft rule.

In this chapter:

- Section 1.1 provides context for this rule change, with reference to AEMO's requirement to review the NER technical standards once every five years.
- Section 1.2 outlines that the draft rule would improve the NEM access standards and the regulatory framework for applying them.
- Section 1.3 explains how the Commission has clarified the relationship between Schedule 5 Participants and Registered Participants.
- Section 1.4 explains how stakeholder consultation informed our draft determination and draft rule.
- Section 1.5 outlines the transitional arrangements in the draft rule.
- Section 1.6 provides an overview of the remaining chapters in this draft determination.

1.1 AEMO is required to review the access standards every five years

Under the NER, at least once every five years, AEMO must review some or all of the technical requirements (access standards) set out in schedules 5.2, 5.3, and 5.3a of the NER to assess whether they should be amended.[15] Each of those NER schedules that set out technical requirements applies to different connecting parties as follows:

- Schedule 5.2 — sets out technical connection requirements for generating systems, integrated resource systems, and synchronous condensers.
- Schedule 5.3 — sets out technical connection requirements for loads, which includes inverter based loads (IBLs) and non-inverter based loads (non-IBLs).
- Schedule 5.3a — sets out technical connection requirements for high voltage direct current networks.

The requirement to review these schedules was introduced through the Commission's *Generator technical performance standards* final determination and rule in 2018. This rule followed the *Independent review into the future security of the national electricity market* led by Dr Alan Finkel AO in 2016, which recommended regular and comprehensive reviews of the technical access standards. Our final determination recognised that:[16]

14 For a detailed overview of each of the rule change requests, see: AEMC, *Improving the NEM access standards - Package 2*, Consultation paper, May 2025, Chapter 1.

15 NER clause 5.2.6A.

16 AEMC, *Generator technical performance standards*, Final determination, 27 September 2018, p i.

> The power system is experiencing a period of change as traditional forms of large-scale, synchronous generation are retiring and being replaced by intermittent, asynchronous and increasingly distributed generation. This shift presents challenges for the secure operation of the power system. In particular, it is becoming more difficult to effectively control frequency and voltage, which could lead to significant power system disturbances and potentially blackouts.

As such, connection standards for Schedule 5 Participants are essential for ensuring that their capabilities and settings are appropriate for meeting system needs (see Box 1). This includes technical requirements such as frequency control, voltage control, and response to power system disturbances.

When conducting the reviews, AEMO must have regard to:[17]

- the National Electricity Objective (NEO)
- the need to achieve and maintain power system security
- changes in power system conditions
- changes in technology capabilities of facilities and plant.

Box 1: Access standards play an increasingly important role in the NEM

To establish a new connection under Chapter 5 of the NER (following the process in rule 5.3 or 5.3A), a connection applicant and the connecting network service provider (NSP) must agree on a set of performance standards for the connecting plant within the parameters set by the access standards in the applicable schedule (Schedules 5.2, 5.3 or 5.3a). Each access standard relates to a technical requirement for the performance of the connecting plant, regarding its impact on the broader power system. Most (but not all) access standards have two components:

- Automatic access standard (AAS) — a connection application cannot be refused if it meets this standard.
- Minimum access standard (MAS) — a connection application must be refused if the plant does not meet this.

This format with a permissible range of access standards was established after a 2001 review by the then National Electricity Code Administrator (NECA), which found that mandatory fixed access standards were inefficient. NECA noted that the cost of meeting those standards will vary dramatically for different types of plants. Some could significantly overachieve against a mandatory standard at low cost, while others may only be able to achieve that standard at prohibitive costs. In addition, the need for plant to meet a mandatory level of technical performance was likely to vary between different locations within the NEM. In light of this, NECA introduced flexibility in access standards by specifying a negotiating range, subject to a mandated minimum.

Once the proposed access standards are agreed upon (with AEMO approval where required), they become the performance standards for the relevant plant and are included in the binding connection agreement between the connection applicant and the NSP. Where applicants are (or will be) registered participants, the performance standards must be registered with AEMO, and an ongoing compliance regime will apply under rule 4.15. This format of access standards has largely been preserved since this time

Source: AEMC, *Improving the NEM access standards* consultation paper, May 2025, p 3.

17 NER clause 5.2.6A(a)(1)-(4).

In December 2023, AEMO completed its first review of the technical requirements for connecting to the NEM and identified numerous opportunities to improve the NER access standards and their application. They then submitted two rule change requests to the Australian Energy Market Commission (AEMC or Commission) in April 2024 to give effect to the final recommendations from the Access Standards Review.

1.2 The draft rule would improve the NEM access standards and the regulatory framework for applying them

The Commission has made a draft rule that strengthens and modernises the technical access standards framework in the NER. These changes recognise:

- Large IBLs, such as data centres, are increasingly seeking connection to the NEM at a scale and pace not previously observed.
- The technical characteristics of these large IBLs present novel and evolving opportunities and challenges for power system security and reliability, which must be addressed. This is especially important because the behaviour of large IBLs in response to grid disturbances can create risks for power system security.
- There is a strong need for greater clarity in the NER to promote the consistent, transparent application of access standards, particularly in relation to these large loads.

Accordingly, the draft rule would:

- Establish a clear and transparent framework for classifying large IBLs that seek connection at the distribution level, because unlike for transmission connections, the application of the Schedule 5.3 access standards to distribution connections is unclear and needs modernising. By introducing a structured tiering approach under Schedule 5.3, the rules (if made) would provide greater certainty as to how the access standards apply to emerging load technologies connecting to distribution networks. This would ensure that technical requirements are proportionate to a load's characteristics and its potential impact on power system security.
- Introduce new disturbance ride-through access standard requirements for IBLs. These standards address voltage and frequency disturbances, as well as post-fault active power recovery, and are designed to mitigate the risk of cascading outages and sudden load disconnection during credible contingency events. This would have the effect of strengthening the resilience of the power system in an environment of increasing inverter based participation.
- Clarify and restrict the scope of credible contingency events that Schedule 5.2 plant is required to ride-through in response to a grid disturbance. This would provide Schedule 5.2 Participants with greater clarity and predictability as to the application of disturbance ride through access standards.
- Enhance power system stability and protection arrangements, through new access standards relating to instability detection and response for large IBLs, and clarify protection system definitions and obligations across Chapter 5. These amendments would promote a consistent and technically robust approach to protection and dynamic performance requirements.
- Make system strength obligations more proportionate and flexible. By limiting the application of short circuit ratio requirements to large IBLs and providing flexibility in their application, as well as enabling high voltage direct current (HVDC) links to procure system strength from third parties, this would support efficient investment outcomes while maintaining appropriate system security safeguards.

- Promote flexibility, as the draft rule would allow loads to disconnect by way of fast ramp down where technically possible, rather than disconnecting in blocks, which may be inefficient.
- Improve compliance, testing and review mechanisms. It would expand testing rights for Schedule 5 participants, support more effective commissioning and ongoing compliance oversight, and provide appropriate flexibility for AEMO in future access standards reviews, subject to transparency guardrails.

Taken together, these reforms would modernise the NER to reflect the increasing penetration of inverter-based technologies across both generation and load, the growing scale and concentration of large loads such as data centres and hydrogen electrolysers, and the emerging system strength and disturbance risks and opportunities associated with these technologies. The draft rule would also promote a more consistent, transparent and predictable application of access standards across the NEM, supporting efficient investment while maintaining power system security and reliability in the long-term interests of consumers.

1.3 The Commission has clarified the relationship between Schedule 5 Participants and Registered Participants

Throughout our consultation with stakeholders to prepare the draft rule, the Commission observed that the relationship between Schedule 5 Participants and Registered Participants is somewhat unclear.

In *Improving the NEM access standards – Package 1*, the Commission introduced the defined term 'Schedule 5 Participant' to clarify the application of the technical access standards in Chapter 5 of the NER. A Schedule 5 Participant is, in simple terms, a connection applicant or party to a connection agreement who owns and operates the types of plant set out in Schedules 5.2, 5.3, and 5.3a of the NER, which includes generating systems, integrated resource systems (IRS), synchronous condensers, loads (both stand alone and part of an IRS), distribution networks, and HVDC links.[18] These participants may be registered, or unregistered.

In essence, the term 'Schedule 5 Participant' operates as a drafting device to:

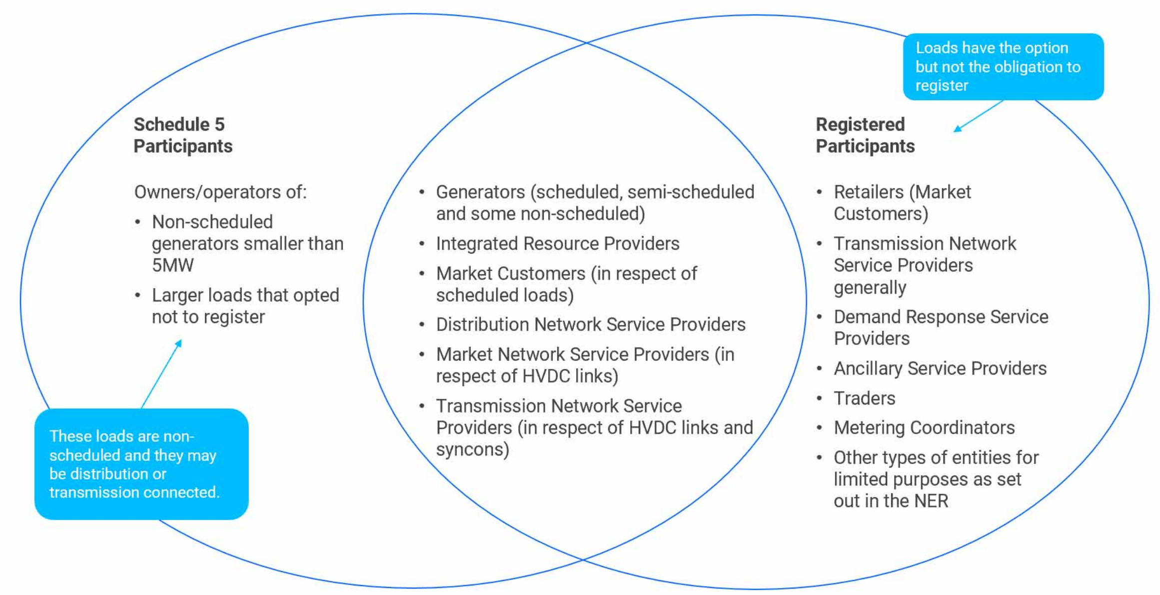
- identify the party responsible for compliance with Schedule 5 technical requirements
- distinguish those obligations from broader obligations that apply to Registered Participants generally.

In a modernised and increasingly complex NEM with increasing numbers of non-registered plant connecting, this clarity is necessary to support enforceability, regulatory certainty and the effective operation of the strengthened access standards framework.

The Commission has developed a Venn diagram (Figure 1.1) to help elucidate the relationship and overlap between Schedule 5 Participants and Registered Participants. The Commission welcomes feedback from stakeholders on how to promote clarity and consistency in this way.

18 For a comprehensive list, see pp 13-14 of AEMC, *Improving the NEM access standards - Package 1*, Final rule determination, 22 May 2025.

Figure 1.1: Relationship between Schedule 5 Participants and Registered Participants



Source: AEMC
Note: Smaller (e.g. residential) loads and distributed generation and storage are connected under Chapter 5A of the NER.

1.4 Stakeholder feedback shaped our determination

Stakeholder input and feedback have helped shape our draft determination.

On 8 May 2025, the Commission initiated this rule change and published a consultation paper. We received 29 submissions from a range of stakeholders across industry, including the market bodies, industry bodies, NSPs, and load operators, including data centres.[19] A constant theme among these submissions was the desire for the Commission to consider how to improve the regulatory framework for applying technical access standards under Chapter 5 of the NER. Stakeholders were also eager for the Commission to consult with industry and develop disturbance ride through access standards that would apply to IBLs for the draft rule.

In addressing this feedback, the Commission set up a technical working group (TWG) with more than 50 representatives across industry from NSPs, the market bodies, data centre load and generator operators, industry bodies, original equipment manufacturers (OEMs), and technical consulting firms. We conducted three sessions to:

- form an industry consensus on the technical characteristics of loads, particularly IBLs, and how they impact power system security based on these technical characteristics
- consider options for how we might define and classify large IBL
- explore whether we could better achieve the objectives in this rule change by introducing new ride through access standards that would apply to IBLs
- consider load modelling capabilities so that compliance with applicable access standards can be reasonably achieved
- explore the types of challenges and opportunities presented, as well as regulatory improvements being made in comparable international jurisdictions, so that our reforms can

19 Stakeholder submissions to the consultation paper are available on our website.

align as much as practicable, thereby reducing technical and regulatory incompatibilities that may deter investment in large loads for the NEM.

We received detailed technical feedback from the TWG representatives throughout these sessions, which has informed the draft rule.

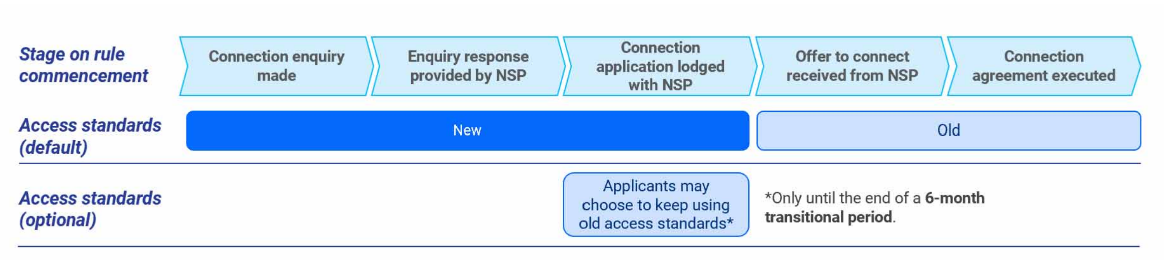
The Commission thanks our stakeholders for their eager engagement with this rule change process and looks forward to continued engagement on this rule change.

1.5 The draft rule includes transitional provisions to minimise disruption and ensure regulatory consistency

The Commission's draft rule includes transitional arrangements for the implementation of the final rule, if made. Transitional provisions are necessary for determining whether connection processes that are ongoing at rule commencement should use new or old access standards.

We propose that the rule would commence when the final rule is published so that connecting parties could immediately apply the improvements to the NER technical access standards and the accompanying regulatory framework. Under the draft rule, the old or new access standards would apply based on the application stage on rule commencement (see Figure 1.2 below).

Figure 1.2: The transitional arrangements would apply based on application stage



The Commission considers that the new access standards should apply by default for almost all connection processes underway, as the new access standards are particularly important for system security when connecting large loads.[20] However, we recognise that some connection applicants may be close to finalising negotiations with their NSP on the rule's commencement date. To minimise disruption for these connection applicants, the draft rule would allow them to continue using the old access standards, until the end of the transitional period, which would be six months.[21] The aim of this approach is to:

- minimise costly rework for connection applicants who have already completed a significant amount of work and are close to receiving an offer to connect
- minimise NSP and AEMO disruption with ongoing technical or modelling issues that may be being resolved.

The Commission notes that the amending rule would not change or alter the rights and responsibilities under existing connection agreements.[22]

20 Draft rule, clauses 1.[XXX].1; 11.[XXX].3.

21 Draft rule, clause 11.[XXX].4.

22 Draft rule, clause 11.[XXXX].5.

The transitional arrangements in the draft rule would also require AEMO to make amendments to the following guidelines within 12 months after the commencement date of the amending rule:[23]

- the Power System Model Guidelines (PSMG)
- the Power System Stability Guidelines (PSSG)
- the System Strength Impact Assessment Guidelines (SSIAG).

We consider that this approach contributes to the NEO, as it promotes system security by implementing the new access standards as soon as reasonably practicable. It would also implement the changes in a way that would not lead to perverse outcomes or excessive disruption to reasonably developed connection applications.

We are seeking stakeholder feedback on these draft arrangements to ensure the final rule is implemented smoothly.

1.6 Overview of paper structure

The remainder of this draft determination is structured as follows:

Chapter 2: Our draft rule addresses the system security risks from large load connections — examines the rapid growth in new large load connections, particularly IBLs, and analyses their technical characteristics and potential impacts on power system security. It outlines the system strength, stability and disturbance risks associated with these connections, providing the evidentiary basis for the draft rule's new load classification framework and targeted access standards.

Chapter 3: We have made a draft rule for classifying and defining large IBL — sets out the draft rule's tiered framework for classifying and applying the Schedule 5.3 access standards to distribution-connected plant, including large IBLs. It also outlines reforms to strengthen compliance, transparency and enforceability of negotiated performance standards.

Chapter 4: We have introduced disturbance ride-through access standards for loads and clarified requirements for generators — describes the draft rule introducing new disturbance ride-through access standards for IBLs, including voltage, frequency and post-fault recovery requirements, and clarifies the disturbance ride-through obligations applicable to generating systems and integrated resource systems.

Chapter 5: We have improved the power system stability and protection requirements — outlines the draft rule's reforms to improve power system stability and protection requirements, including new instability detection and response standards and clearer definitions and obligations for primary and back-up protection systems.

Chapter 6: We have improved the system strength access standards applicable to loads and HVDC links — explains the draft rule's amendments to the system strength framework, including proportionate short circuit ratio requirements for large IBLs and new flexibility for HVDC links to procure system strength from third parties.

Chapter 7: We have made further NER improvements to promote power system security and stability — details additional targeted improvements to Chapter 5, including greater flexibility for under-frequency load shedding via fast ramp down, expanded testing rights for Schedule 5 plant, and enhanced flexibility for AEMO in conducting future technical reviews, with appropriate guardrails.

23 Draft rule, clause 11.[XXX].6.

Chapter 8: The draft rule would promote the National Electricity Objective — assesses how the draft rule promotes the NEO, having regard to the Commission's assessment criteria, stakeholder feedback and regulatory impact analysis.

2 Our draft rule addresses the system security risks from large load connections

Box 2: Key points in this chapter

IBLs such as data centres are connecting to the NEM at a rapid pace

Large IBLs, including utility-scale data centres and hydrogen electrolyser facilities, are connecting to the NEM in increasing numbers as electrification accelerates and new sources of digital and industrial demand emerge. The scale of these facilities is material: individual connection applications can be comparable in size to mid-scale generation projects, and multiple projects are often proposed within the same geographic areas. This growth reflects broader structural trends, including the expansion of cloud computing and artificial intelligence (AI), the development of renewable hydrogen industries, and the electrification of energy-intensive processes, and is occurring at a pace not previously experienced in the NEM.

The Commission has analysed the technical characteristics of large IBLs and recognises their potential adverse impacts on system security

In light of this influx of large loads, submissions to our consultation paper called on the Commission to collaborate with industry, to collectively better understand the range of power electronic loads and how they may interact with the power system. In response, the Commission hosted a series of TWG meetings that were focused on understanding the technical characteristics of large loads and their interaction with power system security.

Through this process, the Commission observed that the technical characteristics of IBLs tend to distinguish them from some traditional large industrial loads, like smelters or mineral processing and mining facilities. Unlike synchronous, induction-based or other conventional loads, IBLs interface with the power system through power electronic converters. Their performance during disturbances, interaction with system strength, contribution to fault current and impact on voltage stability are determined by control systems and software rather than inherent electromechanical properties. The increasing scale, concentration and technical complexity of these facilities present novel and evolving challenges for power system security and reliability that must be addressed.

Traditional non-IBLs are not the focus of this rule change as their technical behaviour is more predictable and presents few system security risks

In this rule change, the Commission is less concerned with large non-IBL facilities, such as mines, processing facilities, refineries, airports and desalination plants. This is because, while such facilities may have high total demand, their aggregate load typically consists of smaller, heterogeneous processes that are more predictable and/or do not exhibit significant grid-interactive behaviours or dynamic responses that can materially impact power system security.

The Commission has analysed stakeholder feedback on the modelling capabilities of IBLs

In response to our consultation paper, many stakeholders made submissions expressing their views on the modelling capabilities of large loads, and called for greater guidance from AEMO (which must develop and maintain the PSMG per clause S5.5.7(a)(3) of the NER).

The modelling capability for IBLs is critical to demonstrating compliance with applicable access standards under the NER. The more control-dependent and dynamic the plant behaviour, the more sophisticated and plant-specific the model must be.

Without suitable plant-specific models, connection applicants may be unable to substantiate compliance, and this can lead to iterative assessment processes and uncertainty in performance standard negotiations, and potentially risk power system security.

The Commission has not made a draft rule with respect to requisite modelling, as AEMO's PSMG is better suited to provide this detail. However, the Commission has analysed stakeholder feedback to inform AEMO's update to the PSMG, which is required under the transitional arrangements of the draft rule.

In this chapter:

- Section 2.1 outlines the forecasted growth of large IBLs connecting to the NEM, with a particular focus on data centres and hydrogen electrolysers.
- Section 2.2 details the Commission's technical analysis of IBL technologies and how they can adversely impact power system security.
- Section 2.3 provides an overview of stakeholder feedback, calling on AEMO to provide more guidance on the modelling requirements for IBLs, to inform updates to the PSMG.

2.1 Large IBLs such as data centres and hydrogen electrolysers are increasingly seeking to connect to the NEM

Large IBLs, including data centres and hydrogen electrolysers, are increasingly seeking connection to the NEM at a scale and pace not previously observed.

Independent forecasts commissioned by AEMO and other studies show significant growth in data centre electricity consumption over the coming decade, enough to materially change local demand profiles in NSW and Victoria where many centres concentrate. Data centres currently consume approximately 3.9 terawatt hours (TWh) of energy annually, or 2 per cent of Australia's annual electricity consumption. Projections indicate this consumption is set to rise to approximately 12 per cent by 2050.[24] This growth is driven by continued digitalisation of the economy, expansion of hyperscale cloud services, artificial intelligence workloads and increasing domestic data sovereignty requirements.

Hydrogen electrolysers that use inverter-based technology may also increasingly connect to the NEM. However, AEMO's 2025 Electricity Statement of Opportunities (ESOO) made a downward revision in hydrogen production expectations due to project cancellations, reduced policy support and delayed green commodity demand.[25] Nevertheless, the long-term outlook remains contingent on policy settings, export market development and the economics of renewable hydrogen production. Accordingly, the connection of electrolysers remains a material consideration for system planning, particularly with respect to system security.

This section provides more detail on the anticipated growth of data centres and hydrogen electrolysers, as well as a general description of their technology type.

2.1.1 There is an influx of data centres connecting to the NEM

There are several types of data centres, designed to meet customer needs

A data centre is a specialised facility that houses servers used to store, process, and deliver vast amounts of data and information. These centres support a wide range of digital services that households and businesses rely on every day, such as streaming, banking, cloud storage, and

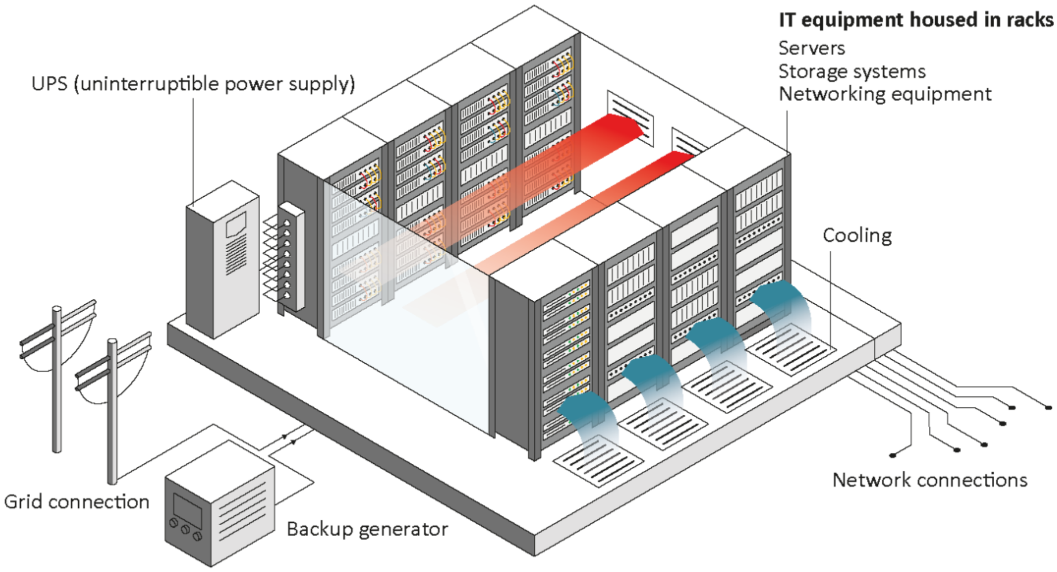
24 Oxford Economics, Data Centre Energy Demand, Final report, July 2025, pp 3-4.

25 AEMO, 2025 Electricity Statement of Opportunities, p 23.

communications. They are critical infrastructure for the functioning of modern digital life and a modern economy.[26]

The key components of a data centre typically include servers, storage systems, networking equipment, cooling and environmental control, uninterruptible power supply (UPS) systems, batteries, on-site back-up power generators, and other infrastructure such as lighting (see Figure 2.1).

Figure 2.1: Data centre components



Source: IEA, Energy and AI, World Energy Outlook Special Report, 2025, Figure 2.1, p 52.

There is a range of data centre types, modelled to suit varying business needs and the customers they serve. The most common commercial types in Australia are:[27]

- **Hyperscale cloud data centres**: these are very large-scale facilities operated by global cloud providers such as Amazon Web Services (AWS), NEXTDC, and AirTrunk. They are designed to deliver computing, storage, and network services at scale. They are typically developed to support the operations of a single organisation, enabling highly centralised control over cloud platforms, AI systems, and large-scale digital services.
- **Colocation facilities**: these are third-party facilities that service multiple tenants. Tenants lease physical space, power, cooling, and network connectivity to house their information technology (IT) equipment.
- **Enterprise facilities**: these tend to be operated by individual businesses for internal needs, such as telecommunications. They are typically smaller and located closer to end-users to provide services that require fast response times. They represent a small share of Australia's existing and prospective data centre development.

Data centres have historically tended to be located in NSW and Victoria, and their electricity demand is growing rapidly

Data centres are emerging as a significant and rapidly growing source of electricity demand within the NEM. There are currently approximately 268 listed data centres across Australia, the majority

26 Oxford Economics, Data Centre Energy Demand, Final report, July 2025, p 7.

27 Ibid.

of which are connected to the NEM (see Table 2.1). Collectively, these facilities consume around 3.9 terawatt hours (TWh) of electricity per annum, equivalent to approximately 2 per cent of national electricity consumption. Projections indicate that this share could increase materially, reaching up to 12 per cent of total electricity consumption by 2050 (see Figure 2.2).[28]

The underlying drivers of this expansion are structural and enduring. Rapid digitisation, growth in cloud computing, AI applications and data storage requirements have materially increased demand for processing capacity. In fact, Australia attracted $10 billion in data centre investment during 2024, making it the second-largest destination globally that year, after the USA.[29]

The growth we are seeing is geographically concentrated. Sydney remains the dominant hub for data centre development, with more than 1,820 MW of rated capacity added over the past decade, reflecting an average annual growth rate of approximately 14 per cent. Melbourne hosts the second-largest concentration, adding over 930 MW across the same period, at an average annual growth rate of 11 per cent.[30] This clustering effect has implications for local network congestion, system strength requirements, the power system's response to disturbances, and coordinated planning between NSPs and AEMO.

To date, the majority of data centre load has been connected at the distribution level, with only around 1.5 per cent of consumption currently transmission-connected. However, this is projected to change significantly. Oxford Economics forecasts that by 2030, approximately 32 per cent of data centre electricity consumption (around 2.0 TWh) will be connected directly to the transmission network, largely reflecting the scale of new hyperscale and AI-driven facilities, particularly in Melbourne.[31]

Accordingly, the regulatory framework must provide clear, transparent requirements across both distribution and transmission networks for NSPs and connection applicants alike to accommodate this anticipated growth while maintaining power system security.

The Commission also notes that several workstreams are underway, being progressed by AEMO, the AEMC, and the jurisdictions, to improve regulatory frameworks, with a particular focus on data centres.[32]

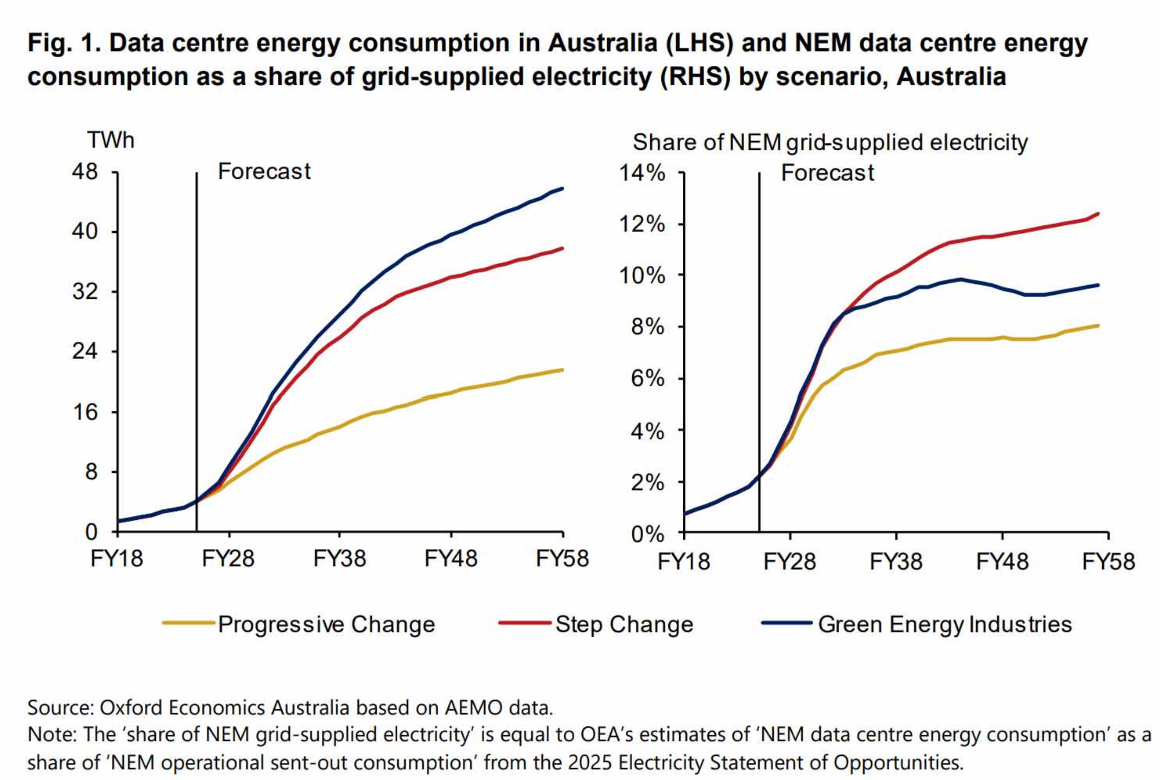
Table 2.1: Data centres across Australia

Market	No. of data centres
Sydney	90
Melbourne	51
Perth	26
Brisbane	24
Canberra	18
Adelaide	18

Source: Data Centre Map, Australia Data Centres (as at February 2026)

28 Ibid., pp 3-4.
29 Australian Government Department of Industry, Science and Resources, National AI plan, 2025, p 6.
30 Oxford Economics, Data Centre Energy Demand, Final Report, July 2025, p 8.
31 Ibid., p 5.
32 For more information, see Appendix B.

Figure 2.2: Data centre electricity consumption in Australia



Source: Oxford Economics, Data Centre Energy Demand, Final report, July 2025, p 4. This report was published as part of AEMO's 2025-26 Inputs, Assumptions and Scenarios Report.

2.1.2 There is potential for increased hydrogen electrolyser connections

Hydrogen electrolysers that use inverter-based technology may also increasingly connect to the NEM. However, the Commission notes that most projects remain at the feasibility or engineering stage.

Hydrogen manufacturing via electrolysis requires a dedicated or grid-connected electricity supply, as it uses electricity to split water into hydrogen and oxygen.[33] If developed at scale, hydrogen manufacturing has the potential to significantly impact NEM demand and system security, depending on the specific characteristics of each connecting plant, its location, and the extent to which load is met by generation behind the connection point from the grid.

The federal government has an ambition for Australia to be a global hydrogen leader. According to the Department of Climate Change, Energy, the Environment and Water (DCCEEW), alongside renewable electricity, hydrogen will play a significant role in decarbonising our economy. The National Hydrogen Strategy notes that Australia already has a globally significant project pipeline of more than 100 projects announced since 2019, representing 20 per cent of all announced projects globally.[34]

33 North American Reliability Corporation (NERC),Characterisation and Risks of Emerging Large Loads, White Paper, July 2025, p 15.

34 DCCEEW, National Hydrogen Strategy, 2024.

Nevertheless, AEMO's 2025 Electricity Statement of Opportunities (ESOO) made a downward revision in hydrogen production expectations due to project cancellations, reduced policy support and delayed green commodity demand.[35]

2.2 The Commission examined the technical characteristics of large loads to understand how they may impact power system security

For the Commission to assess the contribution of the draft rule to the NEO, it is important to examine the technical characteristics of large loads, as their electrical behaviour determines how they interact with the power system during normal operation and disturbances. Understanding factors such as system strength interaction, ride-through capability and dynamic response enables the Commission to assess whether existing access standards remain appropriate, and to ensure that new connections integrate in a manner that maintains power system security and reliability.

Many stakeholders in their submissions to the consultation paper encouraged greater industry collaboration to better understand the range of power electronic-based loads in order to gain a better understanding of performance capabilities and avenues to developing appropriate models.[36] The Commission agrees this is an important starting point to identify whether regulatory gaps exist, and inform how they may be addressed.

In addressing this feedback, the Commission hosted a series of technical working group (TWG) meetings that were focused on understanding the technical characteristics of large loads and their interaction with power system security.[37] This section outlines our technical analysis and the findings from our TWG process to identify how IBLs can adversely interact with power system security.

The Commission recognises that IBL technology is not static. As industry practices and technologies continue to develop, regulatory frameworks and technical understanding must also adapt to ensure they remain fit for purpose and responsive to emerging system needs. In this context, AEMO's periodic technical review of the access standards in the NER, undertaken at least once every five years, plays an important role.[38] These reviews provide a structured opportunity to reassess whether existing performance standards appropriately reflect contemporary technology, system conditions and operational experience. The Commission will continue working with AEMO and the broader industry to ensure our technical understandings remain current.

2.2.1 The 'front end' power electronics used by a load influences its grid interaction

Historically, most large electricity loads in the NEM have been relatively passive from a power system perspective. Industrial motors, resistive heating elements and conventional process equipment largely followed prevailing grid voltage and frequency, drawing current in response to system conditions but not materially influencing them. Their behaviour was primarily determined by inherent electromechanical characteristics, and their interaction with the grid was well understood.

This paradigm is changing. Large loads such as data centres are connecting to the NEM through converter-based or inverter-based power electronic interfaces. As a result, their behaviour is shaped less by physical machine characteristics and more by embedded control systems. In

35 AEMO, 2025 Electricity Statement of Opportunities, p 23.

36 Submissions to the consultation paper: Ergon Energy/Energex, p 1; ENA, p 3; EPEC, p 2; Jemena, p 2; NEXTDC, p 3.

37 See Chapter 1 of this draft determination for details on the TWG process. The TWG documents are accessible on our website.

38 NER clause 5.2.6A; See also Chapter 1 of this draft determination for a detailed description of AEMO's review requirement.

practice, these facilities can exhibit characteristics more commonly associated with inverter-based generation. Depending on their design and control settings, they may actively regulate power consumption, rapidly vary demand, disconnect in response to disturbances, inject or absorb reactive power, and interact dynamically with system strength and protection systems. Accordingly, their aggregate impact on voltage stability, fault levels and disturbance ride-through performance can differ materially from traditional loads.[39]

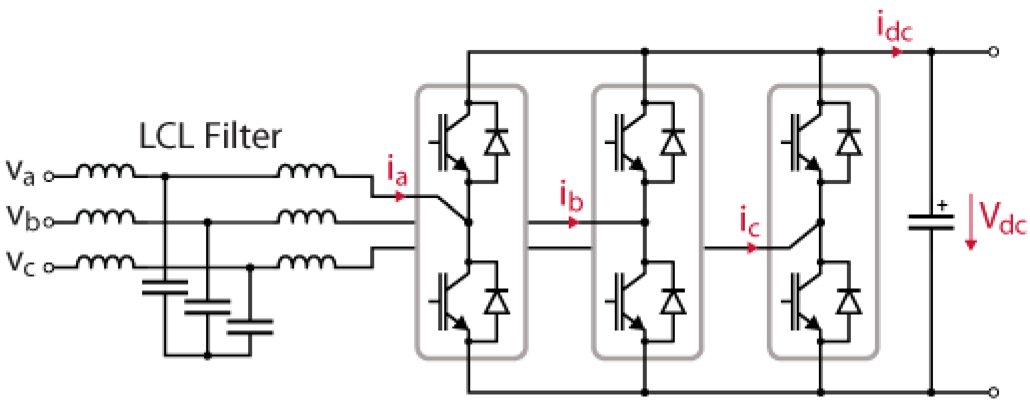
A critical determinant of this behaviour is the load's 'front end' power electronic interface: that is, the portion of the AC/DC (alternating current/direct current) converter directly connected to the grid. The topology and control of this front end dictate how the facility draws current, whether it can control reactive power, how it responds to faults, and how it performs in weak system conditions. In broad terms, common front-end technologies used by large loads can be characterised along a spectrum of increasing controllability and system interaction:

- **Uncontrolled diode bridge rectifiers**, which rely largely on passive components at the AC/DC stage and have limited capacity to shape current draw.
- **Controlled rectifiers**, such as thyristor or silicon-controlled rectifier systems, which allow limited control over conduction and output characteristics.
- **Active front-end converters**, which use semiconductor switching devices (for example, insulated gate bipolar transistors (IGBTs)) to enable fully controllable and often bidirectional AC/DC conversion.

These technical differences are material from a system security perspective. The front-end topology influences harmonic performance, fault current characteristics, reactive power capability and sensitivity to system strength. In traditional large industrial facilities, such as aluminum smelters, the grid interface has typically comprised a transformer and largely passive conversion equipment. By contrast, many modern large loads increasingly employ actively controlled converters at the grid interface, meaning their performance during disturbances and under weak system conditions is determined by control algorithms rather than passive electrical properties.

Figure 2.3 and Figure 2.4 below illustrate the distinction between a typical passive front-end structure and an active front-end converter arrangement.

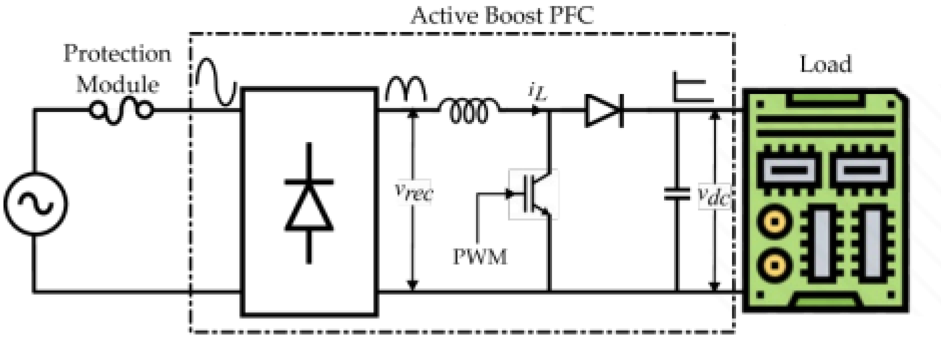
Figure 2.3: Typical active front-end structure (H-bridge converter with LCL filter)



Source: Imperix website, 31 December 2025.

39 NERC Large Loads Task Force, Slides by Pacific Northwest National Laboratory on Fault Dynamics of Converter-Based Loads, 21 April 2025.

Figure 2.4: Typical passive front-end bridge rectifier (for a switched mode power supply)



Source: NERC Large Loads Task Force, [Slides by Pacific Northwest National Laboratory on Fault Dynamics of Converter-Based Loads](), 21 April 2025.
Note: This passive front-end is based on a typical bridge rectifier used by a crypto-mining facility.

2.2.2 We have compared common AC/DC converter front-end technologies to specify their controllability

The Commission conducted a comparison of three common AC/DC converter front-end technologies, being diode bridges, thyristors, and IGBT-based active front ends, highlighting how increasing controllability is associated with greater system interaction and complexity.[40]

At the simplest end, **diode bridge rectifiers** are passive devices that conduct based on the normal AC waveform, typically used by traditional loads such as smelters. They are low cost, fast-switching and suited to high-current applications, but offer no active control over current draw or reactive power. Their output is largely not controlled and is determined by grid conditions, meaning they have limited dynamic interaction with the power system.

Thyristor rectifiers introduce a degree of control by allowing conduction to be triggered. They are commonly used in high-power industrial applications, including smelters and older HVDC or electrolyser installations. However, they rely on the grid voltage waveform for commutation (turn-off), which makes them susceptible to commutation failure during voltage disturbances. While they provide more control than diode bridges, thyristors cannot independently manage their behaviour.

At the most controllable end, **IGBT-based active front-end converters** use fully controllable semiconductor switches to regulate both current and voltage. These systems can actively control real and reactive power, respond rapidly to changing conditions, and support bidirectional power flow. Their performance is governed by control algorithms (including phase-locked loops (PLL)), making them more sensitive to weak system conditions and control instability. These converters are typically applied by data centres, which are explored in more detail in the next subsection.

In summary, as front-end technology progresses from passive diode bridges to fully controlled IGBT converters, the level of controllability and flexibility increases, but so too does the potential for dynamic interaction with system strength, protection systems and voltage stability. This distinction is material when assessing the grid impact of modern large IBLs.

40 Figure 2.5 provides a visual comparison. See also AEMC, Technical Working Group # 1 slides, October 2025.

Figure 2.5: Technology comparison of converter front ends

	Diode Bridges	Thyristors	IGBTs
Typical applications	Smelters, basic conversion applications, low-cost power supplies, cheap crypto mining	Smelters, HVDC, large rectifier, data centres, hydrogen electrolysers (older and higher current)	Data centres, VSDs, chargers, Voltage Source Converter loads, some newer smelters, hydrogen electrolysers, advanced crypto mining, HVDC
Target use	High current, no control	High continuous currents, less control	High variable currents with flexible control
Control	Not controlled	Turn on only. Relies on voltage waveform to switch off	Completely controllable switching on/off
Switching Speed **Cost**	Very Fast Lowest	Slow Lower for high-power applications	Fast Highest
Susceptible to control instability	**No**, operate based on natural conduction. Output is unregulated	**Yes** – commutation failure. Sudden changes in voltage can prevent thyristors switching off	**Yes** – PLL controls can struggle to track grid voltage and create unstable supply. 2 quadrant reactive power controls can have poor voltage oscillation rejection

Source: AEMC.

2.2.3 UPS systems used by data centres tend to be active front ends with a degree of controllability

Data centres may present dynamic challenges to the power system due to the way their internal power architecture interacts with the grid.

Medium to large-scale facilities (30 MW or greater) typically employ UPS systems that operate as an electrical interface between the grid and sensitive IT equipment, ensuring continuous, high-quality power supply. These systems are designed to prevent even very short interruptions (on the order of milliseconds) that could disrupt computing operations or result in data loss.[41]

In contemporary large-scale installations, the core enabling technology is the IGBT, which allows the UPS to actively control how it draws power from, and supplies power to, the electrical system.

If a grid disturbance occurs (such as a voltage dip or frequency excursion), the IGBT rectifier can rapidly reduce or cease drawing power from the grid, while the battery supplies the DC link without interruption. The inverter continues to produce stable AC output for the load (e.g. servers). This seamless transition is made possible by the fast switching capability and controllability of IGBTs.[42]

From a power system perspective, the use of IGBTs means a modern UPS is not a passive load. Its interaction with the grid is governed by control algorithms, including current control loops and PLL.[43] This can influence:

- how the facility responds to faults and disturbances
- its sensitivity to weak system conditions
- its contribution (or lack thereof) to fault current
- dynamic interactions with system strength.

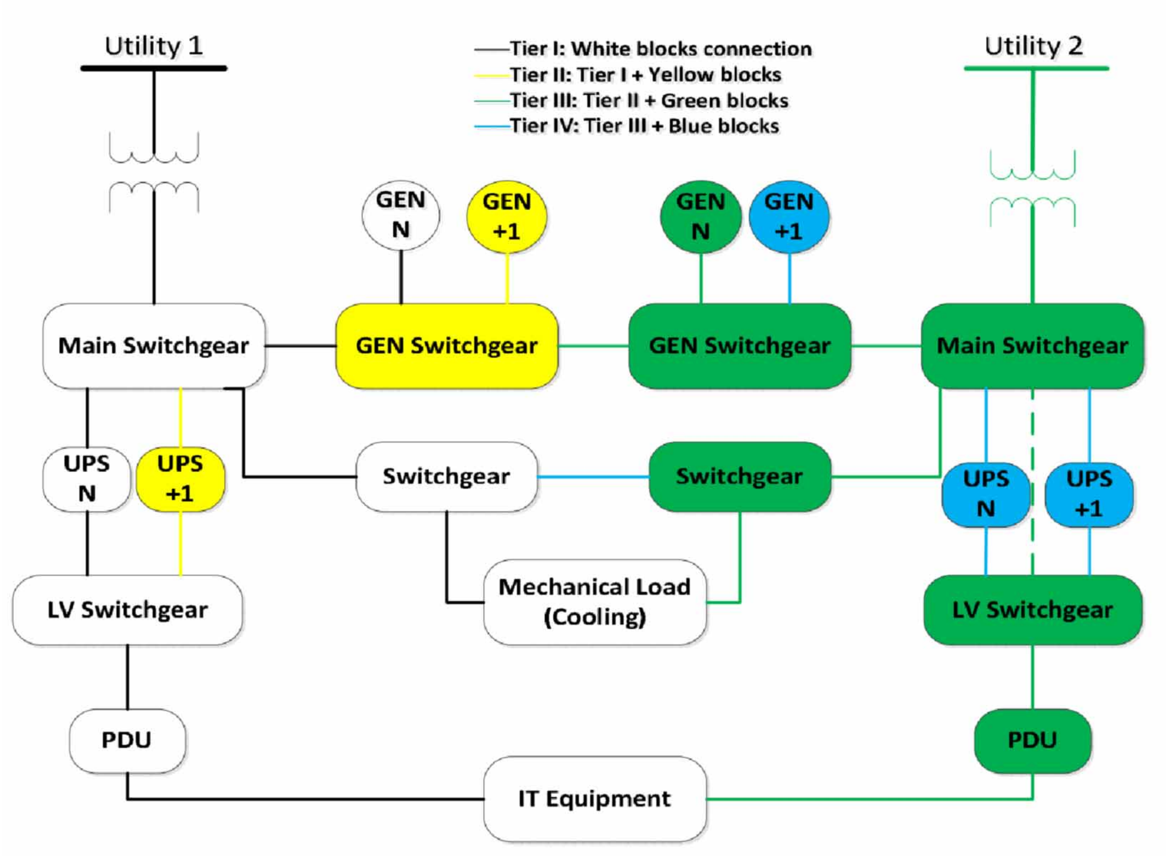
Accordingly, large-scale data centres equipped with IGBT-based UPS systems effectively connect to the grid through actively controlled power electronic converters. While this architecture improves power quality and resilience for the data centre, it also means the facility's electrical behaviour is fundamentally different from traditional electromechanical loads, and must be considered carefully in system security assessments.

41 Eaton, Uninterruptible Power Supply, website.

42 The Institute of Electrical and Electronics Engineers Inc. (IEEE), Data Centre Growth and Grid Readinesss, Technical Report, May 2025, p 46.

43 Vertiv, UPS product description brochure.

Figure 2.6: Data centre components with UPS systems



Source: S Chalise et al., Data center energy systems: Current technology and future direction, 2015 IEEE Power & Energy Society General Meeting, Denver, CO, 2015, pp 1-5 - cited in - NERC, Characterisation and Risks of Emerging Large Loads, White Paper, July 2025, p 11.

2.2.4 IBLs with active, controllable front ends are susceptible to the same system security problems as IBRs

The Commission has observed that active front-end converters used by large IBLs can exhibit dynamic characteristics that mirror those observed in inverter based resources (IBRs), such as solar and wind generators. This means that, in this rule change, the Commission is less concerned with large non-IBL facilities, such as mines, processing facilities, refineries, airports and desalination plants. This is because, while such facilities may have high total demand, their aggregate load typically consists of smaller, heterogeneous processes that are more predictable and/or do not exhibit significant grid-interactive behaviours or dynamic responses that can materially impact power system security.

IBLs with active front-ends behave like grid-following IBRs

The typical active front-end converter used by large IBLs is structurally analogous to the grid-following voltage source converter topology widely deployed in IBRs, such as solar photovoltaics (PV), wind generation, battery energy storage systems (BESS) and HVDC converter stations. In both cases, the converter comprises a fully controllable semiconductor switching bridge (commonly IGBT-based), a DC link, and a control system designed to regulate current injection relative to the grid voltage waveform.

A key feature of this architecture is its reliance on a PLL to estimate and track the grid voltage phase angle. The PLL enables the converter to synchronise with the grid and to control active and reactive power exchange relative to the measured voltage vector. In effect, the converter does not establish system voltage or frequency; rather, it follows the prevailing grid conditions and injects or absorbs current accordingly. This grid-following control structure is fundamentally similar across IBLs and IBRs.

As a consequence, active front-end converters used by large loads can exhibit dynamic characteristics that mirror those observed in inverter-based generation, particularly in areas that have low system strength as a result of retiring synchronous plant. Where short-circuit ratios are low, voltage waveforms may be weaker, more distorted, or more susceptible to rapid phase angle variation. Under these conditions, PLL performance can degrade, potentially leading to loss of synchronism, unstable control interactions, or degraded disturbance ride-through capability.

This underscores the importance of ensuring that access standards appropriately recognise the converter-based nature of emerging large IBLs and their potential implications for system security.

AEMO has completed preliminary dynamic modelling to exemplify how IBLs present risks similarly to IBR

For our TWG, AEMO completed preliminary dynamic modelling to exemplify how IBLs may pose risks to the NEM's system security similarly to IBRs.[44]

AEMO's NEM specific modelling is important for this rule change, as it serves to explain the types of risks that may appear in the NEM context, and why more robust access standards are needed in the NER to address the risks of large IBLs.[45]

Below, the Commission sets out some of the key risks that may emerge in the NEM context, such as:

- how disconnection of large loads can exceed network limits
- the ways in which smaller IBLs can have a cumulative impact on power system security
- how fault-induced undervoltage propagation can be widespread.

Box 3: Disconnection of large loads can exceed network limits

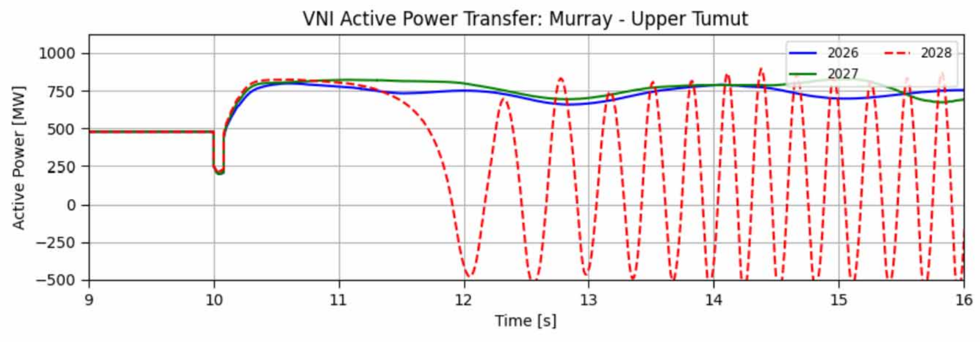
AEMO conducted modelling that considers what happens following a credible fault in Victoria, combined with the sudden loss of a large load (a load contingency). As more large IBLs connect in the absence of appropriate access standards, there is a greater risk that they will disconnect during disturbances rather than remain online.

If a large load trips unexpectedly:

- Demand in that region suddenly falls.
- Power that was flowing into the region must rapidly redistribute across interconnecters.
- This can cause large swings in power transfers.

44 TWG #3 Supplementary AEMO slides, December 2025. Refer to these slides for the inputs and assumptions that informed AEMO's modelling.

45 For international examples, see AEMC, *Improving the NEM access standards - Package 2*, Consultation paper, May 2025, pp 18-21.



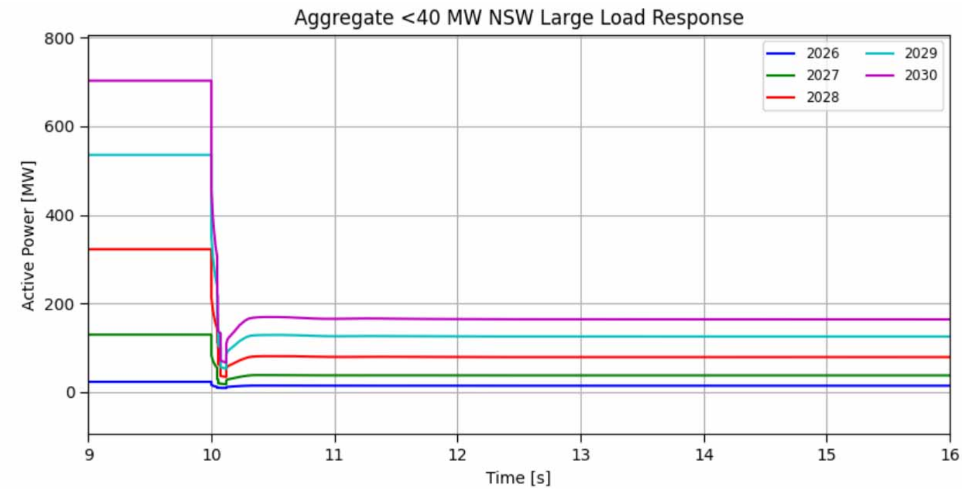
When the size of these contingencies exceeds current network capability:

- Interconnector flows may breach limits.
- System security margins are reduced.
- AEMO may need to apply tighter operational constraints on network transfers.
- This can reduce the efficient utilisation of the network and increase costs.

Source: See TWG #3 Supplementary AEMO slides, December 2025.

Box 4: Smaller IBLs can have a cumulative impact on power system security

The combined impact of many smaller loads can be significant, even if each individual load is relatively small.



The graph models what happens following a credible fault in NSW. It looks at the aggregated response of loads smaller than 40 MW. Around 10 seconds (when the fault occurs), the total demand from these smaller loads drops sharply, meaning many of them reduce consumption or disconnect at the same time.

As more of these loads connect over time, the size of the sudden drop becomes much larger. By 2029–2030, the aggregate reduction in demand is substantial, comparable to, or greater than, the loss of a single large industrial load.

In simple terms:

- Each small load may seem insignificant on its own.

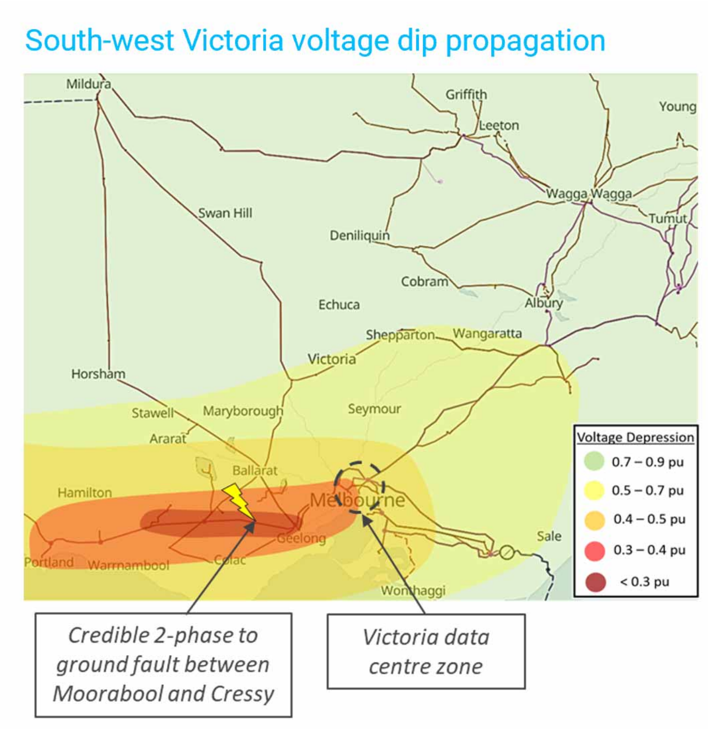
- But if many behave the same way during a disturbance, their combined response can be very large.
- This aggregate effect increases over time as more IBLs connect to the NEM.

Source: See TWG #3 Supplementary AEMO slides, December 2025.

Box 5: Fault-induced undervoltage propagation can be widespread

Voltage dips caused by severe transmission faults can spread over a very large area, far beyond where the fault originally occurred. These widespread dips may trigger multiple data centres to disconnect at the same time, even though the fault occurred far away. This demonstrates how disturbances can propagate across the network and affect many loads simultaneously, creating system security risks.

AEMO modelled a credible two-phase-to-ground fault in south-west Victoria (between Moorabool and Cressy). Even though the fault is remote from Melbourne, it causes voltage across much of the Greater Melbourne area to drop significantly.



The coloured map shows how severe the voltage drop is:

- Darker red areas mean very deep voltage dips (below 0.3–0.4 per unit).
- Orange and yellow areas show moderate voltage dips (0.4–0.7 per unit).
- Even areas further away still experience noticeable voltage depression.

Importantly, AEMO's modelling shows that voltages in Melbourne can fall below **0.5 per unit**, which is a severe dip. Even less severe faults could push the voltage below **0.7 per unit**, which is the ITIC threshold often used for sensitive equipment like data centres. If voltage drops below these thresholds, data centres and other inverter based loads may disconnect to protect equipment.

Source: See TWG #3 Supplementary AEMO slides, December 2025.

2.3 We consider that AEMO should clarify the modelling requirements of large IBLs

In response to our consultation paper, many stakeholders made submissions expressing their views on the modelling capabilities of large loads, and called for greater guidance from AEMO.

The modelling capability for IBLs is critical to demonstrating compliance with applicable access standards under the NER. Without suitable plant-specific models, connection applicants may be unable to substantiate compliance, and NSPs may be required to apply conservative assumptions. This can lead to iterative assessment processes, uncertainty in performance standard negotiations, and potentially inefficient system strength remediation outcomes.

Accordingly, adequate modelling capability is fundamental to providing a clear, technically robust pathway for IBL proponents to demonstrate compliance with the NER access standards and for NSPs to assess that compliance in a consistent and efficient manner.

Under clause S5.5.7(a)(3) of the NER, AEMO must develop and maintain the PSMG describing AEMO's requirements when developing mathematical models for plant, including the impact of the plant's control and protection systems on power system security (for more information, see Box 6).

The Commission has not made a draft rule with respect to requisite modelling, as AEMO's PSMG is better suited to provide this detail. However, the Commission has analysed stakeholder feedback below, which ought to guide AEMO in updating its PSMG, as required under the transitional arrangements of the draft rule.[46]

Box 6: AEMO is required under the NER to provide guidance on power system modelling for connection applicants

Under clause S5.5.7(a)(3) of the NER, AEMO must develop and maintain Power System Model Guidelines (PSMG) describing, for relevant power system technologies at the transmission and distribution system levels, AEMO's requirements when developing mathematical models for plant, including the impact of the plant's control and protection systems on power system security.

In summary, AEMO's PSMG set out:

- the type of information, including models, that connection applicants (including loads) can be asked to provide
- when AEMO (or the NSP) will request detailed information from connection applicants.

With respect to Schedule 5.3 load participants specifically, clause S5.3.1 of the NER requires them to provide to AEMO and the NSP (amongst other information):

- models of the control systems of the Schedule 5.3 Participant's equipment, in a suitable form as per the PSMG (clause S5.3.1(a1)(2)(iv))
- any other information specified in the PSMG (clause S5.3.1(a1)(3)).

There are potential operational implications if models do not adequately represent plant, including:

- requirements to conduct testing under clause 5.7.6, or
- restricted operation of the plant under clause 5.7.3(f).

46 Draft rule, 11.[XXX].6.

2.3.1 Stakeholders are seeking more detailed guidance on modelling requirements for IBLs

Stakeholders broadly agreed that the modelling capability for large IBLs is less mature than for generation and is undergoing development both in Australia and internationally.

- **Modelling capabilities are still maturing:** Ergon noted that while dynamic modelling requirements are set out in AEMO's SSIAG, there is limited industry maturity in providing applicable models.[47] Similarly, Transgrid and Energy Networks Australia (ENA) observed that nationally and globally available large load models lack maturity, that plant-specific OEM models are often unavailable, and that existing models are frequently not fit for purpose to demonstrate compliance with access standards under Schedule 5.3 of the NER.[48] EPEC Group (EPEC) further submitted that many OEM models for load-side equipment either do not exist or would not meet AEMO's model acceptance (DMAT) requirements.[49] Collectively, stakeholders indicated that many proponents do not currently have access to suitable PSCAD (Power Systems Computer Aided Design) or EMT (electromagnetic transient) models capable of supporting compliance assessments.
- **More guidance from AEMO is desired**: A recurring concern related to demonstrating withstand short circuit ratio, as required under clause S5.3.11(b) of the NER. Transgrid and ENA noted practical difficulties in applying the current SSIAG methodology where appropriate models are not available, and highlighted the need for AEMO to review aspects of the assessment approach.[50] Stakeholders such as ENA called for a thorough assessment of current large load modelling practices, including a review of international and domestic approaches, evaluation of model adequacy, and the development of an interim modelling methodology where existing models are not fit for purpose.[51] Further, TM Advisory recommended detailed consultation between the AEMC, AEMO and NSPs, including phased or transitional arrangements.[52]
- **Stakeholders want modelling requirements to be proportionate to risk**: SA Power Networks and Ausgrid submitted that modelling requirements should be balanced against the scale and system impact of the load, noting that smaller proponents may face disproportionate cost impacts.[53] NEXTDC and AWS cautioned that imposing detailed upfront PSCAD or PSSE (Power System Simulator for Engineering) modelling requirements, particularly for data centres with UPS systems, could limit OEM choice, increase costs, delay connections and deter investment, especially given Australia's relatively small market share for these technologies.[54]

While stakeholders raised concerns regarding cost, timing and model availability, there was no broad opposition to enhanced dynamic modelling in principle. EPEC, for example, supported the direction toward dynamic modelling to support system security, subject to acknowledging current capability constraints.[55] More broadly, stakeholders indicated that improved modelling capability over time would be supported where requirements are technically justified, proportionate to system impact, accompanied by streamlined assessment processes, and supported by interim or transitional arrangements where necessary.

47 Ergon Energy/Energex submission to the consultation paper, p 5.
48 Submissions to the consultation paper: Transgrid, p 12; ENA, p 8.
49 EPEC submission to the consultation paper, p 2.
50 Submissions to the consultation paper: Transgrid, p 7; ENA, p 8.
51 ENA submission to the consultation paper, p 3.
52 TM Advisory submission to the consultation paper, p 4.
53 Submissions to the consultation paper: SA Power Networks, p 1; Ausgrid, p 3; Jemena, p 2.
54 Submissions to the consultation paper: NEXTDC, p 3; AWS, p 5.
55 EPEC submission to the consultation paper, p 2.

3 We have made a draft rule for classifying and defining large IBL

Box 7: Key points in this chapter

The Commission has made a more preferable draft rule to establish a clear and consistent tiered framework for classifying Schedule 5.3 plant, including large IBL, in the NER.

A clear, robust definition of large IBL in the NER would support regulatory transparency and consistency, thereby ensuring the security and reliability of the grid. Further, it would complement Australia's ambition to be an attractive location for data centre investment.

Updating the regulatory framework would also manage the system security risks that modern loads, such as data centres and hydrogen electrolysers, pose to the system. These risks relate to power electronic behaviour, interaction with system strength, and disturbance ride-through capability. As such, the draft rule would promote the secure and reliable operation of the power system by recognising the technical impact of large IBLs and ensuring the proportionate application of technical access standards. This would mean that technical compliance costs would be commensurate with a load's interaction with and impact on power system security.

We are introducing a tiered framework for classifying IBLs connecting to the distribution network

The draft rule would introduce a tiered classification framework for distribution-connected Schedule 5.3 plant, based on plant type and nameplate MW capacity. The purpose of this framework is to address the fact that Schedule 5.3 access standards are currently applied to large IBLs at the distribution level in an unclear and inconsistent manner. Further, the tiering framework is intended to take a proportionate approach, ensuring that larger IBLs posing the greatest risk to system security are appropriately required to meet the Schedule 5.3 access standards.

- Tier 1 connection: applies to IBL with a nameplate rating of up to 30 MW, and non-IBL regardless of its MW nameplate rating.
- Tier 2 connection: applies to IBL with a nameplate rating of at least 30 MW but less than 100 MW.
- Tier 3 connection: applies to IBL with a nameplate rating of 100 MW or greater.

The Schedule 5.3 access standards would apply to Tier 1 and Tier 2 connections at the discretion of NSPs, having regard to the expected impact of the connection on the quality and security of network services to other network users. Further, AEMO is to advise on the access standards that are AEMO Advisory Matters (an AEMO advisory matter is an issue that relates directly to AEMO's formal responsibilities under the National Electricity Law (NEL) and the NER, particularly in the connection and access standards framework in Chapter 5).

For Tier 3 connections, the Schedule 5.3 access standards would automatically apply in their entirety, subject to the specific requirements in each access standard.

Schedule 5.3 access standards would continue to apply in full to transmission connections and Registered Participants The Commission has not included a new classification framework for large IBLs connecting at the transmission level, or who have opted to be registered under the NER. This is because the Schedule 5.3 access standards currently apply automatically to all loads connecting to the transmission network and to registered participants.

We have provided guidance on the types of modelling needed to demonstrate compliance with performance standards

The Commission has also provided guidance on the modelling expected to be produced by Schedule 5.3 Participants to demonstrate compliance with the applicable performance standards.

These views could support AEMO in updating its PSMG, which they would be required to do under the transitional arrangements of this draft rule.

We have made targeted reforms to promote compliance with performance standards by non-registered Schedule 5 Participants

Additionally, the Commission's draft rule makes targeted, incremental reforms that would promote compliance with access standards recorded in connection agreements for non-registered Schedule 5 Participants, including loads, generators, and integrated resource systems. These reforms would also improve visibility for AEMO and the Australian Energy Regulator (AER) on the performance standards agreed upon between NSPs and non-registered Schedule 5 Participants.

Collectively, the Commission considers that these reforms in the draft rule would promote the NEO by:

- supporting the safe, secure and reliable operation of the power system as large IBL connections increase
- providing clearer and more predictable regulatory settings for proponents and NSPs
- ensuring regulation remains technology-neutral and proportionate to system impact.

In this chapter:

- Section 3.1 describes how emergence of large IBL requires a clear NER framework for applying the Schedule 5.3 access standards.
- Section 3.2 explains the tiering system for classifying Schedule 5.3 plant, including large IBL, that is seeking connection to distribution networks and Commission's rationale.
- Section 3.3 outlines the various approaches considered by the Commission for classifying IBL, and how these were considered against the NEO.
- Section 3.4 explains the Commission's draft rule for promoting compliance with applicable performance standards, particularly for non-registered Schedule 5 Participants.

3.1 The emergence of large IBL requires a clear NER framework for applying the Schedule 5.3 access standards

The Australian electricity system is undergoing a profound transformation, as decarbonisation, industrial electrification, and the rapid growth of energy-intensive technologies are reshaping the ways in which we must maintain power system security and reliability. As outlined in Chapter 2, new IBL technologies, such as hyperscale data centres and hydrogen electrolysis facilities, connect to the power system via power-electronic interfaces. They can materially influence system stability, particularly through their behaviour during disturbances, their impact on network strength, and their interaction with frequency and voltage control. To manage these risks we need concepts, like large IBL, in the regulatory framework so we can classify and apply the relevant technical access standards.

The NER and associated access standards were originally designed for a system dominated by conventional, synchronous generation and relatively passive load. Accordingly, the NER currently does not clearly distinguish between small, passive loads and large IBL that have asynchronous generator-like impacts. This creates:

- uncertainty for proponents about the applicable connection requirements under the NER framework
- inconsistent treatment of plant and technology across NSPs

- increased risk that technical requirements are not appropriately applied. For instance, some NSPs may be applying technical requirements in overly onerous ways that are not suitable for the plant technology, or in a more relaxed way, potentially risking the stability and reliability of the grid.

Internationally, the evolution of grid codes and technical standards reflects a similar imperative to differentiate between traditional loads, such as smelters, and those with significant system impact, such as hyperscale data centres and hydrogen electrolysers. Across North America and Europe, regulators and system operators are adapting to the emergence of large, power-electronic-driven resources by specifying performance requirements that scale with the size and dynamic behaviour of the connection, in a way that is bespoke to the characteristics of their grids and regulatory frameworks.

Without a clear, fit-for-purpose definition of large IBL, connection applicants, NSPs, and system planners face uncertainty about when technical requirements should apply and how to design networks that remain secure as these loads proliferate. Definitional clarity is therefore central to this rule change. It would enable fit-for-purpose regulation that would prioritise the secure and reliable operation of the power system by recognising the technical impact of large IBLs and ensuring the proportionate application of technical access standards. This means that technical compliance costs would be commensurate with a load's interaction with and impact on power system security.[56]

In our consultation paper, the Commission identified the need for clearer definitions and thresholds for IBL to ensure system security without imposing disproportionate burdens on smaller or less impactful connections. Many stakeholder submissions to the consultation paper emphasised that the term 'large load' should be explicitly defined for absolute clarity with appropriate registration and technical requirements, such that the right level of access standards can be applied consistently across the NEM.

3.1.1 The current framework does not adequately define and classify large IBL

Over the course of our consultation on this rule change, the Commission has observed that the current framework for defining and classifying large IBL needs reform to adapt to the influx of large IBL in the NEM, which can adversely impact power system security. The problems with the current framework are as follows:

1. The classification of IBL as a large IBL under AEMO's SSIAG has been over-leveraged beyond the system strength framework to other schedule 5.3 access standards, and is no longer fit for purpose.
2. Schedule 5.3 of the NER is being inconsistently applied across distribution network service providers (DNSPs), based on differing approaches for classifying large IBL, and differing understandings of how certain load technologies may interact with power system security. This has been exacerbated by the absence of a clear framework for classifying loads to determine when and how the Schedule 5.3 access standards would apply.

Classification of IBL as a large IBL under AEMO's SSIAG is not fit-for-purpose

Under the NER, AEMO is required to prescribe criteria for classifying IBR, including IBL, for the purposes of assessing their impact on system strength.[57] The SSIAG, made under clause 4.6.6 of

56 Further, it would also help ensure Australia remains an attractive location for data centre investment, which is essential to our digital economy and the federal government's data sovereignty objectives. For more information, see: Australian Government Department of Industry, Science and Resources, National AI Plan, 2025.

57 NER clause 4.6.6.

the NER, fulfil this requirement and also sets out the criteria for classifying IBR and IBL as large, which relies on:

- the technical character of the plant (being inverter based and potentially susceptible to control-related instability),[58] and
- a capacity threshold of being greater than 5MW or 5MVA to warrant a detailed system strength impact assessment.

Section 2.2 of the SSIAG:

- AEMO considers that the size of plant (other than a production unit) or IBR should be determinative of the need for a system strength impact assessment. Hence, the key criterion for classifying plant (other than a production unit) as an IBL or an IBR as an LIBR is a minimum capacity of 5 MW or 5 MVA.
- For clarity, it is noted that plant (other than a production unit) can only be an IBL if it also meets the criteria inherent in the NER definition of inverter based load itself. That is, the plant (other than a production unit) must be:

  (i) supplied by power electronics, including inverters; and

  (ii) potentially susceptible to inverter control instability.

This definition recognises that loads with power electronic interfaces, such as large data centres, hydrogen electrolysers, and other industrial facilities with inverter-connected equipment, can behave differently from conventional loads during disturbances and therefore warrant targeted and proportionate consideration of their impacts on system strength.

The Commission has identified that this definition of large IBL, developed explicitly for the system strength framework, has been over-leveraged as an informal threshold for connecting parties determining the application of schedule 5.3 access standards. Furthermore, stakeholder submissions to our consultation paper highlighted that the SSIAG classification for large IBL is no longer fit-for-purpose. They submitted that:

- "...the current threshold of 5 MW or 5 MVA is considerably too low. Progressing this rule change with the current definition would immediately create an administrative burden on DNSPs who must process connection applications".[59]
- "The definition of 'large loads' should be considered by the Commission in the context of this rule change as the broader system impact of a 5MW load is different to the impact of a 200MW load".[60]
- "The proposed 5MW limit for a large IBL is an extremely low threshold. Instituting such a low threshold limit risks a significant step change in work for network service providers to process small connections to the distribution network. It also risks incurring material risks and costs for the small loads with no consequential material benefit."[61]
- "Different market participants and bodies often have varying definitions of large loads. Some have used 50 MW as a starting point to differentiate wholesale and retail loads, while [AEMO's SSIAG] applies a minimum capacity of 5 MW to categorise IBL."[62]

58 This builds upon the NER Chapter 10 Glossary definition of 'inverter based load': "plant (other than a production unit) that is supplied by power electronics, including inverters, and potentially susceptible to inverter control instability..."

59 Ausgrid submission to the consultation paper, p 3.

60 Ergon Energy/Energex submission to the consultation paper, p 2.

61 CPU submission to the consultation paper, p 2.

62 Hydro Tasmania submission to the consultation paper, p 2.

Accordingly, the Commission's view is that a more holistic classification framework for large IBL, with fit-for-purpose thresholds, is necessary for determining the application of the Schedule 5.3 access standards.

The application of Schedule 5.3 access standards to large IBL is unclear and inconsistent at the distribution level

Clause S5.3.1a of the NER sets out the types of Schedule 5.3 plant the Schedule 5.3 access standards apply.

Currently, each of the access standards in Schedule 5.3 of the NER automatically apply to IBLs and non-IBLs that are registered under Chapter 2 of the NER,[63] or seek to connect to a transmission network (see Figure 3.1).[64]

If an IBL or non-IBL seeks to connect to a distribution network and is not registered, NSP must apply the Schedule 5.3 access standards to the extent that the load would otherwise adversely affect the quality or security of network service to other network users (see Figure 3.1).[65] During the Commission's consultation, stakeholders have raised several concerns regarding the existing framework for distribution network connections:

- Schedule 5.3 of the NER is being inconsistently applied across DNSPs, based on differing approaches for classifying large IBL, and differing understandings of how certain load technologies may interact with power system security.[66] Where DNSPs take differing approaches to classifying large IBLs, or to assessing how particular load technologies interact with power system security, similar connections can be subject to materially different requirements depending on location. This means that connection applicants cannot reliably predict which regulatory obligations will apply, how they will be assessed, or what compliance is required, even for materially similar projects. Further, if Schedule 5.3 is applied narrowly or inconsistently, some connections may not be required to meet appropriate access standards, resulting in residual risks being managed operationally rather than through upfront technical requirements. Potential inconsistent applications of Schedule 5.3 may also be driven by confusion over the relationship between Schedule 5 Participants and Registered Participants.[67]
- In the absence of clear, explicit disturbance ride through access standards, representatives to the TWG expressed that some DNSPs are looking beyond the current Schedule 5.3 access standards and applying their own type of disturbance ride through standards in connection agreements. This also creates unpredictability and uncertainty for connection applicants, possibly lengthening the time it takes to connect to the gird. It was also noted during the TWG meetings that DNSPs are asking for differing modelling requirements, which can at times be quite onerous for the connection applicant.
- The inconsistent application of Schedule 5.3, exacerbated by the absence of a clear classification framework, can lead to misaligned incentives and cost outcomes. For instance, NSPs are primarily incentivised to manage impacts within their own networks for which they

63 The Commission notes that, presently, it is uncommon for loads to obtain market registration under Schedule 5.3 of the NER.

64 NER clause S5.3.1a(a1)(1)(iii).

65 NER clause S5.3.1a(a1)(2).

66 See for instance, Ausgrid submission to the consultation paper, p 2.

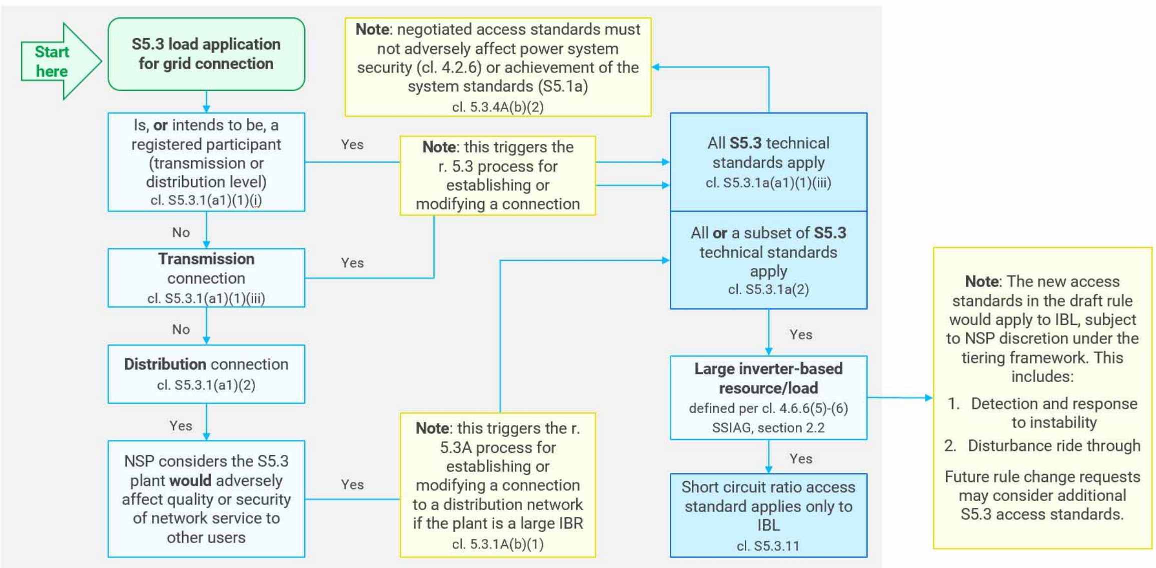
67 For more information on the relationship between Registered Participants and Schedule 5 Participants, see Chapter 1 of this draft determination.

are accountable. Where upstream transmission-level risks are not fully understood or assessed by a DNSP at the connection stage,[68] the burden of managing those risks may fall to the relevant transmission network service provider (TNSP) or AEMO through operational interventions, such as constraints or FCAS procurement. This can increase system costs which are ultimately borne by consumers rather than being efficiently allocated to the parties that create the risks.

- Inconsistency, particularly at the distribution level, is reducing AEMO's visibility and ability to plan for emerging risks. AEMO relies on connection frameworks and technical standards to understand and manage the aggregate impact of loads on system security. Divergent DNSP practices and differing assumptions about load behaviour limit the quality and consistency of information available to AEMO, complicating system planning and operational decision-making as large, technology-enabled loads continue to grow.

Taken together, these issues suggest that inconsistent application of Schedule 5.3 may undermine system security, efficient investment signals, and the long-term interests of consumers, indicating the need for clearer, more consistent regulatory settings.

Figure 3.1: Current applicable access standards under Schedule 5.3



Source: AEMC
Note: This flow diagram is for illustrative purposes only - NER clauses are not produced here verbatim.

3.2 The Commission has developed a tiering system for classifying Schedule 5.3 plant, including large IBL

The Commission has made a draft rule establishing a tiered framework for applying the Schedule 5.3 access standards to distribution-connected Schedule 5.3 plant.[69] It comprises three tiers for classifying IBL based on MW thresholds, supported by impact-based assessments to ensure access standards are applied commensurately with potential system security risk, recognising differing local network conditions.

68 The Commission notes that DNSPs are not the system operator of the NEM, and so are not expected to have full visibility of inter-regional power flows, dynamic system security impacts, or aggregate effects across multiple connections that fall outside their network.

69 Draft rule, clause S5.3.1a(a1).

Each tier within this framework determines:

- the applicable MW thresholds
- whether the Schedule 5.3 access standards apply automatically, or apply subject to an NSP assessment
- the extent to which IBL-specific access standards are engaged
- treatment of non-IBL connecting to a distribution network.

Importantly, IBLs with a nameplate rating of 30 MW or greater would be classified as large IBL under the draft rule. This differs from the current threshold of 5 MW or greater, in AEMO's SSIAG.

The purpose of this three-tiered classification framework is to address the growing risk that large IBLs are being treated inconsistently across the NEM, which is reducing AEMO's visibility and ability to plan for system security needs.[70]

By introducing MW-based tiers combined with impact-based NSP assessment, the Commission seeks to provide upfront regulatory certainty, align compliance obligations with the scale and technical behaviour of the connection (particularly power electronic characteristics and disturbance performance), preserve flexibility for local network conditions, and ensure that compliance costs are commensurate with system security risk, thereby promoting security, transparency and efficient investment.

It is noted that a classification framework for determining how the Schedule 5.3 access standards ought to apply was not proposed by the rule change proponent. However, the Commission considered that clarifying this in the NER would be essential for ensuring proponents have clarity on how the access standards framework would apply to them.

The Commission undertook targeted stakeholder consultation, including through a series of TWG meetings with representatives from AEMO, NSPs and proponents of Schedule 5.3 plant (such as data centres), to receive and apply feedback on how we might develop a classification framework for the draft rule.[71]

The Commission welcomes further stakeholder feedback on this draft rule to help refine it for the final rule, if made. We are interested in understanding whether stakeholders consider that this framework promotes the applicable NEO assessment criteria by:[72]

- providing a clear regulatory framework that appropriately classifies Schedule 5.3 plant based on their size and potential system security impact
- offering certainty as to the circumstances in which the Schedule 5.3 access standards would apply
- embedding flexibility by maintaining a certain level of NSP discretion so that the regulatory framework is not overly prescriptive.

The details and rationale for the draft rule are set out in this part as follows:

- Section 3.2.1 outlines the new and amended definitions in the draft rule that would support the clear application of the classification framework, as well as the Commission's rationale.
- Section 3.2.2 provides a detailed description of the draft rule for classifying Schedule 5.3 plant, including classifying IBL as a large IBL. It also details the Commission's rationale behind the draft rule for classifying Schedule 5.3 plant.

70 These risks are detailed above in section 3.1.1.

71 Consultation materials from the TWGs are available here.

72 See also Chapter 8 of this draft determination, which details how the draft rule would promote the NEO.

- Section 3.2.3 provides the Commission's views on what types of modelling ought to be produced to demonstrate compliance with the Schedule 5.3 access standards. This is to address stakeholder feedback, promote consistency across NSPs, and aid AEMO in updating the PSMG.
- Section 3.2.4 clarifies that the classification of IBR that is not IBL (asynchronous generating units and asynchronous bidirectional units) as a large IBR will still be done pursuant to the criteria in AEMO's SSIAG, and explains why.

Figure 3.2: Summary of the tiering framework for classifying Schedule 5.3 plant in the draft rule

	Classification tier	Plant size	Plant type	Application of S5.3
	Tier 1	< 30 MW	• **IBL** connections to **distribution networks** • **Non-IBL** connections to **distribution networks**, regardless of MW size	• NSP must apply the applicable S5.3 access standards to the extent that the plant would otherwise adversely affect the quality or security of network service *Note: this maintains the existing NSP discretion* • Regarding the new disturbance ride through access standards under the draft rule, the NSP may apply them only to the extent that there may be an aggregate of Tier 1 loads that may have an adverse system security impact
LARGE IBL	Tier 2	30-100 MW	• IBL connections to **distribution networks**	• NSP must apply the applicable S5.3 access standards to the extent that the load would otherwise adversely affect the quality or security of network service. *Note: this maintains the existing NSP discretion* • Regarding S5.3 access standards that only apply to IBL, the NSP may apply those access standards to the extent it considers appropriate, having regard to the expected impact of the connection on the quality and security of network services to other network users
LARGE IBL	Tier 3	> 100 MW	• IBL connections to **distribution networks**	• All S5.3 access standards automatically apply, including (for IBL) any IBL specific access standards. *Note: This removes existing NSP discretion* *Further note: all load connections to transmission networks, or registered loads, regardless of MW size, would be considered as being like a Tier 3 connection*

Source: AEMC
Note: Across each Tier, AEMO will advise on AEMO Advisory Matters.

3.2.1 New and amended NER definitions under the draft rule

The draft rule would amend and introduce new definitions to the glossary in Chapter 10 of the NER to support the draft framework for classifying Schedule 5.3 plant. These definitions are, in part, informed by feedback from the TWG representatives, who generally favoured clear NER definitions that are not overly prescriptive, to account for and promote investment in evolutions in load technologies.

Table 3.1: New and amended NER definitions

Term	Definition	Rationale
Inverter based load	Plant (other than a production unit) that is supplied by power electronics, including inverters, converters and rectifiers, and potentially susceptible to power electronic control instability.	The draft rule amends this definition to: • clarify that power electronics includes converters and rectifiers, in addition to inverters • replace 'potentially susceptible to inverter control instability' to 'potentially susceptible to power electronic control instability', to ensure the definition clearly captures the range of power electronics that may be potentially susceptible to control instability • remove reference to the SSIAG, as Schedule 5.3 plant would be classified as IBL through the NER framework in the draft rule.
Large inverter based load	An inverter based load with a nameplate rating of 30 MW or greater.	This is a new NER definition in the draft rule, introduced to make clear that IBL with a nameplate rating of 30 MW or greater would be classified as large IBL.
Large inverter based resource	An inverter based resource that is either of the following: • an asynchronous production unit classified as a large inverter based resource applying criteria specified in the system strength impact assessment guidelines; or • a large inverter based load.	The draft rule amends this definition to specify that: • IBL would no longer be classified as large IBL by applying the criteria specified in the SSIAG, because under the draft rule, it would be classified under the NER tiering framework. • Asynchronous production units will still be classified as a large IBR by applying the criteria specified in the SSIAG.

3.2.2 Description of the draft rule for classifying Schedule 5.3 plant and the Commission's rationale

The classification framework only applies to distribution network connections and comprises three tiers based on MW size and plant type, described below.[73]

Tier 1 connections - Small IBL and all non-IBL

Plant and MW thresholds

Schedule 5.3 plant with a nameplate rating of up to (but less than) 30 MW, and all Schedule 5.3 plant that are non-IBL seeking distribution connection, regardless of MW size, would be classified as a Tier 1 connection under the draft rule.[74]

73 As noted in section 3.1.1, the NER is already clear on how the Schedule 5.3 access standards apply to transmission network connections and registered participants that are Schedule 5.3 Participants.

74 Draft rule, clause S5.3.1a(a1)(2).

The Commission considers this threshold for classifying small IBLs that are less than 30 MW as a Tier 1 connection to be appropriate for several reasons.

- First, the 30 MW threshold is analogous to the breakpoint used to classify generating units as scheduled or non-scheduled under the NER. Generating units with a nameplate rating below 30 MW are, by default, classified as non-scheduled unless AEMO determines otherwise. This approach is reflected in AEMO's *Guide to Registration Exemptions and Production Unit Classifications* (REPUC) and is consistent with AEMO's prior review practices.
- Second, the Commission considers that Schedule 5.3 plant below 5 MW would generally be unlikely, in isolation, to adversely affect other network users.[75] However, the Commission has not adopted a 5 MW threshold as the starting point for Tier 1. Stakeholders noted that, in certain contexts, such as areas with limited network strength or where multiple smaller inverter based loads are embedded within the same part of the network, the cumulative impact of smaller loads less than 5 MW may still pose material system security risks. The aggregation of smaller, flexible loads operating under a single virtual power plant (VPP) or similar control framework may further alter risk profiles.

Further, the Commission considers that non-IBLs connecting to distribution networks, regardless of size, should be classified as a Tier 1 connection. This is because, while non-IBLs can present risks to power system security, they are less likely to have system wide impacts. They also tend to not have back up power supply through a UPS system, meaning they are incentivised to ride through disturbances and maintain grid connection.[76]

Application of Schedule 5.3

In Schedule 5.3 of the NER, there are access standards that apply only to IBL. This currently includes the short circuit ratio requirements in clause S5.3.11 and under the draft rule, would include the new access standards for:

- disturbance ride through,[77] and
- instability monitoring.[78]

From this group of IBL-specific access standards, only the new disturbance ride through access standards in the draft rule would apply to Tier 1 connections, and only to the extent that the NSP considers appropriate, having regard to the expected **aggregate impact** of all Tier 1 connections on its network on the quality and security of network services to other Network Users.[79]

- This recognises that small loads can have a cumulative impact during grid disturbances, as impacts arise not only from the largest connections but also from the combined behaviour of smaller connections. An aggregated response can match, or even exceed, the severity of responses from larger individual connections.[80]
- The disturbance ride through access standards would be considered as AEMO advisory matters, and as such, as the NSP would be required to consult with AEMO on the application of these access standards.
- As noted in Chapter 6, the Commission's view is that the short circuit ratio requirements in clause S5.3.11 should only apply to large IBLs because while small IBLs may have an

75 As noted above, an IBL with a nameplate rating of 5 MW or greater is currently classified as a large IBL under AEMO's SSIAG.
76 For more information, see Chapter 2 of this draft determination, which explains why the focus of this rule change is on IBLs.
77 Draft rule, clauses S5.3.12 and S5.3.13.
78 Draft rule, clause S5.3.14.
79 Draft rule, clause S5.3.1a(a1)(2)(iii)(A).
80 See Chapter 2, which explains how smaller loads may have an aggregate impact on power system security, similar to that of a large IBL.

aggregate impact in a distribution network if several are connected in similar locations, this would likely be a local distribution network issue rather than at the transmission level. The relevant DNSP is best positioned to forecast such issues and propose efficient solutions for the distribution network.

- Similarly, as noted in Chapter 5, the new access standard in the draft rule would apply to large IBL because only IBL over 30 MW in size are likely to materially contribute to instability.

The remainder of the Schedule 5.3 access standards that apply to non-IBL and IBL alike would apply to Tier 1 connections to the extent that the NSP considers that the connection or operation of the plant would otherwise adversely affect the quality and security of network services to other Network Users.[81] This approach is consistent with the current NER framework:

- Under clause S5.3.1a(a1)(2) of the NER, the Schedule 5.3 access standards currently apply to non-registered distribution connected loads only to the extent that the NSP considers the connection or operation of the plant would otherwise adversely affect the quality or security of network services to other network users.
- Retaining this level of NSP discretion recognises feedback from TWG representatives that local network conditions may materially differ, and that the Schedule 5.3 access standards would therefore require a bespoke application in a manner consistent with the specific requirements of each access standard.

Tier 2 connections - Large IBL

Plant and MW thresholds

Schedule 5.3 plant that is an IBL with a nameplate rating of at least 30 MW but less than 100 MW would be classified as a Tier 2 connection under the draft rule.[82] Under the draft rule, this would mean IBL connections to distribution networks with a nameplate rating of 30 MW or greater would be classified as large IBL.

The 30 MW starting point aligns with thresholds commonly used in AEMO frameworks, including the PSMG, to distinguish smaller plant from larger plant that may warrant more detailed power system modelling and impact assessment.

For the upper limit, the TWG considered whether to set it at 80 MW or 100 MW. The Commission decided to set it at 100 MW because:

- According to some TWG representatives, the 80 MW threshold may capture Schedule 5.3 plant whose individual system impacts do not warrant the full application of S5.3 access standards and generator-equivalent modelling (see Tier 3 connections). As such, raising the threshold from 80 MW to 100 MW would help ensure that the most onerous modelling and access standard requirements are reserved for projects with genuinely material system security implications. The Commission is persuaded by this concern about regulatory proportionality, and considers that the 100 MW threshold is a more appropriate demarcation point between moderate and high-risk IBL connections, particularly where multiple smaller IBLs may already be managed through other assessment tools and NSP discretion.
- Classifying IBL between 30 and 100 MW as large IBL is broadly consistent with international approaches, although jurisdictions differ in where they draw the lower and upper bounds and in how they treat large loads in practice. Several comparable jurisdictions use thresholds in the same order of magnitude as the Commission's proposed band, often placing mandatory large-

81 Draft rule, clause S5.3.1a(a1)(2)(iii)(B).

82 Draft rule, clause S5.3.1a(a1)(2)(ii).

load treatment at around 50-75 MW, which means the Commission's upper limit of 100 MW sits comfortably within international practice.

Application of Schedule 5.3

Under the draft rule, the IBL-specific access standards in clauses S5.3.11 (short circuit ratio), S5.3.12 (response to frequency disturbances), S5.3.13 (response to voltage disturbances) and S5.3.14 (instability monitoring and detection) would apply to Tier 2 connections to the extent that the NSP considers appropriate, having regard to the expected impact of the connection on the quality and security of network services to other network users.[83]

This approach maintains the existing NSP discretion over the extent to which these access standards apply (if at all), subject to the specific requirements in each access standard. However, the Commission notes that the NSP would need to consult with AEMO on the application of each of these IBL-specific access standards, as they are AEMO advisory matters.

Similar to Tier 1 connections, the remaining Schedule 5.3 access standards would apply to Tier 2 connections to the extent that the NSP considers that the connection or operation of the plant would otherwise adversely affect the quality and security of network services to other Network Users.[84]

Tier 3 connection - Large IBL

Plant and MW thresholds

Tier 3 applies to IBL with a nameplate rating of 100 MW or greater.[85] Like Tier 2 connections, Tier 3 connections would be classified as large IBL.

As explained in the section on the Tier 2 threshold above, the 100 MW starting point reflects the Commission's view that IBL of this size is more likely to have a material impact on power system security and therefore warrants more stringent requirements

Application of Schedule 5.3

For Tier 3 connections, all Schedule 5.3 access standards would apply automatically, in accordance with each standard's specific requirements.[86] This approach is analogous to the current application of Schedule 5.2 access standards to generators and reflects the potential system security impacts associated with very large IBLs.

It is also consistent with the existing application of the Schedule 5.3 access standards to Schedule 5.3 Participants that:

- are, or intend to be, Registered Participants for that plant
- have appointed, or intend to appoint an intermediary for that plant[87]
- have connected, or intend to connect, to a transmission network.[88]

Under this approach, NSP discretion is reduced in recognition of the scale of potential impact, while still allowing flexibility in how compliance is demonstrated.

83 Draft rule, clause S5.3.1a(a1)(2)(ii)(A).
84 Draft rule, clause S5.3.1a(a1)(2)(ii)(B).
85 Draft rule, clause S5.3.1a(a1)(2)(i).
86 Draft rule, clause S5.3.1a(a1)(2)(i)
87 Note: when an intermediary is appointed for a plant, AEMO would register the intermediary as a Registered Participant under NER clause 2.9.3.
88 NER clause S5.3.1a(a1)(1).

3.2.3 The Commission has provided guidance on the types of modelling that should be provided under each connection tier

The draft rule does not prescribe the specific types of modelling required for each connection, as we consider it more appropriate to set out this level of technical detail in AEMO's PSMG.

The PSMG is the primary instrument for specifying detailed, technical modelling requirements for power system studies, including assumptions, methodologies, and data inputs. Locating modelling requirements in the PSMG ensures they are developed and maintained by the body with operational responsibility for system security and deep technical expertise in power system modelling. Further, modelling requirements evolve over time in response to changes in system conditions, technology, and emerging risks, particularly in a power system with increasing levels of IBL. Embedding prescriptive modelling requirements in the NER would reduce flexibility and risk the requirements becoming outdated. By contrast, the PSMG can be updated more readily to reflect contemporary modelling practices and system needs, while remaining consistent with the framework established in the Rules.

However, the Commission has analysed stakeholder feedback to provide views on the types of modelling that ought to be produced. This is intended to promote consistency and predictability across NSPs.[89] These views can also serve as guidance for AEMO when updating the PSMG to clarify modelling expectations of Schedule 5.3 Participants.

Tier 1 connections: Low-level modelling or protection studies.

Tier 2 connections: Low-to-moderate-level modelling or protection studies.

Tier 3 connections: High degree of modelling, including PSCAD and PSSE studies, comparable to requirements for Schedule 5.2 plant.

The Commission expects that NSPs would seek low-to-moderate-level modelling or protection studies for Tier 2 connections, commensurate with the degree of potential system impact and consistent with AEMO's PSMG. Assessment of the percentage voltage change may also help determine the appropriate level of modelling. In cases where the percentage change is significant, it may be appropriate to require a higher degree of modelling.

The Commission also expects that Tier 3 connections would produce a high degree of modelling, including PSCAD and PSSE studies, to demonstrate compliance with the Schedule 5.3 access standards. These requirements are intended to align with generator modelling obligations under the PSMG.

3.2.4 IBR would still be classified as a large IBR using the criteria in the SSIAG

In light of this classification framework being embedded in the NER through the draft rule, the classification of IBL as large IBL would no longer be determined pursuant to the SSIAG or confined to the system strength framework.[90] As such, AEMO would need to update the SSIAG to remove references and requirements for classifying IBL as a large IBL.

It is important to note that the classification of IBR that is not IBL (asynchronous generating units and asynchronous bidirectional units) as large IBR will still be done pursuant to AEMO's SSIAG.[91] The Commission has preserved this arrangement, as the framework for applying access

89 See Chapter 2 of this draft determination, which outlines stakeholder feedback on the modelling capabilities of IBLs.

90 The draft rule amends the NER to remove clause 4.6.6(a)(5), which requires AEMO to prescribe the criteria for classifying plant as IBL. It also amends clause 4.6.6(a)(6) to remove AEMO's discretion for classifying IBL as large IBL.

91 NER clause 4.6.6(a)(6).

standards under Schedule 5.2 of the NER for asynchronous generating units and asynchronous bidirectional units differs from the application of Schedule 5.3 for loads. Specifically, Schedule 5.2 access standards apply to asynchronous generating units and asynchronous bidirectional units irrespective of size, and do not delineate between transmission and distribution network connections.[92]

As such, it is important to retain the current classification of IBR that is not IBL as large IBR, to ensure the appropriate application of short circuit ratio requirements under clause S5.2.5.15 of the NER to asynchronous production units.

3.3 The Commission considered various approaches for classifying Schedule 5.3 plant

In developing the draft rule to classify Schedule 5.3 plant, the Commission considered a range of regulatory design options, prior technical work undertaken by AEMO, and international approaches to defining and regulating large loads. The Commission assessed these matters against the NEO assessment criteria,[93] with a particular focus on promoting power system security, clear regulatory frameworks, and a proportionate application of technical standards.

The options considered by the Commission are set out in this part as follows:

- Section 3.3.1 outlines the options considered by the Commission for classifying Schedule 5.3 plant and how these were assessed against the NEO assessment criteria.
- Section 3.3.2 explains how the framework for classifying Schedule 5.3 plant builds upon AEMO's Access Standards Review.
- Section 3.3.3 outlines some of the ways 'large load' is defined in comparable international jurisdictions, which were considered by the Commission in developing the framework for classifying Schedule 5.3 plant.

3.3.1 We considered various options for classifying loads and tested them against the NEO assessment criteria

The Commission considered a range of options for classifying Schedule 5.3 plant for the purposes of applying the Schedule 5.3 access standards. These options included approaches based solely on system impact, fixed thresholds, or a combination of both.

Following testing these options at the TWG, the Commission prefers an approach that combines tiered thresholds with system impact assessment. This option would provide greater regulatory certainty for proponents at early stages of project development, while retaining flexibility to ensure that access standards apply in a manner proportionate to actual system risk. In contrast, the alternative options were not preferred by the Commission or TWG as they could introduce unnecessary regulatory complexity, rely on factors that are insufficiently correlated with system risk, or fail to adequately address emerging system security challenges associated with large IBL.

The Commission's detailed assessment of each option against the NEO as is set out in Table 3.2 below.

92 NER clause S5.2.1(b)(1).

93 For more information about the applicable NEO assessment criteria, see Chapter 8 of this draft determination.

Table 3.2: Options considered by the Commission for classifying Schedule 5.3 plant

Option	Description	Commission's analysis
Option 1: System impact and tiered thresholds	Classification of IBL as large IBL achieved through: • Thresholds (MW and/or voltage change at the connection point) • System impact assessments by NSPs per the applicable S5.3 access standards	• The Commission's view is that this approach best promotes the NEO assessment criteria. • As expressed by representatives to the TWG, it is pragmatic and sensible to differentiate load by technical behaviour and controllability, and not just technology label or raw MW size. The focus on power-electronic behaviour, interaction with system strength, and disturbance ride-through capability is consistent with how modern data centres, electrolysers and similar loads actually present risk to the system. • Detailed reasoning is provided in section 2.2.
Option 2: System impact only	Classification of IBL as large IBL achieved through system impact assessments by NSPs per the applicable S5.3 access standards	• We consider that this approach may result in regulatory complexity, and therefore, would not enable us to achieve the applicable NEO criteria. • This is because system impact 'screening' with respect to each access standard would be needed, to inform whether the plant is large IBL. • Awaiting the outcome of this process to know whether the plant would be classified as a large IBL would likely lead to uncertainty and potential adverse cost ramifications.
Option 3: MW threshold only	Classification of IBL as large IBL achieved through MW thresholds (tiered or otherwise)	• While this may be administratively 'simple', a standalone MW threshold is not always directly correlated with system risk; fixed MW bands do not account for local network strength or voltage levels. • Accordingly, the Commission's view is that this approach may not meet the NEO criteria for ensuring safety, security and reliability.
Option 4: Connection point voltage change only	Classification of IBL as large IBL achieved through the voltage percentage change at the connection point only (with potential thresholds, or at NSP discretion)	• This approach may not promote regulatory certainty per the NEO assessment criteria, as it may be overly complex to design such a framework, and application of such a framework could be similarly complex for connection participants. • It may also risk safety, security and reliability as this approach could unnecessarily exclude large connections with power system impact at lower voltages.

Option	Description	Commission's analysis
Option 5: Do nothing	Maintain the current regulatory framework	• Submissions to the consultation agreement called on the AEMC to develop a clear regulatory framework for applying the Schedule 5.3 access standards. This intent was also widely supported by representatives to the TWG. • If we do nothing, we may risk the safety, security and reliability of the power system as some large loads increasingly shift from being passive to active in their grid interaction. The Commission does not consider this to be a viable approach (see Chapter 2, which details the risks posed by large IBL to the system security and stability of the NEM). • We also may risk falling behind comparable international jurisdictions that are more competitive in the data centre market, risking investment in Australia due to a lack of clear and transparent regulatory frameworks.
Option 6: Compulsory registration for large IBLs	Require IBLs 30 MW or greater to register with AEMO, which would attract the automatic application of access standards under Schedule 5.3 of the NER.	• The Commission explored whether to make it compulsory for large IBLs that are 30 MW or greater to register with AEMO, which would attract the automatic application of access standards under Schedule 5.3 of the NER. Some stakeholders support this approach as it would avoid ambiguity and be clear. • The Commission's view is that, at this stage, this may be a heavy-handed approach that could be overly onerous. As noted by Essential Energy in their submission to the consultation paper, imposing the full technical work package as required under NER Schedule 5.3 on every IBL proponent could lengthen connection timeframes, increase costs, and risk deterring regional data centre investment without delivering commensurate benefits or protections to the network. • Compulsory registration could also heavily erode the technical discretion of DNSPs in a way that may compromise power system security. For instance, Ausgrid submitted that AEMO's current models do not completely capture the sub-transmission and distribution networks. As a result, AEMO does not, and is unable to, identify many system needs at a distribution level. As such, flexibility and discretion should be built into the NER around the technical assessment of connecting load facilities, and this discretion must be given to the DNSP responsible for managing the connection application rather than AEMO.

Source: AEMC.

3.3.2 The framework for classifying Schedule 5.3 plant builds upon the important headway made in AEMO's review

The Commission's draft rule for classifying Schedule 5.3 plant builds directly upon AEMO's Access Standards Review and the extensive stakeholder feedback received through that process.[94] By explicitly leveraging AEMO's prior technical analysis and consultation, the Commission avoids re-litigating settled issues and duplicating work, while remaining focused on addressing the clear gaps identified in that earlier review. This approach promotes regulatory efficiency, institutional coherence, and continuity in reform.

During its review, AEMO examined potential approaches to defining and classifying 'large' loads but was unable to complete this component of the work within the prescribed timeframe due to complexity, a diverse range of stakeholder feedback, and the need for further analysis and consultation.

Since AEMO's review concluded, several developments have strengthened the case for progressing this reform through this rule change.

- Industry understanding of large load technologies, including IBL, has matured. There is now greater practical experience connecting large IBL to the NEM, providing empirical insights into system impacts. These learnings have been a key focus of the Commission's consultation through this rule change process.
- Federal, state and territory governments are increasingly focused on regulatory certainty and transparency for large energy-intensive facilities.[95]
- In addition, regulatory and technical advancements in comparable international jurisdictions provide useful reference points for refining classification approaches.

Taken together, these factors mean the Commission can build on AEMO's technical groundwork while responding to the evolving operating environment. This ensures that reforms to the access standards are evidence-based, forward-looking, and proportionate to emerging system security risks, thereby supporting investment certainty and the long-term interests of consumers.

How AEMO considered defining large loads in its Review

AEMO's review initially focused on introducing a size threshold for large loads (see Figure 3.2 below). While stakeholders generally supported greater clarity on what constitutes a large IBL, feedback on the way forward was mixed. AEMO's consultation moved away from explicit standalone MW thresholds and emphasised flexibility and evidence-based assessment, recognising the difficulty of a one-size threshold for mixed-technology sites.

The Commission has drawn upon this feedback to inform the draft rule, including feedback such as:[96]

- the proposed definition for IBL was quite broad and needed refining to recognise technical performance capabilities
- IBLs with UPS systems should not be able to disconnect from the grid at will, as this could compromise power system security

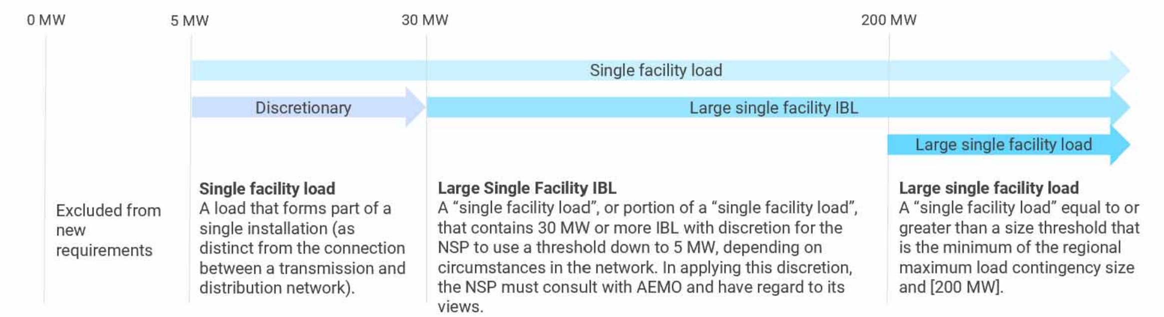
94 For more information, see: AEMO, Review of technical requirements for connection (NER clause 5.2.6A), April 2024, website.

95 See for instance DCCEEW, Energy and Climate Change Ministerial Council meetings and communiques, 16 December 2025 Communique.

96 For more information on stakeholder feedback to AEMO's Access Standards Review, see our summary in the slides for TWG #2, as well as AEMO, Review of technical requirements for connection (NER clause 5.2.6A), April 2024, website.

- in determining what constitutes a 'large load', traditional non-IBLs, like smelters, should not need to demonstrate compliance with new access standards where they pose minimal to no system security risk.

Figure 3.3: Thresholds considered by AEMO in its Review



Source: AEMC, adapted from AEMO's Review Addendum to the Draft Report, April 2023.

3.3.3 The Commission considered international approaches to defining and regulating large loads

Across the globe, regulators from comparable jurisdictions are also grappling with similar risks posed by data centres, including:

- sudden large, simultaneous disconnections from many data centres, which can destabilise frequency and dispatch
- regulatory gaps between rules for generators and very large loads, particularly IBLs.

Within jurisdictions such as the United Kingdom, the European Union, Canada, Ireland, the United States, and Singapore, large loads (including large IBLs) are increasingly being defined and regulated to address their potential impacts on power system security and to enhance operational visibility. Similar to developments in the NEM, these reforms have been driven by the rapid growth of large IBL connections, particularly data centres, hydrogen electrolysers and other high-demand facilities.

The Commission has considered these international experiences as part of this rule change. They provide useful context for determining whether, and in what manner, the NER should define and regulate large loads to promote power system security while continuing to support efficient investment and innovation.

Taken together, international approaches demonstrate that jurisdictions are seeking to manage the influx of large IBLs through a range of mechanisms, including MW-based size thresholds, connection point voltage criteria, system impact assessments, or combinations of these elements. The choice of approach reflects the specific characteristics and policy priorities of each jurisdiction, and involves placing differing emphasis on regulatory certainty through prescriptive thresholds and flexibility through principles-based, engineering judgement.

Figure 3.4: High level summary of the ways in which international jurisdictions are defining and classifying large loads

Absolute size threshold	ERCOT (Texas) SB6 applies a threshold of 75 MW for a customer connection to be considered a large load.
Multi-dimensional threshold	Fingrid is proposing three size thresholds (Power class E: 10-30 MW, Class F: 30-250 MW and Class G: ≥250 MW), with differentiated technical requirements applying for specific power classes and load types (e.g. data centres, electric boilers and other demand facilities). A multi-dimensional threshold could also include a connection point voltage.
Impact on power system	The NERC (North America) definition characterises a large load as one that poses a reliability risk to the bulk power system due to demand or operation characteristics. However, there is no threshold. Examples include, but are not limited to, data centres, cryptocurrency mining facilities, hydrogen electrolysers, manufacturing facilities, and arc furnaces.
Connection point voltage	AESO (Alberta, Canada) and the German TSOs apply technical requirements to data centres (AESO) and electrolysers (German TSOs) that are connected to the high voltage transmission network.

Source: AEMC

3.4 The Commission has made a draft rule to promote compliance with applicable performance standards

Rule 4.15 of the NER sets out the legal obligations on Registered Participants to ensure their plant complies with its agreed performance standards and to manage, report and rectify any breaches.

The AER's submission to our consultation paper recommends that the Commission extend rule 4.15 of the NER to all Schedule 5 Participants, including non-registered participants. The AER considers this desirable, as it would ensure their compliance with the applicable performance standards post-connection and allow the AER to seek civil penalties for any breach.[97]

As explained in the following section, the Commission's view is that the AER's approach may be inappropriate for non-registered Schedule 5 Participants, as it could be too onerous, given that such participants have not undergone the registration process under Chapter 2 of the NER.

As an alternative approach, the Commission's draft rule would make targeted, incremental reforms to promote compliance with access standards recorded in connection agreements for non-registered Schedule 5 Participants, including loads, generators, and integrated resource systems. These reforms would improve visibility for AEMO and the AER on the performance standards agreed upon between NSPs and non-registered Schedule 5 Participants.

In this section:

- Section 3.4.1 outlines why the AER seeks to apply the compliance requirements under rule 4.15 of the NER to non-registered Schedule 5 Participants.
- Section 3.4.2 explains the Commission's targeted, incremental reform approach, aimed at ensuring non-registered Schedule 5 Participants comply with their performance standards.

97 AER submission to the consultation paper, p 1.

Box 8: Connection agreements must record performance standards

Under rule 5.3.7 of the NER, a connection agreement between connecting parties must include the proposed performance standards with respect to each of the technical requirements identified in schedules 5.2, 5.3 and 5.3a, and each proposed performance standard must have been established in accordance with the relevant technical requirement.

The proposed performance standards must be based on the automatic access standard or the negotiated access standard developed in accordance with clause 5.3.4A of the NER.

3.4.1 The AER recommended extending the compliance requirements in rule 4.15 of the NER to non-registered Schedule 5 Participants

As noted above, rule 4.15 of the NER requires Registered Participants to ensure that their plant complies with the agreed performance standards specified in the connection agreement. This is achieved through:

- imposing strict ongoing compliance obligations
- requiring formal monitoring systems
- mandating immediate reporting of breaches
- establishing a clear rectification and review process
- enabling regulatory oversight by AEMO and the AER
- backing obligations with civil penalty provisions.

In its submission to the consultation paper, the AER proposed that those compliance requirements should extend to all Schedule 5 Participants, not just Registered Participants. This would include distribution connected data centres that tend not to be registered.

Reasons for this include:[98]

- The recent Package 1 rule change introduced the term 'Schedule 5 Participant' so that the technical requirements under schedules 5.2, 5.3 and 5.3a apply based on plant type, rather than based on registration status.[99] As such, this broader term should be used in rule 4.15 of the NER to capture non-registered participants.
- In this rule change, the proponent recommended that testing requirements under clause 5.7.2 of the NER should apply to all Schedule 5 participants, not just Registered Participants.[100] Accordingly, the AER would like a consistent approach for the compliance requirements in rule 4.15 of the NER.
- Extending the compliance and enforcement requirements to all Schedule 5 Participants would recognise that they are equally able to be non-compliant with performance standards as compared with the plant of Registered Participants. Because of this, the AER recommends it should be able to seek civil penalties on these non-registered participants for breaches of their performance standards.

CitiPower, Powercor and United Energy (CPU) also considered that the AEMC should consider extending enforceability and compliance requirements under rules 4.14 and 4.15 to all 'schedule 5

98 AER submission to the consultation paper, p 1.

99 The AER mistakenly considers that the Package 2 final rule broadens connection requirements under Schedules 5.2, 5.3 and 5.3a of the NER to non-registered participants. However, it only acts to make clear that the access standards apply to those participants, regardless of registration status. Accordingly, the final rule in Package 1 does not broaden the application of access standards in the way suggested by the AER. See AER submission to the consultation paper, p 1.

100 See Chapter 7 of this draft determination, which provides a draft rule on this proposal to extend the testing requirements to all Schedule 5 Participants.

participants', which includes non-registered participants. This is because any schedule 5.2, 5.3 and 5.3A participant should be able to demonstrate and ensure ongoing compliance with their performance standards.[101]

In recognising the AER's concerns, the Commission's view is that:

- Under rule 4.15, the AER can take enforcement action against the Registered Participant if its plant is not meeting performance standards, regardless of whether there is a non-registered third party who caused the non-compliance.
- Extending the compliance requirements to non-registered Schedule 5 Participants could be considered overly onerous, as it would capture smaller, non-registered participants who would be required to demonstrate rigorous and ongoing compliance in a way that is not commensurate with risk.
- It could also blur the distinction between registered and non-registered participants. Chapter 2 is designed to ensure that entities with material system or market impact are formally registered and regulated accordingly. Extending rule 4.15 without adjusting the registration framework risks imposing participant-level regulatory burdens on entities that deliberately chose not to register.

However, the Commission has identified that there are improvements that could be made to ensure non-registered participants are appropriately encouraged to comply with the rules and their applicable performance standards, which are outlined below.

3.4.2 The Commission's draft rule introduces a targeted, proportionate approach to compliance

Ensuring compliance with the NER technical standards for connections is important for underpinning the safety, security and reliability of the grid. The Commission recognises that, in light of the increasing number of non-registered Schedule 5 Participants such as data centres, we need to address any compliance gaps under the NER.

Accordingly, the Commission has made a draft rule, promoting the NEO, that encourages non-registered Schedule 5 Participants to comply with their applicable performance standards, in a way that is commensurate with risk and recognises their choice not to obtain registration under Chapter 2 of the NER.

AEMO would maintain a register of performance standards for all Schedule 5 Participants

Under clause 4.14(n) of the NER, AEMO is required to establish and maintain a formal register of the performance standards applicable to Registered Participants' plant. The draft rule seeks to extend the application of this clause to all Schedule 5 Participants.

It is a light-touch approach that would ensure AEMO and the AER have complete visibility over all performance standards made in accordance with Schedules 5.2, 5.3 and 5.3a, regardless of registration status.[102]

Connection agreements with non-registered Schedule 5 Participants would need to provide reasonable assurance of ongoing compliance with performance standards

Further, the draft rule would require connection agreements with non-registered participants to include terms and conditions that provide reasonable assurance from the connection applicant of

101 CPU submission to the consultation paper, p 4.

102 NER clause 4.14(n). We note that, per paragraph (n1), by 1 July each year, AEMO must provide to the AER and up-to-date copy of the register of performance standards required to be maintained, including a copy of the corresponding performance standards.

ongoing compliance with the performance standards, in a manner consistent with good electricity practice.[103] This could materially improve compliance outcomes for unregistered Schedule 5 Participants by leveraging private contractual arrangements as a practical enforcement mechanism.

In the absence of a direct regulatory compliance regime under the NER, embedding enforceable compliance obligations within connection agreements creates a clear and legally binding pathway to secure ongoing adherence to agreed access standards. Importantly, this approach aligns incentives without fundamentally altering the registration framework established under Chapter 2 of the NER. It preserves the distinction between registered and non-registered participants, while ensuring that plant connected to the power system, regardless of registration status, continues to operate in a manner that supports system security. Moreover, the Commission understands that, in practice, connection agreements are already the primary vehicle for ensuring enforceable commitments to technical performance standards.

103 Draft rule, clause 5.7.3(b)(1)-(2).

4 We have introduced disturbance ride-through access standards for loads and clarified requirements for generators

Box 9: Key points in this chapter

The Commission has made a draft rule that would:

- Introduce disturbance ride-through access standards for IBL as part of the Schedule 5.3 access standards, including:
  - voltage disturbance ride-through and active power recovery
  - frequency disturbance ride-through
  - avoiding protection systems that respond to small phase shifts or multiple successive faults
- Require all types of Schedule 5.3 plant to provide information about their ride-through capability to the NSP or AEMO, if requested, as part of the connection process
- Clarify and restrict the scope of credible contingency events used in the disturbance ride-through access standards for Schedule 5.2 plant (generators and integrated resource systems), such that:
  - the automatic access standard includes non-credible contingencies that AEMO is likely to reclassify as credible
  - both the automatic and minimum access standards include credible contingencies used by the NSP in its network planning.

The ride-through capability of Schedule 5.3 plant is becoming increasingly relevant as more large loads, such as data centres, connect to the NEM. The behaviour of large loads, particularly IBL, following a disturbance or contingency event can create risks for system security. Under the NER, there are currently no specific ride-through requirements for loads, meaning they are permitted to trip (disconnect) in any circumstance, even if the access standards do not require it. The disconnection of multiple loads due to a disturbance could result in significant supply disruptions for consumers if this risk is not managed. AEMO also identified that AEMO and NSPs lack visibility of any ride-through capability that large loads do have, which can impact their ability to prepare for and respond to contingency events effectively and efficiently.

The Commission considers that introducing disturbance ride-through requirements for IBL, along with information provision for all Schedule 5.3 plant, would promote the NEO by managing these system security impacts. Clear and predictable technical standards would also support a transparent, efficient connections process.

The draft rule would also clarify the requirement for Schedule 5.2 plant to ride through disturbances caused by credible contingency events. Currently, this requirement is potentially unbounded because AEMO may reclassify non-credible contingencies as credible at any time depending on network conditions. This creates uncertainty and compliance risk for connection applicants. The draft rule would improve regulatory certainty and predictability by clarifying which contingency events are covered by the automatic and minimum access standards.

In this chapter:

- Section 4.1 explains the draft rule provisions for the disturbance ride-through capability of loads, including ride-through access standards for IBL, information provision for all Schedule 5.3 plant, and limits on how protection systems can operate for IBL.
- Section 4.2 explains the amendments to the ride-through access standards for generators in the draft rule, which would clarify and restrict the scope of credible contingency events.

Source: AEMC.

4.1 We have made a draft rule to introduce disturbance ride-through requirements for IBLs

As discussed in Chapter 2, the rapid growth of data centres and other IBL poses risks to system security in the NEM. A key risk is the potential for disconnection of multiple large IBL following a disturbance, which can impact power system stability and possibly lead to a major supply disruption, as outlined in section 4.1.1. With more large IBL connecting to the NEM, and without any requirements for large load ride-through capability in the NER, the Commission is concerned that:

- Large load disconnections could negatively impact security outcomes for consumers, because they may contribute to widespread outages.
- The costs of managing this risk under the existing framework may increase, and these costs would be passed on to consumers. For example, to manage the impact of a potential large loss of load, AEMO may need to procure additional contingency FCAS.

We consider that introducing disturbance ride-through access standards for IBL would contribute to the NEO by supporting system security as more large IBL connects to the NEM, and keeping costs down. Explicit access standards would also improve clarity and consistency for all parties involved in the connection process.

The Commission has made a draft rule that differs from the proposal in AEMO's rule change request.[104] The draft rule would introduce a set of disturbance ride-through access standards that would apply to IBL.[105] The Commission has opted to progress disturbance ride-through standards instead of AEMO's proposal for designing protection systems and settings to maximise ride-through capability, following consultation with stakeholders including AEMO. The draft rule would also create a requirement for connecting loads to provide information about their ride-through capability to AEMO and the NSP on request.[106]

In this section:

- Section 4.1.1 explains the issues associated with the disturbance ride-through capability of large loads that this rule change is seeking to address.
- Section 4.1.2 summarises the changes that AEMO proposed in the rule change request relating to the disturbance ride-through capability of loads.
- Section 4.1.3 outlines the draft rule ride-through access standards and our reasoning for introducing these standards

104 AEMO rule change request overview, pp 69-71.

105 Draft rule, clause S5.3.13.

106 Draft rule, clause S5.3.1(a1)(2A).

- Section 4.1.4 sets out the detailed design of the ride-through access standards.
- Section 4.1.5 explains the draft rule information provision requirement, and how and why it differs from AEMO's proposal.

4.1.1 The behaviour of large loads during a disturbance is becoming significant for system security

A secure power system must withstand disturbances, including generator and load disconnections

Following a power system disturbance, the ride-through and response of all plant connected to the network is critical to avoid plant tripping unnecessarily, voltage decline and power system instability.

Faults and disturbances in the power system can cause plant, including large loads, to disconnect. Electrical plant generally has protection systems that measure power system quantities (such as current, voltage and frequency) and disconnect the plant if the measured quantities exceed certain limits, in order to prevent damage to equipment. Protection systems are critical equipment and plant disconnection can be an appropriate response to a fault or disturbance. However, in order to maintain the security and stability of the power system as a whole, it is important that only the minimum amount of power system equipment is disconnected following a disturbance.

'Ride-through capability' refers to the ability of plant to stay connected and continue operating during and after a disturbance. There are comprehensive ride-through requirements for generators and integrated resource systems. There are no existing disturbance ride-through requirements for loads, so loads are permitted to trip at any time or in any circumstances. Loads with UPS, such as data centres, may be more likely to disconnect from the power system in a disturbance as they can switch to back-up supply without interrupting services to their users (such as data centre customers). UPS technology is critical for continued data centre operation.

AEMO is responsible for managing power system security, including the impact of faults and plant disconnections. AEMO must ensure the power system returns to a secure operating state after a contingency event, such as the loss of a generator or large loss of load, while maintaining supply to consumers.[107] AEMO has several tools at its disposal to manage contingency events and the risk of contingency events in operational timeframes, including:

- Constraints in dispatch, including inter-regional transfer limits
- Primary frequency response
- Frequency control ancillary services (FCAS)
- Network support and control ancillary services (NSCAS)
- Directions and instructions
- Lack of Reserve (LOR) market notices and the Reliability and Emergency Reserve Trader (RERT) function
- Minimum System Load (MSL) market notices and actions that increase demand or reduce distributed PV generation
- Emergency under frequency load shedding (UFLS) and over frequency generation shedding.

These mechanisms all have costs – some of which are preventative or insurance costs and some of which are only incurred when there is a security incident.

107 NER clauses 4.2.3, 4.2.4, 4.2.6.

The impact of load disconnections is increasing with the influx of large IBL

As more large loads, and especially IBL, connect to the NEM (see section 2.1), load disconnections could have a more significant impact on the grid. The disconnection of a very large load could impact the grid by upsetting the supply-demand balance and causing or exacerbating a frequency or voltage disturbance.

While most individual loads are not large enough to have a significant impact by themselves, the Commission is concerned about the aggregate effect of multiple large or moderately-sized IBL. (See also Box 4 in Chapter 2.) IBL accounts for the majority of incoming large loads and data centres account for the majority of incoming IBL. Data centres are likely to have similar design features, including protection settings (in part because they use equipment supplied by relatively few OEMs). Data centres are also likely to be clustered in specific locations, such as major cities or industrial zones within those cities. This means that a number of data centres might see the same power system disturbance and respond in the same way (that is, by disconnecting).

Specifically, a risk of cascading outages may emerge as more large loads connect.[108] A cascading outage is an uncontrollable succession of plant disconnections, each of which is triggered by the events preceding it.[109] For example:

- A transmission fault occurs and causes a voltage disturbance
- One or more data centres disconnect as a result of the initial disturbance
- Those disconnections exacerbate the voltage disturbance because of the sudden reduction in power consumption
- The larger voltage disturbance causes other plant to disconnect
  - Since voltage is a local quantity, nearby plant would be most severely affected, but the impacts could be geographically widespread
  - Other types of plant including generators and non-IBLs could also be impacted.

This risk is greatest when multiple large loads respond to disturbances in a similar way, and when they are co-located or clustered close together.[110] These characteristics of data centres contributed to the July 2024 Virginia large load loss incident, where 60 data centres with a similar protection setting tripped after a lightning arrestor failure, resulting in 1500 MW of load being disconnected.[111]

An aggregate loss of load, including as a result of cascading outages, could have the following negative impacts:

- Loss of supply for the loads directly affected (especially any non-UPS loads), and loss of revenue for any generators or storage affected
- Reduced power quality, where voltage and frequency may stray outside the normal range
- In a severe case, blackouts in an area of the grid, which would impact supply to residential and small business customers as well as large loads
- In an extreme case, a system black, which would impact supply to a large number of consumers for an extended period. Restart costs would also be passed on to consumers.

If a large amount of IBL continues to connect under the existing framework, AEMO and NSPs would face increased costs to manage the risk of large load disconnections, which could be

108 As noted in AEMO's rule change request overview, pp 69-70.

109 NER Chapter 10 glossary definition of 'cascading outage' (paraphrased).

110 AEMO rule change request overview, pp 69-70.

111 NERC, Incident Review: Considering Simultaneous Voltage-Sensitive Load Reductions, January 2025, pp 1-2.

passed on to consumers. While there are tools available for AEMO to manage system security risks, such as dispatch constraints and contingency FCAS, AEMO would likely need to use these tools more frequently and to a greater extent. AEMO may also need to take actions that have other impacts on consumers, such as:

- Reducing interconnector power transfer limits (see also Box 3 in Chapter 2), which could increase wholesale prices in some regions
- Actions to manage MSL conditions, such as recalling planned outages, curtailing non-essential generation or shedding reverse flowing feeders (which would disconnect some small customers).

Similar risks associated with the disturbance ride-through behaviour of large loads are emerging in many international jurisdictions, influenced by the global growth of data centres. Several jurisdictions have introduced or are proposing disturbance ride-through and other technical requirements for large loads to address these risks. Appendix A provides more information on emerging international ride-through requirements.

4.1.2 AEMO proposed two amendments to address disturbance ride-through risks

The issue being addressed by the draft rule

AEMO's rule change request identified the system security impacts associated with large load disturbance ride-through discussed above. In particular, AEMO raised issues with the visibility of load ride-through capability and incentives for strong ride-through capability.[112]

Currently, a lack of visibility of loads' ride-through capability is contributing to system security risks and the cost of managing them.[113] AEMO and NSPs do not necessarily have access to information about loads' ride-through capability (that is, when they will trip as a result of a disturbance), because:

- Since there are no ride-through requirements for loads, loads' ride-through capability is typically not recorded in their performance standards
- If the performance standards do include ride-through capability, the NSP will have visibility but AEMO only receives a copy if the Schedule 5.3 Participant is a Registered Participant[114]
- The existing information provision requirements in clause S5.3.1 of the NER do not always provide a full picture of loads' ride-through capability because it is influenced by a range of factors, which differ for different load technologies.

This lack of visibility affects AEMO's and NSPs' ability to understand the potential impact of contingency events, which can increase costs because they must make conservative assumptions to manage risks. This issue is likely to become more material as more large IBL connects to the NEM.[115]

Further, since there are no ride-through requirements for loads, new load connections may not always be designed with strong ride-through capability. AEMO's rule change request noted the possibility that loads' protection settings may not fully use the inherent capability of their protection systems, effectively lowering their ride-through capability. AEMO considered that these

112 AEMO rule change request overview, pp 69-71.

113 Ibid., pp 69-70.

114 NER clause 4.14(n).

115 AEMO rule change request overview, pp 69-70.

conservative protection settings could cause loads to trip unnecessarily, contributing to the system security challenges outlined above.[116]

AEMO's proposed solution

To address these issues, AEMO proposed two changes regarding the ability of loads to ride through disturbances.

AEMO previously considered introducing disturbance ride-through requirements standards for loads in its Access Standards Review. AEMO concluded that while ride-through requirements for loads would likely be needed in the future, more consultation was required.[117] As a result, AEMO did not propose disturbance ride-through access standards in the rule change request, but only the light-handed information provision and maximisation measures.[118]

Provision of information on ride-through capability

AEMO proposed to address the lack of visibility of loads' ride-through capability via information provision. Under AEMO's proposal, Schedule 5.3 connection applicants would need to provide information about the load's ride-through capability to the relevant NSP, if requested by that NSP in consultation with AEMO. The NSP would also have the option to include that information in the load's performance standards, and if so, it would be required to provide AEMO with a copy.[119]

Consistent with the existing information provision requirements in clause S5.3.1 of the NER, the proposed change would apply to all Schedule 5.3 load connections (and modifications), but the NSP would have discretion on whether to request the information or not. For example, NSPs may be more likely to request ride-through information for a load that is large, inverter-based, or connecting in a higher-risk location.

AEMO considered that the provision of ride-through capability information to the NSP and AEMO would assist them in maintaining the stable operation of the network and system security. Visibility of how loads will behave following a disturbance may enable AEMO to reduce the complexity and cost of preparing for and responding to contingency events. AEMO noted it would also provide insight into the behaviour and capability of large loads to inform future work on managing large loads in the NEM.[120]

Protection settings to maximise ride-through performance

AEMO proposed an amendment to the protection systems access standards for loads (S5.3.3) to encourage the design of protection systems and settings with greater ride-through capability. The proposed rule would require the NSP and Schedule 5.3 Participant to cooperate to design protection systems and settings that maximise ride-through capability, subject to engineering and safety requirements. The proposed rule would apply to all Schedule 5.3 load connections (and modifications).[121]

The intent was that protection settings should allow for operation beyond the requirements of the performance standard where reasonable, to use as much of the inherent ride-through capability as

116 Ibid., pp 70-71.

117 AEMO, Access Standards Review, final report, December 2023, pp 102-103.
AEMO also commenced a Large Loads Review considering this question in late 2024, but paused it due to a potential scope overlap with this Package 2 rule change process. (AEMO, Schedule 5.3 Large Loads Access Standards Review Kick-off, December 2024.)

118 AEMO rule change request overview, pp 69-71.

119 AEMO rule change request proposed drafting, p 185 (proposed amendment to S5.3.1(a1)) and p 189 (proposed new clause S5.3.4A).

120 AEMO rule change request overview, p 70.

121 Ibid., p 71.
AEMO rule change request proposed drafting, pp 187-188 (proposed amendments to clause S5.3.3(c)).

is practical with little or no additional cost. AEMO's proposal also included a caveat that safety and engineering requirements would be prioritised over maximising ride-through performance.[122]

The Package 1 rule change introduced an analogous requirement for generators and integrated resource systems (Schedule 5.2 plant) to maximise their ride-through capability. Schedule 5.2 plant's protection settings are required to be set such that the plant remains in operation as much as possible when not otherwise required to disconnect, subject to safety requirements and good engineering practice.[123] The proposal for loads differs slightly from the maximisation requirement for generators in that it is a requirement for cooperation between the network user and the NSP.[124]

Box 10: Current arrangements for disturbance ride-through

The existing Schedule 5.3 access standards require loads to have protection systems that will disconnect faulted elements when faults occur in or close to the plant itself. Box 19 in Chapter 5 describes these requirements in more detail.

In addition, the network user and the NSP are required to cooperate in the design and implementation of protection systems where there is inter-operation between the parties' protection systems or any shared use of equipment (NER clause S5.3.3(c)). A similar requirement applies to generators, integrated resource systems, and HVDC links (NER clauses S5.2.5.9(e) and S5.3a.6(c)).

Under the NER, there are currently no specific ride-through requirements for loads, meaning loads are permitted to trip (disconnect) in any circumstance, even if the access standards do not require it. For example, a large load may be designed to trip in response to voltage disturbances in order to prevent damage to its own equipment.

By contrast, there are extensive ride-through requirements for generators. The access standards require generators to remain in continuous uninterrupted operation (CUO) during:

- frequency disturbances (NER clause S5.2.5.3)
- voltage disturbances (NER clauses S5.2.5.4 and S5.2.5.6)
- multiple successive disturbances, provided each disturbance meets certain conditions - referred to as multiple fault ride-through (NER clause S5.2.5.5)
- a sudden power system load reduction, known as partial load rejection (NER clause S5.2.5.7).

Generators are also required to provide beneficial responses to disturbances, including:

- recovering active power to a certain level in a timely manner (NER clause S5.2.5.5A)
- injecting or absorbing reactive current to stabilise voltages after a fault (NER clause S5.2.5.5A)
- automatically reducing output power or disconnecting in response to an over-frequency event (NER clause S5.2.5.8).

Source: AEMC.

4.1.3 The draft rule would introduce access standards for disturbance ride-through to promote system security

We developed a draft rule to introduce new access standards for IBL for disturbance ride-through, including voltage and frequency disturbances and post-fault active power recovery.[125] In addition,

122 AEMO rule change request overview, p 71.

123 NER clause S5.2.5.8(b5). See also AEMC, *Improving the NEM access standards - Package 1*, final determination, pp 66-67.

124 AEMO rule change request overview, p 71.

125 Draft rule, clauses S5.3.12 and S5.3.13.

Schedule 5.3 connection applicants would need to provide information on their ride-through capability to the NSP and AEMO, at the NSP's request.[126] This would promote the NEO by managing the system security impacts of large IBL ride-through behaviour using clear and predictable technical standards.

The draft rule would introduce new disturbance ride-through access standards for IBL connecting to the grid. These access standards would apply to all Tier 3 and transmission-connected IBL, and some Tier 1 and Tier 2 IBL, subject to NSP discretion, as per the tiering framework outlined in Chapter 3. Under this approach, NSPs would only apply the disturbance ride-through access standards to Tier 1 and Tier 2 IBL where there is potential for an adverse system security impact.[127] This responds to stakeholder concerns that applying any new technical requirements to all IBL larger than 5 MW (as per the SSIAG definition) would be disproportionate to the risk.[128] Further, the disturbance ride-through access standards would not apply to non-IBL, as the risks associated with large load disconnections primarily arise from the growth in IBL.

The disturbance ride-through access standards in the draft rule would cover the following:

- Voltage disturbance ride-through, with three main components including:[129]
  - A voltage ride-through curve indicating the depth and duration of disturbances that IBL must be able to manage
  - Limits on increasing or decreasing active power or current during a disturbance, with different limits applying to different parts of the ride-through curve
  - A requirement for timely active power recovery after a disturbance.
- Frequency disturbance ride-through, with IBL being required to stay connected during certain frequency disturbances aligned with the Frequency Operating Standard (FOS)[130]
- Avoiding protection systems that operate in response to small phase shifts or multiple successive faults.[131]

Disturbance ride-through access standards would support system security

Introducing disturbance ride-through access standards for IBL would promote the NEO by addressing the system security risks posed by the rapid growth of IBL in the NEM, in a way that is clear, consistent and predictable. The Commission's view is that disturbance ride-through access standards, along with information provision, would address the issues raised in the rule change request more effectively than AEMO's initial proposal. Although AEMO considered disturbance ride-through access standards for loads in its Access Standards Review, it only proposed the light-handed information provision and maximisation measures in its rule change request.[132] However, the outlook for large loads is evolving rapidly, and the environment has changed since AEMO completed its review and submitted the rule change request.

Data centres have emerged as by far the dominant type of large IBL and continue to grow in size and number, and their ride-through capability is becoming increasingly significant. There is also potential for growth in other types of large IBL, such as electrolysers. Developing effective access standards now will provide a foundation for managing disturbance ride-through risks into the

126 Draft rule, clause S5.3.1(a1)(2A).

127 Draft rule, clause S5.3.1a(a1).

128 Submissions to the consultation paper: Essential Energy, pp 1-2; Ausgrid, p 3; EUAA, pp 4-5; Jemena, p 2; NEXTDC, p 9; AWS, p 3.

129 Draft rule, clause S5.3.13.

130 Draft rule, clause S5.3.12.

131 Draft rule, clause S5.3.3(f) and (g).

132 AEMO, Access Standards Review, final report, December 2023, pp 102-103.
AEMO rule change request overview, pp 69-71.

future as more large IBL connect to the NEM. In addition, we are now able to draw on recent developments to better understand the issues and develop effective solutions. Many international jurisdictions, such as the Electric Reliability Council of Texas (ERCOT) (USA) and Fingrid (Finland), are now introducing or consulting on ride-through requirements for large loads.[133] In Australia, AEMO and NSPs have gained further experience in connecting and managing large loads, including working with large load operators to decide modelling and technical requirements. Finally, there is ongoing innovation in data centre and UPS technology, which may be increasing their technical potential for ride-through capability.

Disturbance ride-through access standards would improve system security by ensuring that all IBL with the potential to adversely impact system security would have an appropriate level of ride-through capability. We have set the automatic and minimum access standards at a level that would significantly reduce the risk of IBL disconnecting at least during credible disturbances, provided that the impact of the disturbance is managed in accordance with the system standards. Reducing the risk of multiple large load disconnections would help ensure the power system remains stable after a disturbance and avoid customer outages. It would also avoid some costs that would otherwise be needed to maintain power system security, such as procuring additional FCAS.

The Commission acknowledges that the draft rule access standards may impose costs on some parties, but we consider the benefits for consumers outweigh these costs. Schedule 5.3 connection applicants may face increased costs in designing and building plant to comply with the new access standards. Connection applicants, NSPs and AEMO would also need to commit increased resources to prepare, assess, negotiate and advise on connection applications. This may include additional or more detailed modelling of IBL ride-through behaviour.[134] Finally, the new access standards may create barriers to connection for some loads, although the draft rule seeks to minimise this by providing flexibility. TWG feedback suggests that data centres and other large load connections are already facing ad hoc technical requirements and complex connection processes as NSPs seek to manage the impact of large IBL on their networks.[135] We consider that creating clear, consistent access standards will support a more efficient connections process in the long term.

The draft rule is informed by stakeholders' preference for explicit access standards

In submissions to the consultation paper, several stakeholders expressed a preference for explicit ride-through access standards instead of or in addition to AEMO's maximisation proposal.[136] Some stakeholders supported the rule change proposal as they agreed with AEMO's views that load protection settings may be overly conservative and considered the proposal was a reasonable, flexible way to address this.[137] Others, while also supportive, noted that disturbance ride-through access standards may be more effective than maximisation alone.[138] This feedback was reinforced during the TWG process, with most stakeholders including NSPs, load operators, OEMs and AEMO agreeing that disturbance ride-through access standards would be a better solution.

133 See Appendix A for more information.
134 See section 2.3 for further discussion of the modelling requirements for IBL.
135 See section 3.1.1 for a more detailed discussion of this issue.
136 Submissions to the consultation paper: EPEC, p 6; Gridmo, p 2; Transgrid, p 17; Hydro Tasmania, p 4; TE H2, p 2.
137 Submissions to the consultation paper: Ergon Energy/Energex, p7; SA Power Networks, p 6; ENA, p 5; AWS, pp 7-8; NEXTDC, p 8.
138 Submissions to the consultation paper: EPEC, p 6; Gridmo, p 2; Transgrid, p 17; Hydro Tasmania, p 4; TE H2, p 2.

Stakeholders also raised several concerns with the maximisation proposal following the consultation paper:

- Several stakeholders questioned how maximisation would impact the negotiation process, for example how disagreement between connection applicants and NSPs could create delays and additional costs.[139]
- Parties from both sides of the connections process were concerned that the suggested drafting was ambiguous. Some NSPs considered they would be unable to enforce the proposed rule, while loads considered that NSPs would be able to use the proposed rule to demand better ride-through performance, even at material cost.[140]
- The Energy Users Association of Australia (EUAA) and Gridmo, which did not support AEMO's maximisation proposal in its original form, were concerned that the proposed rule may impact customers' right to disconnect.[141]
- Transgrid considered that 'protection settings', as used in AEMO's suggested rule drafting, would not capture the behaviour of control (rather than protection) systems that can also disconnect plant (for example, due to poor power quality).[142]
- Ausgrid was concerned that the maximisation proposal would require additional modelling, with time and cost implications, and that there was insufficient evidence of the issue to be addressed.[143]
- ElectraNet noted that keeping IBL online during disturbances could risk dynamic instability in certain conditions, depending on the technology.[144]
- Data centres noted that maximising ride-through capability could increase costs and that it would not be feasible for loads to meet the same standard of ride-through capability as generators, due to the technical differences.[145] Data centres also questioned how ride-through requirements would be applied to a data centre that scales up gradually in size, which is common in the industry.[146]

The Commission agrees that AEMO's proposed requirement for protection system and settings to maximise ride-through capability could be open to different interpretations and may lead to delays in the negotiation process. Although the intent of the proposal is to utilise inherent ride-through capability at little or no additional cost, we consider it is likely to be applied inconsistently so it may not be effective and may result in unnecessary costs. In addition, the maximisation proposal would not support a consistent level of ride-through capability across all or most IBL. We consider that explicit access standards would provide greater certainty and predictability for connection applicants, NSPs and AEMO, which would better support system security as well as a clear, efficient connections process.

How we designed the new disturbance ride-through access standards

We have sought to align the automatic access standards with the system standards (Schedule 5.1a of the NER) for normal operation and/or with the impacts of credible contingencies, where relevant. This is appropriate because the system standards represent the quality of service that

139 Submissions to the consultation paper: AirTrunk, p 10; EPEC, p 6; EUAA, pp 9-10; Gridmo, p 2; ElectraNet, p 1.
140 Submissions to the consultation paper: SA Power Networks, p 5; EUAA, p 10; Gridmo, p 2; EPEC, p 6.
141 Submissions to the consultation paper: EUAA, p 9; Gridmo, p 2.
142 Transgrid, submission to the consultation paper, pp 16-17.
143 Ausgrid, submission to the consultation paper, pp 2-3.
144 ElectraNet, submission to the consultation paper, p 1.
145 Submissions to the consultation paper: AWS, p 7; AirTrunk, p 10.
146 Submissions to the consultation paper: AirTrunk, p 10; NEXTDC, p 6; TM Advisory, p 4.

load connections can generally expect. That is, NSPs operate the network and manage connections in such a way as to keep power system conditions within the system standards wherever possible.[147] Additionally, the new automatic access standards would be at the same level or less onerous than the automatic access standards that apply to generators (Schedule 5.2).

We have designed the minimum access standards to provide flexibility for loads that may have different technical capabilities. This approach acknowledges the variety of technical characteristics amongst IBL, including but not limited to data centres, so that loads do not face unreasonable barriers to connection. To this end, the draft rule includes a low-level minimum access standard for some key aspects of ride-through capability.[148] For other aspects of ride-through capability there would be no minimum access standard.[149]

We have used a numerical formulation for the access standards wherever possible. During the TWG process, stakeholders expressed a strong preference for a clear, numerical formulation such as a ride-through curve, rather than a direct requirement to ride through contingency events, for example. This approach would provide simplicity and certainty for connection applicants and help limit modelling requirements.

The Commission has sought to align the new access standards in the draft rule with those in comparable international jurisdictions. If Australia's access standards align with practices in other mature markets, investors could reuse feasibility studies, grid-integration assumptions, and risk models developed for other jurisdictions, thereby reducing technical and regulatory incompatibilities that may deter investment in large loads for the NEM. Further, this approach would benefit connecting loads, such as large data centres, because OEMs that supply standardised load equipment would be better able to do so in Australia. This would shorten procurement, reduce engineering hours, and lower equipment integration risk for the NEM. Those savings would flow directly into lower capex and faster commissioning for data centre developers, whilst ensuring system security is maintained.

Appendix A provides more information about proposed or existing large load ride-through requirements in other jurisdictions.

4.1.4 Detailed description of the draft rule access standards

Voltage disturbance ride-through

Voltage disturbances can occur on the network for a number of reasons including a fault, loss of generation, or loss of load. These power system disturbances can cause the voltage to vary outside its normal operating range, which can affect how plant operates and trigger protection systems. While it is sometimes necessary for plant to trip off in a voltage disturbance to protect sensitive equipment, it is also important for plant to ride through disturbances where possible in order to maintain system stability and avoid undesirable outcomes such as cascading outages.

We have designed the voltage disturbance ride-through requirements to address both shallow and deep voltage disturbances. Shallow disturbances include voltages sags or swells, which are relatively small in magnitude and may last for seconds or minutes. These may be caused by distant faults, high impedance faults, or to a lesser extent, operational activities such as start-up of large transformers or motors. Deep disturbances are typically caused by faults, involve a larger voltage drop (even to zero or near-zero voltage), and are shorter (measured in milliseconds).

147 NER clause 5.2.3(b).

148 Draft rule, clause S5.3.13(f) and (g).

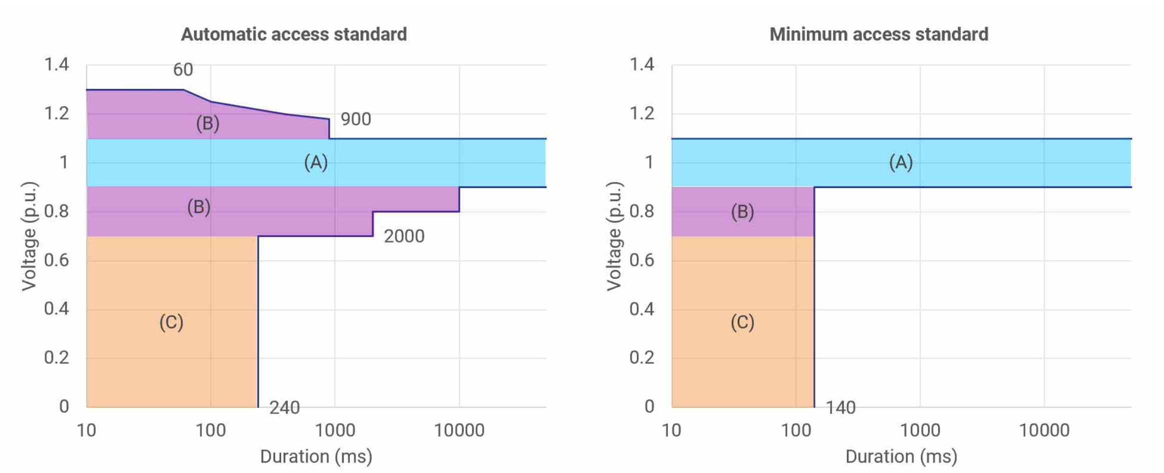
149 Draft rule, clause S5.3.12.

Voltage disturbances are location dependent: typically, plant that is close to a fault will experience the largest voltage disturbance, while plant that is further away will see a smaller disturbance. The ride-through requirements also cover transient (brief) overvoltages to a certain extent. It is important to consider different types of disturbances to support resilience in a range of power system conditions.

The new voltage disturbance ride-through standard is illustrated in Figure 4.1 below. There would be different requirements in each of the marked regions in Figure 4.1 as follows:

- **Region A:** Plant must not disconnect during a disturbance, and must maintain its active power and current consumption within the allowed limits (discussed below), depending on the variation in voltage, for the duration of the disturbance.
- **Region B:** Plant must not disconnect during a disturbance, and must maintain its active power and current consumption within the allowed limits, depending on variation in voltage, for the duration of the disturbance. After the disturbance, the active power must also return to between 90% and 110% of the pre-disturbance active power level (post-fault active power recovery).
- **Region C:** Plant is permitted to disconnect or reduce active power by any amount, but its active power and current consumption must not exceed the allowed maximum levels, depending on the variation in voltage, for the duration of the disturbance. After the disturbance, the active power must also return to between 90% and 110% of the pre-disturbance active power level.

Figure 4.1: Voltage ride-through curves



Source: Draft rule, clause S5.3.13.

Note: In both the automatic access standard and minimum access standard, consistent with Schedule 5.2 conventions, a voltage disturbance would be defined as starting when the voltage goes below 0.9 p.u. (per unit) or above 1.1 p.u. (similar to NER clause S5.2.5.4(a0)). A voltage disturbance would be taken to end when the voltage recovers to within 0.9-1.1 p.u. provided it remains in that range for 20 milliseconds (similar to NER clause S5.2.5.5(a)). See draft rule, clause S5.3.13(b)(i)-(iii).

For the automatic access standard, the overvoltage ride-through curve would be aligned with the system standards.[150] The Commission understands that some UPS models, and potentially other equipment, cannot withstand 130% overvoltages (while 120%, for example, may be achievable). However, we are confident that any such technical limitations could be accommodated in a negotiated access standard, noting the minimum access standard only goes up to 110%.[151]

150 Draft rule, clause S5.3.13(c)(1), (c)(2) and (d).
For the corresponding system standards, see NER clause S5.1a.4.

Since there is no quantitative system standard for undervoltages, we have designed the undervoltage ride-through curve based on the voltage ride-through requirements for generators and the relevant fault clearance times. For voltage disturbances where the voltage does not fall below 70%, the undervoltage curve is aligned with the corresponding requirements for generators.[152] The automatic access standard would require IBL to withstand voltage variations in the range 90-110% of nominal voltage regardless of duration.[153] That is, IBL should generally be capable of operating continuously in this voltage range. We understand that most data centres are likely to be able to stay connected and continue operating at voltages between 70-110%, for the durations indicated for the automatic access standard in Figure 4.1.

The automatic access standard would also include requirements for active power recovery after disturbances, including very short, deep disturbances, discussed further below.[154]

We have set the minimum access standard to a lower, less onerous level in the draft rule to provide flexibility for different load technologies. The minimum access standard would only require:[155]

- capability for continuous operation in the 90-110% voltage range, which is the same as the automatic access standard,
- active power and current limits during voltage disturbances subject to Figure 4.1, discussed further below,
- active power recovery after very short, deep disturbances, with different parameters to the automatic access standard, discussed further below.

The minimum access standard for voltage disturbance ride-through would also include a caveat that Schedule 5.3 plant does not need to continue operating if the ratio of voltage to frequency (relative to nominal values) exceeds a value of:

- 1.15 for more than 2 minutes, or
- 1.10 for more than 10 minutes.[156]

This is to ensure consistency with the access standards for Schedule 5.2 plant, so that loads are not subject to more onerous requirements than generators.[157]

The voltage disturbance ride-through access standard would be deemed to be an AEMO advisory matter.[158] This is consistent with voltage disturbance ride-through for Schedule 5.2 plant, which is also an AEMO advisory matter.[159]

Deep disturbance duration

The automatic and minimum access standards would include requirements for how IBL responds to deep disturbances, where the voltage falls below 70% of nominal voltage and may fall to zero. IBL would not strictly be required to stay connected during these disturbances, but would need to recover in a timely manner provided that the disturbance is short.[160]

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151 Draft rule, clause S5.3.13(g).

152 NER clause S5.2.5.4.

153 Draft rule, clause S5.3.13(c)(2).

154 Draft rule, clause S5.3.13(c)(3) and (4).

155 Draft rule, clause S5.3.13(g).

156 Draft rule, clause S5.3.13(g)(1).

157 NER clause S5.2.5.4(b)(3).

158 Draft rule, Chapter 10 glossary definition of 'AEMO advisory matter'.

159 NER clause S5.2.5.4 is included in the Chapter 10 glossary definition of 'AEMO advisory matter'.

160 Draft rule, clause S5.3.13(c)(4), (d), and (g)(3).

The disturbance durations are based on the worst-case primary protection fault clearance times in the system standards, shown in Table 4.1.[161] (See Box 11 for more information.) The maximum fault clearance times depend primarily on the fault location and connection voltage. In order to prevent a large scale loss of load and the resulting system security issues, IBL would need to wait until the fault is cleared by the network's protection systems and then start to bring load back onto the grid.

Box 11: Voltage disturbances and faults

Propagation of voltage disturbances

Voltage disturbances are somewhat localised, but can affect a wide area. The most severe impact occurs close to the fault, and the voltage can drop down to near zero in the most affected areas. See also Box 5 in Chapter 2.

Faults on higher voltage power lines will propagate down to lower voltages, but the reverse is not true. This is because the transformer impedance shields the upstream parts of the network from fault that occur downstream. This means that higher voltage transmission faults are likely to affect a larger number of loads (and other plant).

In addition, voltage disturbances may propagate over a larger area as renewables replace synchronous generators and with other changes to the grid, thus potentially affecting more large loads. For example, modelling by Fingrid has shown that the effect of a fault in Finland's 400 kV transmission network would impact a larger area in 2030 compared to 2025.

Fault clearance times

Clauses S5.1a.8 and S5.1a.9 of the NER specify the maximum fault clearance times for short circuit faults, as shown in Table 4.1. Faults at higher voltages are cleared more quickly than those at lower voltages.

Source: AEMC.
Fingrid, Draft for comments: KJV2026 Grid code specification for demand connections, June 2025, pp 16-17.

Table 4.1: System standard fault clearance times

Nominal voltage at fault location (kV)	Time (milliseconds)		
	Within a substation, connected plant, or on the near portion of a power line (relative to the protection system)	On the remote portion of a power line	Cleared by back-up or breaker fail protection
400 kV and above	80	100	175
at least 250 kV but less than 400 kV	100	120	250
more than 100 kV but less than 250 kV	120	220	430
less than or equal to 100 kV	As necessary to prevent plant damage and meet stability requirements		

Source: NER clauses S5.1a.8, S5.1a.9.

161 NER clause S5.1a.8.

In the automatic access standard, the deep disturbance duration of 240 milliseconds would ensure that plants respond in the correct way to a fault anywhere on the transmission or sub-transmission network that is cleared by primary protection.[162] This is based on the longest primary protection clearing time for any voltage over 100 kV in Table 4.1, plus 20 milliseconds (one cycle) of buffer time for the voltage to stabilise. Buffer time is required because the voltage disturbance caused by a fault will last slightly longer than the fault clearance time, while the voltage returns to a normal range. Consistent with TWG feedback, load would not be required to recover quickly from disturbances that are cleared by back-up or breaker fail protection, which is slower.

We selected a shorter duration of 140 milliseconds for the minimum access standard to provide some flexibility, noting that many international standards have similar requirements for approximately 150 milliseconds.[163] Most, although not all, faults that have a widespread impact would be cleared within 120 milliseconds as shown by Table 4.1. We have again added 20 milliseconds for the voltage to stabilise.

Post-fault active power recovery

The draft rule includes requirements for Schedule 5.3 plant to recover its active power within a certain time after a disturbance, by returning to a level of active power close to the pre-disturbance level.[164]

Generators usually need to remain in CUO as defined in the NER during voltage disturbances, but this definition (in full) would not work well for loads.[165] At a minimum, the load must stay connected to the network, unless required to disconnect under its performance standards. However, staying connected is not sufficient to solve the problem we have identified with ride-through of large IBL – particularly for large UPS loads – because the load could reduce its active power without disconnecting. For this reason, we have included active power recovery requirements (discussed here) and active power and current limits (discussed below) in the new access standard.

A UPS will respond to low voltage by drawing less power from the grid and making up the difference from its battery. This is unavoidable (due to the UPS rectifier current limit), but can be managed through existing frequency control mechanisms for a short period. However, after the disturbance ends, if the active power consumption doesn't return to the pre-disturbance level, the grid still sees a significant drop in demand as if a large amount of load had disconnected – with a corresponding power system security impact. Therefore, it is important that IBL is able to recover quickly after the disturbance in order to maintain the balance of supply and demand and maintain voltage stability.

The draft rule requirement for active power recovery would be that IBL must return to within 90-110% of its pre-disturbance active power level within:

- 500 milliseconds after the end of a voltage disturbance, for the automatic access standard[166]

162 Draft rule, clause S5.3.13(d).

163 Draft rule, clause S5.3.13(g)(3).
AESO, AESO Connection Requirements for Transmission-Connected Data Centres, Draft for Stakeholder Review, August 2025, p 14.
EirGrid, Grid Code Modification Proposal Form - MPID 345 Fault Ride Through, RoCoF and Post Fault Active Power Recovery for Demand Facilities, November 2025, p 7.Energinet, Technical Regulation 3.4.3 Requirements for Transmission-Connected Demand Facilities, Revision 1, September 2024, p 7.ERCOT, Nodal Operating Guide Revision Request - Large Electronic Load Ride-Through Requirements, November 2025, p 5.
RTE, Article 8.3.5 - Cahier des Charges des capacités constructives d'une Installation de consommation, version 1.0, February 2024, p 26.
See Appendix A (appendix A.1)] for more information.

164 Draft rule, clause S5.3.13(c)(1)(iii), (c)(3)(iii), (c)(4)(ii), (g)(2)(iii) and (g)(3)(ii),

165 NER clause S5.2.5.4(a) and (b), and NER Chapter 10 glossary definition of 'continuous uninterrupted operation'.

166 Draft rule, clause S5.3.13(c)(1)(iii), (c)(3)(iii) and (c)(4)(ii).

- One second after the end of a voltage disturbance, for the minimum access standard.[167]

This would apply to all undervoltages below 90% of nominal voltage, as well as all overvoltages between 110-130% of nominal voltage, provided that the duration of the disturbance is within the relevant ride-through curve in Figure 4.1. A voltage disturbance would be taken to end when the voltage returns to the range 90-110% of nominal voltage and remains for 20 milliseconds.[168]

We have selected 500 milliseconds for the automatic access standard because we understand AEMO would be able to manage the impacts of a voltage disturbance and resulting loss of load on the power system for that amount of time. Based on our consultation so far, many UPS models and other relevant data centre products have the capability to recover from zero to at least 90% active power within that time. A 500-millisecond recovery time also aligns with the standards proposed by EirGrid (Ireland) and Fingrid (Finland) (see Appendix A).[169]

If a UPS does not recover within 500 milliseconds by default, we understand this capability can typically be added through control system changes rather than hardware changes. Therefore, we do not expect compliance with this part of the access standard to impose significant costs. The Commission understands that recovering more quickly than 500 milliseconds is likely to be technically challenging because the control system needs to first confirm that the connection point voltage is stable, then ramp up the power drawn from the grid from zero to the desired value.

Flexibility may be required to accommodate different IBL technologies, and the impact of some loads recovering more slowly is likely to be manageable. However, an automatic recovery slower than one second may be unhelpful as AEMO would need to procure more 1-second FCAS. For this reason, the recovery time for the minimum access standard in the draft rule is set at one second.[170]

Flexibility in the minimum access standard

The draft rule also includes some flexibility to agree to a lower minimum access standard on a case-by-case basis. If agreed by the NSP and AEMO, a connection applicant may be able to negotiate a performance standard that is lower than the usual minimum access standard. The NSP and AEMO would need to consider the impact of credible faults at the connection point, the plant's technical capability, and the potential system security impact of plant disconnection.[171]

We have included this option in the draft rule primarily to provide flexibility for IBL other than data centres, as we have less information on the capabilities of other IBL and future developments are uncertain.

Flexibility in the minimum access standard is also particularly important for post-fault active power recovery because a one-second recovery time may not always be feasible. In this case, the connection applicant, NSP and AEMO would be able to agree on an alternative process and/or timing to restore the load and record it in the plant's performance standards.[172] Notwithstanding, we consider it is important to specify a minimum access standard for deep voltage disturbances and active power recovery because this aspect of ride-through behaviour is a key part of the system security risks we have identified.

167 Draft rule, clause S5.3.13(g)(2)(iii) and (g)(3)(ii).

168 Draft rule, clause S5.3.13(b)(3)(ii).

169 EirGrid, Grid Code Modification Proposal Form - MPID 345 Fault Ride Through, RoCoF and Post Fault Active Power Recovery for Demand Facilities, November 2025, p 5.
Fingrid, Draft for comments: KJV2026 Grid code specification for demand connections, June 2025, pp 38-40.

170 Draft rule, clause S5.3.13(g)(2)(iii) and (g)(3)(ii).

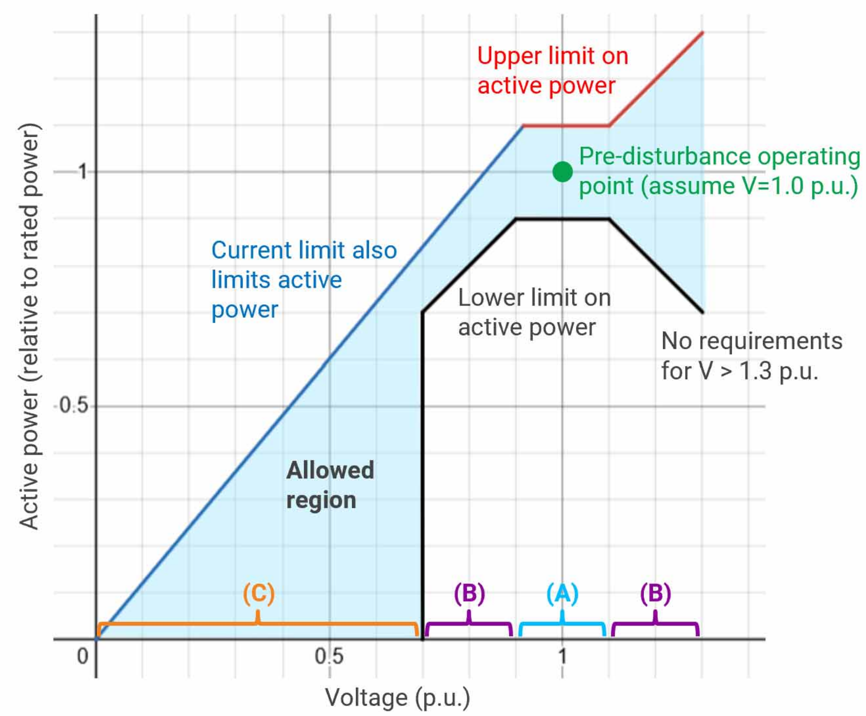
171 Draft rule, clause S5.3.13(f).

172 This would be through the use of the negotiated access standard framework set out in clause 5.3.4A of the NER.

Active power and current limits

Table 4.2, Table 4.3, and Figure 4.2 set out the active power and current limits for the voltage ride-through access standard set out in the draft rule.[173] Generally, these limits would apply for the both the automatic access standard and minimum access standard, subject to the disturbance durations shown in Figure 4.1. That is, the automatic access standard would be that plant has to comply with the active power limits in Figure 4.2 for the duration indicated on the automatic access standard curve in Figure 4.1, and similarly for the minimum access standard. The minimum access standard would not include any requirements for voltages exceeding 110% of nominal voltage. The active power and current limits and our reasoning for these limits are detailed in Table 4.2 and Table 4.3.

Figure 4.2: Active power and current limits



Source: Draft rule, clause S5.3.13.
Note: Regions A, B and C indicated on the x-axis correspond to the same regions in Figure 4.1.
Voltage is measured relative to the nominal voltage (% or p.u.).
Active power and current are measured relative to the pre-disturbance level, that is, the amount the load was consuming prior to the disturbance.
This chart assumes the load is consuming 100% of its rated power at the nominal voltage at the time of the disturbance and that the load has a unity power factor.
Current refers to the total of active and reactive current.

173 Draft rule, clause S5.3.13(c) and (g).

Table 4.2: The Commission's rationale for active power and current limits during voltage disturbances

Shallow undervoltages	Deep undervoltages	All undervoltages
Region B	Region C	All regions
70-90%	0-70%	0-100%
Lower power limit	No lower power limit	Current limit
Proportional to the voltage difference	Plant may reduce active power to zero and/or disconnect	Pre-disturbance current plus 20% of the rated current
This requirement acknowledges that IBL may need to reduce active power for technical reasons during an undervoltage, while ensuring that some level of active power is maintained to support power system stability. Allowing an active power reduction proportional to the voltage drop is similar to some requirements in other jurisdictions, such as ERCOT. We understand it is consistent with how many UPS models operate in undervoltage conditions. The UPS would switch part of the data centre load to the battery approximately in proportion to the voltage drop. This is because drawing the same power at a lower voltage requires more current, but UPS hardware typically has a rectifier current limit that prevents this.	The Commission understands that existing UPS technology will move all of its load to battery supply if the input voltage at the rectifier drops below a certain value, due to technical limitations. • This behaviour may be considered 'disconnecting' under the NER. • For many OEMs, the lower voltage limit is around 50%, but we understand it can be as high as 70%. As discussed above, we consider it is acceptable for IBL to reduce its active power to zero during a deep disturbance, provided it recovers quickly. Therefore, the draft rule does not include a requirement for IBL to stay connected when the voltage falls below 70%.	The access standard includes a current limit because increased current draw by large loads during a disturbance could exacerbate undervoltage conditions. Without a current limit, we consider there is a risk that some IBL would draw more current when the voltage is low in order to maintain (some level of) active power, due to the P=VI relationship. Although most UPS have a hardware current limit, this requirement would prevent a large current increase where the plant is not operating at full load at the time of a disturbance. It would also provide certainty for AEMO, NSPs, and connection applicants, including non-UPS loads. The current limit would also act as an upper limit on active power for many undervoltage disturbances. Note this would be a limit on total current (active and reactive). In effect, the current limit may be more restrictive for loads operating at a low power factor.

Source: AEMC. See draft rule, clause S5.3.13.
ERCOT, Nodal Operating Guide Revision Request - Large Electronic Load Ride-Through Requirements, November 2025, pp 5-6.

Table 4.3: The Commission's rationale for active power and current limits during voltage disturbances (continued)

All undervoltages	Smaller disturbances	Overvoltages
All regions	Region A	Region B
0-100%	90-110%	110-130%
Upper power limit	Upper and lower power limits	Upper and lower power limits
110% of the pre-disturbance active power	90-110% of the pre-disturbance active power	Proportional to the voltage difference (automatic access standard only)
This requirement would prevent large increases in active power consumed by IBL during an undervoltage. In many cases the maximum current would act as a stricter active power limit than the maximum active power. This would occur for larger undervoltage disturbances and/or when the IBL is operating close to its rated load. Generally, the 110% active power limit would take effect for smaller undervoltages or when an IBL is operating significantly below its rated load.	This requirement is relevant where a power system disturbance causes a sudden change in voltage, but the voltage does not leave the range of 90-110%. The draft rule includes flat active power limits for this range because proportional limits would become very restrictive when the voltage is close to nominal. Actual connection point voltage often differs slightly from nominal voltage in normal power system operation. This requirement is focussed on how IBL responds to a variation resulting from a power system disturbance and would not prevent IBL from adjusting its active power consumption by any amount as part of its normal operations.	The Commission understands that data centres' likely response to a moderate overvoltage is to hold active power approximately constant. Therefore, we do not expect that these upper and lower power limits would be very onerous, provided that the plant can continue operating in the voltage range 110-130%. We understand that not all UPS models, or other plant, can withstand a 130% overvoltage. We note that ride-through of voltage disturbances over 110%, including active power limits, is only required for the automatic access standard and not the minimum access standard.

Source: AEMC. See draft rule, clause S5.3.13.

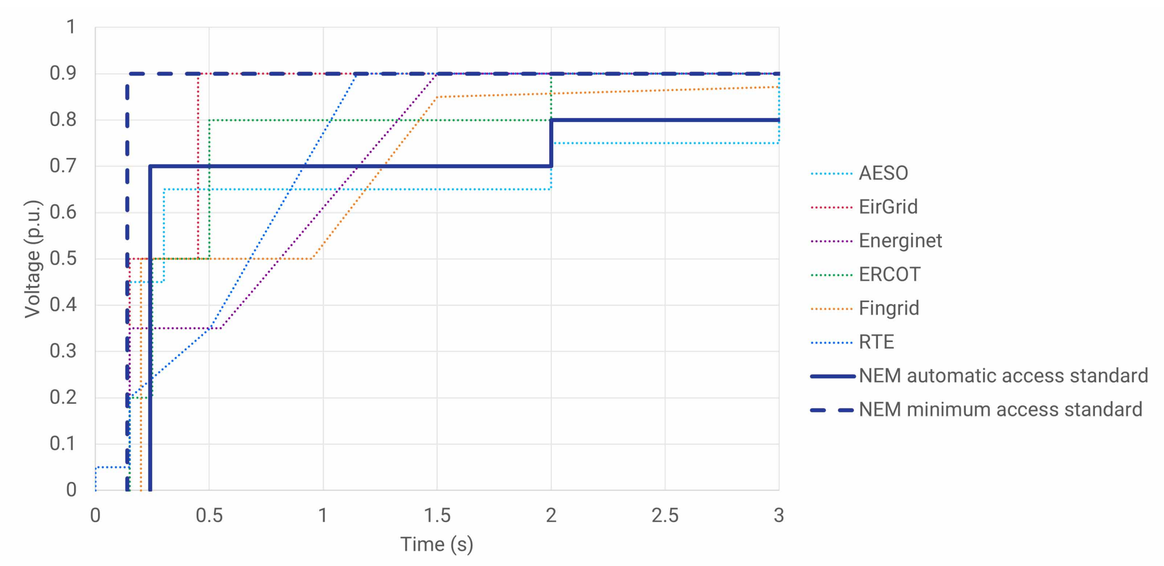
The voltage disturbance ride-through access standard in the draft rule is aligned with international requirements

In developing the voltage disturbance ride-through requirements for the draft rule, we have considered requirements that are being consulted on or introduced internationally.

Figure 4.3 shows the draft rule undervoltage ride-through curve plotted against several analogous ride-through curves from other jurisdictions. Our draft undervoltage ride-through requirements, including the deep disturbance ride-through durations, are well within the range of the standards that large loads are facing overseas.

Appendix A provides more information about proposed or existing large load ride-through requirements in other jurisdictions.

Figure 4.3: Undervoltage ride-through curve comparison with international requirements



Source: AEMC.
AESO, AESO Connection Requirements for Transmission-Connected Data Centres, Draft for Stakeholder Review, August 2025, p 14.
EirGrid, Grid Code Modification Proposal Form - MPID 345 Fault Ride Through, RoCoF and Post Fault Active Power Recovery for Demand Facilities, November 2025, p 7.
Energinet, Technical Regulation 3.4.3 Requirements for Transmission-Connected Demand Facilities, Revision 1, September 2024, p 7.
ERCOT, Nodal Operating Guide Revision Request - Large Electronic Load Ride-Through Requirements, November 2025, p 5.
Fingrid, Draft for comments: KJV2026 Grid code specification for demand connections, June 2025, p 36.
RTE, Article 8.3.5 - Cahier des Charges des capacités constructives d'une Installation de consommation, version 1.0, February 2024, p 26.

Frequency disturbance ride-through

The power system frequency needs to be maintained within an acceptable range, as set out in the FOS, to support the stable operation of the system. Frequency disturbances can occur in the power system when there is a significant loss of generation or load, because this upsets the balance of supply and demand. It is important for large IBL to ride through frequency disturbances for a number of reasons.

- Unlike voltage disturbances, frequency disturbances are global and can affect a whole region or all of the mainland NEM. Therefore, it is very likely that multiple large loads would be affected, and multiple disconnections would lead to a significant aggregate loss of load.

- Voltage and frequency disturbances may co-occur if they have the same root cause, such as a fault or plant tripping. Therefore, voltage disturbance ride-through capability may not be effective unless it is combined with frequency disturbance ride-through capability.

Box 12 sets out the draft rule frequency disturbance ride-through access standard.

Box 12: Frequency disturbance ride-through access standard for the draft rule

The automatic access standard for frequency ride-through would be aligned with the FOS determined by the Reliability Panel, which forms part of the system standards (NER S5.1a.2). IBL would be required to stay connected and continue operating as long as the frequency stays within the FOS, as shown in Figure 4.4, unless the magnitude of the rate of change of frequency (RoCoF) exceeds (draft rule, clause S5.3.12):

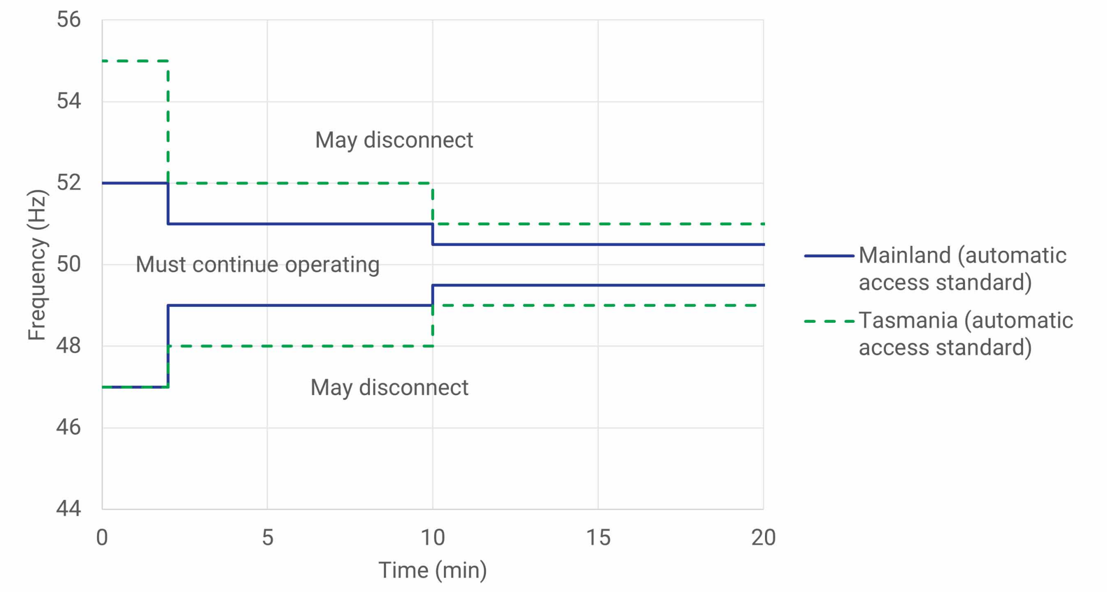
- 4 Hertz per second for more than 0.25 seconds,
- 3 Hertz per second for more than 1 second, or
- other limits as determined by the Reliability Panel from time to time. (Currently there are no such other limits in force.)

Since the access standard would be linked to the FOS, the frequency bands, stabilisation time and recovery time may change with future Reliability Panel decisions. A different FOS applies in Tasmania. Figure 4.4 shows the automatic access standard according to the current FOS for the mainland and for Tasmania.

We have not included a minimum access standard for frequency ride-through in the draft rule. This means that negotiated access standards may be anywhere below the automatic access standard, with no minimum requirement. A performance standard with no requirements for frequency ride-through would be permitted provided that the conditions in clause 5.3.4A of the NER are met.

Source: AEMC.

Figure 4.4: Frequency disturbance ride-through curve



Source: Draft rule, clause S5.3.12.

The frequency disturbance ride-through access standard would only apply to IBL, because IBL has a greater system security impact than non-IBL as outlined in section 4.1.1.

The Commission understands that riding through frequency disturbances is not technically challenging for UPS loads, such as data centres. These loads have an inherent incentive to ride through frequency disturbances to continue operating without using back-up supply. (One of the functions of a UPS is to correct power system quantities such as frequency in order to supply high quality power to the load.) Therefore, introducing a frequency ride-through access standard would have low costs while providing significant benefits in assuring NSPs and AEMO that plant is able to ride through frequency disturbances. Even where this ride-through capability is inherent, creating an access standard would mean that the capability is recorded in the plant's performance standard and known by the NSP and AEMO.

The low minimum access standard would avoid creating unreasonable barriers to connection, for any plant whose frequency ride-through capability is limited for a technical reason. This would not affect the efficacy of the access standard overall because we think this type of plant is rare, and because clause 5.3.4A of the NER applies.

The frequency disturbance ride-through access standard would be deemed to be an AEMO advisory matter.[174] This is consistent with frequency disturbance ride-through for Schedule 5.2 plant, which is also an AEMO advisory matter.[175]

Limits on how protection systems operate

The draft rule would introduce two new protection system requirements for IBL, to supplement the disturbance ride-through access standards.[176] Since the new access standards would not require IBL to withstand any phase shifts or multiple successive faults, we have taken a light-touch alternative approach to these characteristics. The draft rule would prevent IBL from using protection systems that operate for phase shifts less than 20 degrees or for multiple faults in a certain time period as set out in Box 13.

> **Box 13: Draft rule for limits on how protection systems operate**
>
> The draft rule would stipulate that, for Schedule 5.3 plant that is an IBL:
>
> - Vector shift protection or similar protective functions must not operate for phase shifts less than 20 degrees (draft rule, clause S5.3.3(f)).
> - Protection systems must not operate based solely on the number of faults or disturbances that occur during a period of time (draft rule, clause S5.3.3(g)).

Source: AEMC.

Both new protection system requirements would appear as part of the general requirements in clause S5.3.3 of the NER, which covers protection systems and settings. We consider it is appropriate to include them as general requirements, which are not open for negotiation, because they are important for power system security and we understand they are not likely to be onerous. Similar to the other Schedule 5.3 access standards, the application of the new requirements would be subject to the tiering framework outlined in Chapter 3, with some NSP discretion for Tier 1 and Tier 2 IBL.[177] However, we are interested in stakeholder views as to whether the protection system

174 Draft rule, Chapter 10 glossary definition of 'AEMO advisory matter'.

175 NER clause S5.2.5.3 is included in the Chapter 10 glossary definition of 'AEMO advisory matter'.

176 Draft rule, clause S5.3.3(f) and (g).

177 Draft rule, clause S5.3.1a(a1).

requirements should be included in the automatic access standard only to provide more flexibility for different IBL technologies.

Clause S5.3.3 is not an AEMO advisory matter; however, we are interested in stakeholder views on whether it should become one. The most closely related Schedule 5.2 access standards (clauses S5.2.5.8 and S5.2.5.9) are deemed to be AEMO advisory matters.[178]

Vector shift protection

The draft rule would stipulate that IBL must not have vector shift protection or similar protective functions that operate for phase shifts less than 20 degrees.[179] Avoiding protection systems that respond specifically to phase shifts less than 20 degrees would help prevent unnecessary tripping of IBL that would impact system security. There is an equivalent requirement for Schedule 5.2 plant.[180]

For the avoidance of doubt, Schedule 5.3 plant would still be permitted (but not required) to have vector shift protection that operates for phase shifts greater than or equal to 20 degrees. Plant would not be strictly required to ride through any phase shifts, but must not have protection functions that are explicitly triggered by phase shifts less than 20 degrees.

Vector shift protection may be used to detect islanding. For example, a data centre may apply vector shift protection to determine if it has been separated from the rest of the network (e.g. by an upstream network fault or system black). It could then disconnect, use battery to support the load while it starts up a diesel back-up supply, and operate as an island. Avoiding protection functions that operate for small phase shifts would prevent IBL from switching into island mode unnecessarily due to minor disturbances.

Protection for multiple successive faults

The draft rule would require that IBL must not have protection systems that operate based solely on the number of faults that occur during a period of time.[181] This would preclude protection functions that operate by 'counting' faults or disturbances, to address the risk of cascading outages where multiple loads with similar protection settings trip after a specific number of disturbances. This risk has been shown to be significant in the past, as this type of protection settings contributed to the 2016 South Australia system black and the 2024 large load loss incident in Virginia.[182]

Under the draft rule, Schedule 5.3 plant would not be strictly required to ride through multiple successive disturbances. The draft rule would only prevent protection that is triggered by a specific number of faults.[183] By comparison, the Schedule 5.2 access standards include extensive multiple fault ride-through requirements, many of which were introduced in 2018, partly because of the South Australia system black.[184]

178 NER Chapter 10 definition of *AEMO advisory matter*.

179 Draft rule, clause S5.3.3(f).

180 NER clause S5.2.5.8(b6).

181 Draft rule, clause S5.3.3(g).

182 AEMO rule change request, *Generator technical performance standards*, August 2017, p 27.
NERC, Incident Review: Considering Simultaneous Voltage-Sensitive Load Reductions, January 2025, pp 1-2.

183 Draft rule, clause S5.3.3(g).

184 NER clauses S5.2.5.5 and S5.2.5.5A.
AEMC, *Generator technical performance standards*, final determination, September 2018, pp 207-216.

4.1.5 The draft rule would improve visibility of ride-through capability for all Schedule 5.3 plant

The draft rule would enable NSPs to request information about connecting loads' ride-through capability (including both IBL and non-IBL).[185] The Commission considers this would support system security by closing a gap in the existing information requirements in Schedule 5.3. The information provision requirement is described in Box 14.

Under clause S5.3.1 of the NER, currently, connection applicants must provide a range of information to AEMO and the NSP, including information on protection and control systems, and models as specified by the PSMG. However, this information does not necessarily provide a full picture of loads' ride-through behaviour. Additional information would assist NSPs and AEMO in managing system security risks by allowing them to understand, predict and plan for large loads' responses to power system disturbances.

In submissions to the consultation paper, stakeholders generally agreed that there was a lack of visibility of large loads' ride-through capability and supported AEMO's proposal for information sharing.[186] Detailed stakeholder feedback is discussed below.

Box 14: Draft rule for information provision on loads' ride-through capability

Under the draft rule, Schedule 5.3 connection applicants (for IBL and non-IBL) would be required to provide information about the load's ride-through capability, as requested by the NSP in consultation with AEMO. Connection applications would need to provide this information to both the NSP and AEMO (draft rule, clause S5.3.1(a1)(2A)).

This ride-through information would generally not be included in the load's performance standards. However, the draft rule would not prevent the information from being used in performance standards if it is relevant to any access standards that apply to the load connection.

Source: AEMC.

Information provision would apply to both IBL and non-IBL, subject to NSP discretion

The information provision requirement in the draft rule would apply to all Schedule 5.3 plant, including IBL and non-IBL of all sizes, whenever the NSP chooses to request information. This is because, although IBL may have a larger impact, the ride-through behaviour of large non-IBL can also contribute to system security impacts. The loss of any significant load during a disturbance would affect local voltage stability and the balance of supply and demand. In practice, information provision would be less relevant for IBL which is subject to the disturbance ride-through access standards.

In its submission to the consultation paper, the EUAA did not support applying AEMO's proposal to non-IBL as it considered disturbance ride-through was only a risk for IBL.[187] SA Power Networks noted that information provision may only be appropriate for large loads.[188] The Commission agrees that most of the system security impacts associated with large loads arise from IBL and for this reason the ride-through access standards would only apply to IBL. However, we consider it is appropriate to apply the light-touch information provision requirement to non-IBL, without explicit access standards. NSPs (and AEMO) would be able to exercise their discretion and only request information where there is a need.

185 Draft rule, clause S5.3.1(a1)(2A).

186 Submissions to the consultation paper: Ergon Energy/Energex, p.6; Transgrid, p.16; Ausgrid, p.3; TE H2, p.2; Hydro Tasmania, pp.3-4; SA Power Networks, p.5; ENA, p.5; EPEC, p.5; AirTrunk, p.9; CPU, p.3; NEXTDC, p.8; AWS, p.7.

187 EUAA submission to the consultation paper, pp 7-8.

188 SA Power Networks submission to the consultation paper, p 5.

For IBL, the disturbance ride-through access standards would supersede information provision to an extent, as NSPs and AEMO would likely be able to obtain all relevant information through the connection negotiation process. However, information provision may be a suitable alternative for any Tier 1 and Tier 2 IBL for which the NSP elects not to apply the disturbance ride-through access standards (or only applies some of them). This would enable NSPs to use a flexible approach for IBL whose ride-through capability may have a lesser impact on system security. An NSP may determine that no additional information is required for a relatively small or straightforward load connection, or a connection to which disturbance ride-through access standards apply.

The draft rule would provide flexibility to request appropriate, relevant information from different loads

The Commission has designed the information provision in the draft rule to be flexible and adaptable to loads of different types and sizes.[189] This flexibility is important to minimise the costs and regulatory burden of the draft rule. NSPs could choose what, if any, information to request from each load on a case-by-case basis, subject to consultation with AEMO. For example, NSPs may request (but would not be limited to requesting):

- Details of protection and control systems and settings
- Voltage and frequency ride-through curves for the load
- Relevant manufacturer datasheets
- Information about the load's reactive power behaviour during a disturbance
- Information about how different parts of a load facility may respond to a disturbance
- RMS (root-mean-square) and/or EMT models of the load, where appropriate.

Some stakeholders, although generally supportive, raised questions about the amount of detailed information that could be requested. AWS noted that loads and generators have fundamentally different ride-through capabilities, that capabilities vary among load technologies, and that detailed ride-through information may not be available early in the connection process.[190] EPEC and NEXTDC questioned whether information requests could include a level of modelling that may not be feasible for loads.[191] (The modelling capabilities of and modelling requirements for loads are discussed in section 2.3.) When making information requests, the Commission expects NSPs and AEMO to take into account what data or modelling the load would reasonably be able to provide at that stage of the connection process.

AWS also noted the need to protect sensitive information.[192] Commercially sensitive information provided under this draft rule would be treated as confidential according to rule 8.6 of the NER.[193]

Stakeholders suggested other modifications to AEMO's rule change proposal, including:

- Making the requested information more transparent and consistent across NSPs, without being prescriptive, for example by creating minimum information requirements.[194]
- Providing flexibility for either the NSP or AEMO to initiate a request, during or after the connection process, to account for uncertainty in the impact of large loads[195]

189 Draft rule, clause S5.3.1(a1)(2A).

190 AWS submission to the consultation paper, p 7.

191 Submissions to the consultation paper: EPEC, pp 2, 5; NEXTDC, pp 3-4.

192 AWS submission to the consultation paper, p 7.

193 In addition, AEMO is subject to confidentiality obligations in sections 54 to 54G of the NEL.

194 Submissions to the consultation paper: TE H2 p 2; AirTrunk, p 9; AWS, p 7.

195 CPU submission to the consultation paper, p 3.

- Gathering information from existing loads (perhaps voluntarily) in addition to new connections.[196]

The Commission considers it is important to maintain flexibility in the draft rule, rather than prescribing any information requirements. Although the ability to request information sits with the NSP, the NSP is required to consult with AEMO.[197] We expect that NSPs would work with AEMO to meet any of AEMO's reasonable information needs.

This information provision requirement is part of the connections framework and would only apply to plant that is establishing or modifying a connection.[198] We note that clause S5.3.4 of the NER requires Schedule 5.3 Participants to seek the NSP's (and where relevant, AEMO's) approval when changing protection or control settings for existing plant, which may impact its ride-through capability.

We have made minor changes from AEMO's proposal for the draft rule

Our draft rule differs from AEMO's proposal in that there is no direct link to the performance standards, but any information provided to the NSP would also be automatically provided to AEMO.[199] We consider that linking information provision to the performance standards would, in effect, allow non-IBL to be held to a certain standard of ride-through capability, because performance standards form part of the Schedule 5.3 Participant's contractual obligations in its connection agreement.[200]This would not be consistent with the Commission's draft determination to apply ride-through access standards to IBL only.

In the original rule change request, the NSP would have been required to provide a copy of the Schedule 5.3 plant's performance standards to AEMO whenever the NSP elected to include the provided ride-through information in those performance standards.[201] We understand the intent was to give AEMO, as well as the NSP, visibility of large loads' ride-through capability. To provide AEMO with this visibility, the draft rule would stipulate that the connection applicant must provide the ride-through information requested by the NSP directly to both the NSP and AEMO.[202] This simpler approach would streamline the implementation of the information provision requirement and allow the system security benefits to be realised more efficiently. It would also complement the expansion of AEMO's register of performance standards to non-Registered Participants (see section 3.4.2) as AEMO would have access to both the performance standards and any additional ride-through information provided.[203]

4.2 We have made a draft rule to clarify aspects of the disturbance ride-through access standards for generators

The Commission has made a draft rule that would clarify the set of credible contingency events that Schedule 5.2 plant is required to ride through under the disturbance ride-through access standards in clause S5.2.5.5 of the NER. Both the automatic and minimum access standards would require ride-through of credible contingency events used by the NSP for its network planning, while the automatic access standard would also require ride-through of non-credible

196 Hydro Tasmania submission to the consultation paper, pp 3-4.

197 Draft rule, clause S5.3.1(a1)(2A).

198 NER clause 5.3.1(a).

199 Draft rule, clause S5.3.a(a1)(2A).

200 NER clause 5.3.4A(i).

201 AEMO rule change request proposed drafting, pp 189 (proposed new clause S5.3.4A).

202 Draft rule, clause S5.3.1(a1)(2A).

203 Draft rule, clause 4.14(n).

contingency events that AEMO is likely to reclassify as credible.[204] Further, the draft rule would require NSPs, in consultation with AEMO, to provide Schedule 5.2 applicants with a list of non-credible contingency events that are likely to be reclassified as credible contingency events.[205]

Collectively, the Commission considers that these amendments would improve regulatory certainty and predictability for Schedule 5.2 Participants, by ensuring the scope of credible contingency events that must be ridden through is not unbounded in scope. It also ensures that the minimum access standard is not overly onerous, recognising there are technical limitations to the types of credible contingency events a plant can ride through.

4.2.1 The issue being addressed by the draft rule

Schedule 5.2 plant are subject to a range of disturbance ride-through requirements, which are important for power system security because they help to keep generation online, maintain system stability, and continue supplying consumers following a contingency event.

The Schedule 5.2 access standard for disturbance ride-through capability includes a requirement to ride through any disturbance caused by a credible contingency event.[206] Although the NER provides guidance on what is considered a credible contingency, AEMO has the power to deem a contingency event as credible or non-credible.[207] In addition, AEMO can reclassify events that are usually considered non-credible to be credible contingency events depending on network conditions (such as a storm, for example).[208]

As identified in AEMO's rule change request, the requirement to ride through credible contingency events is unbounded in scope.[209] This creates uncertainty for Schedule 5.2 Participants, NSPs, and AEMO, as well as compliance risk for Schedule 5.2 Participants. Ambiguity around the types of events that must be ridden through can create differing interpretations between connection applicants, NSPs and AEMO. This has the potential to lengthen negotiations, increase modelling complexity, and introduce avoidable costs and delays.

4.2.2 The draft rule would clarify and restrict the scope of credible contingency events

To address the issues raised above, the Commission has made a draft rule that would clarify and restrict the scope of credible contingency events for the disturbance ride-through access standard in Schedule 5.2 of the NER.[210] The draft rule would also improve the minimum and automatic access standards in clause S5.2.5.5 of the NER, as set out in Box 15.

204 Draft rule, clause S5.2.5.5(u).
205 Draft rule, clause S5.2.4(e1)(1BA).
206 NER clause S5.2.5.5(c)(1).
207 NER clause 4.2.3.
208 NER clause 4.2.3A(g).
209 AEMO rule change request overview, p 45.
210 NER clause S5.2.5.5.

Box 15: Draft rule to clarify and restrict the scope of credible contingency events

Under the draft rule, the automatic access standard would be that Schedule 5.2 plant must ride through (draft rule, clause S5.2.5.5(u)(1)-(2)):

- all credible contingency events used by the NSP for its network planning (as provided by clause S5.1.2.1 of the NER), and
- all non-credible contingency events specified by the NSP, in consultation with AEMO, that are likely to be reclassified as credible under clause 4.2.3A of the NER, and are likely to cause a significant disturbance at the Schedule 5.2 plant's connection point.

The minimum access standard would be that Schedule 5.2 plant must ride through all credible contingency events used by the NSP for its network planning, as provided by clause S5.1.2.1 of the NER), and unlike the automatic access standard, would not require plant to ride through credible contingency events likely to be reclassified as credible under clause 4.2.3A of the NER (draft rule, clause S5.2.5.5(u)(1)).

The draft rule would retain the existing requirement for the Schedule 5.2 plant's performance standard to include any operational arrangements to ensure that the plant will meet its agreed performance levels under abnormal network or plant conditions, to avoid interrupted operation on account of a routinely reclassified event (NER clause S5.2.5.5(s)).

The draft rule would also change how 'credible contingency events' is interpreted for the purpose of clause S5.2.5.5 and introduces a new requirement for a list of events likely to be reclassified to be maintained and published by the NSP, in consultation with AEMO (draft rule, clause S5.2.4(e1)(1BA).

The rest of clause S5.2.5.5, including access standards for riding through specific types of faults and multiple disturbances, would remain unchanged.

Source: AEMC.

Note: The draft rule specifies that Schedule 5.3 plant should ride through events that are 'likely' to be reclassified as credible. We consider this wording is clearer than AEMO's proposed wording, 'routinely reclassified'.

The draft rule would require NSPs, in consultation with AEMO, to publish a dynamic list of events likely to be reclassified

The Commission considers that clarifying and narrowing the scope of the term 'credible contingency events' for the purposes of Schedule 5.2 plant disturbance ride-through would promote the NEO by enhancing regulatory certainty, transparency and consistency in the application of the Rules.

Under the draft rule, NSPs would be required to prepare a list, in consultation with AEMO, of non-credible contingency events that are likely to be reclassified as credible contingency events.[211] NSPs would be required to provide this list to a Schedule 5.2 connection applicant, and the list would serve as guidance in applying the automatic access standard.

The list would not need to be exhaustive, recognising that reclassification decisions depend on system conditions and other factors that may change over time. Stakeholders such as Transgrid supported this approach.[212]

However, stakeholders noted practical challenges, including that any list could become outdated and that the likelihood of reclassification depends on evolving system conditions, weather events and bushfire risk.[213] The Commission acknowledges that the set of events likely to be reclassified

211 Draft rule, clause S5.2.4(e1)(1BA).

212 Transgrid submission to the consultation paper, p 6.

213 Submissions to the consultation paper: Transgrid, p 2; Gridmo, pp 2-3; Vestas, pp 3-4; Akaysha, pp 4-5; ENA, p 5; CPU, p 4; AWS, p 10.

will change over time and that inherent uncertainty exists in the current framework. As AEMO observed, even without reclassification, the technical parameters of the most significant credible contingency affecting a plant may evolve as the power system changes.[214]

We consider that these concerns could be addressed if the list is regularly updated. The Commission also notes that the list is not intended to be exhaustive, nor is it intended to be binding in its own right. Accordingly, the list would operate as guidance from NSPs to inform the development of the performance standard. Moreover, NSPs and AEMO would retain discretion to study or manage other contingency events where necessary for system security, and reclassification decisions would continue to be made under the existing operational framework.

In summary, the Commission considers that this approach strikes an appropriate balance between clarity and flexibility. It enhances transparency and predictability for proponents, while preserving AEMO's and NSPs' ability to manage system security in a changing power system.

The draft rule would improve regulatory certainty and predictability in the access standard

The draft rule would clearly delineate the events captured by the automatic and minimum access standard, providing a more predictable and consistent foundation for access standard negotiations. The minimum access standard would require Schedule 5.2 plant to ride through only credible contingency events used by the NSP in its network planning.[215] The automatic access standard would also require ride-through of specified non-credible contingency events that are likely to be reclassified as credible and are likely to cause a significant disturbance at the connection point.[216] In this respect, the draft rule differs from AEMO's proposal, which would have included likely reclassification events in both the automatic and minimum access standards.[217]

Creating separation between the minimum and automatic access standards preserves the integrity of the access standards negotiation framework. It allows proponents that cannot meet the automatic standard due to technical limitations or prohibitive costs to seek a negotiated access standard. For example, a negotiated outcome might require ride-through of all credible planning events and a defined subset of likely reclassification events. This approach is consistent with Transgrid's recommendation in its submission to the consultation paper.[218] It would also address Akaysha's concern that including likely reclassification events in both the minimum and automatic access standards would be onerous and may create barriers to connection.[219]

Clarifying the events that are included in the minimum and automatic access standard would reduce interpretive ambiguity, support a more efficient and timely connections process, lower regulatory risk for proponents, and promote investment confidence.

The Commission has addressed stakeholder feedback

In developing the draft rule, the Commission carefully considered stakeholder feedback to our consultation paper.

Some stakeholders supported refining the current unbounded scope of credible contingency events a Schedule 5.2 plant must ride through. For instance:

214 AEMO, submission to the consultation paper, p 12.

215 Draft rule, clause S5.2.5.5(k)(1) and (u)(1).

216 Draft rule, clause S5.2.5.5(c)(1) and (u).

217 AEMO rule change request overview, p 46.

218 Transgrid submission to the consultation paper, p 6.

219 Akaysha submission to the consultation paper, pp 4-5.

- Vestas acknowledged that the current definition of credible contingencies appears open-ended and lacks clear boundaries. They submitted that currently, there are different interpretations and understandings among stakeholders including NSPs and proponents, which leads to inconsistency in communication.[220] Accordingly, Vestas agreed that clarity would help harmonise expectations across the NEM, which would be particularly valuable for OEMs operating across multiple jurisdictions.
- Similarly, Alinta, EPEC, CPU, and Gridmo submitted that specification in the NER of what constitutes credible and non-credible contingency events would provide better guidance for establishing and complying with a performance standard.[221]

However, some stakeholders did not agree there is an issue to be addressed,[222] or expressed concern with how to refine the scope of credible contingency events for the purposes of ride-through requirements applicable to Schedule 5.2 plant. For instance:

- ElectraNet was concerned that introducing rigid definitions may remove engineering judgement.[223] We consider that our approach to the minimum and automatic access standard in the draft rule addresses this concern. By limiting the additional automatic access standard requirement to non-credible contingency events that are both likely to be reclassified and likely to cause a significant disturbance at the connection point, the draft rule targets system security risks without imposing an unbounded obligation. The Commission also considers that this clarification does not prevent NSPs or AEMO from undertaking broader engineering assessments where appropriate. Rather, it defines the baseline ride-through capability required under the access standards framework, while preserving operational and study flexibility.
- Akaysha and Transgrid noted that AEMO and NSPs rely on operational measures, such as emergency control schemes and constraining generators in affected areas, to manage non-credible contingency events when they are reclassified as credible.[224] The Commission agrees that these measures will continue to play a critical in managing system security, alongside ride-through capability.
- Transgrid questioned whether the disturbance ride-through access standard would include protected events.[225] Since protected events are a sub-category of non-credible contingency events, the automatic access standard would generally not cover protected events, except where they are likely to be reclassified as credible by AEMO.[226]
- AWS asked the Commission to ensure that any clarifications to the disturbance ride-through requirements for generators did not inappropriately impact the requirements for loads.[227] The Commission notes that clarifying the scope of credible contingency events in the draft rule would not change any access standards for loads. As discussed in section 4.1, the draft rule disturbance ride-through requirements for IBL are formulated numerically wherever possible and do not include a general obligation to ride through contingency events.

220 Vestas submission to the consultation paper, p 3.
221 Submissions to the consultation paper: Alinta, p 1; EPEC, p 8; CPU, p 4; Gridmo, p 2.
222 Submissions to the consultation paper: Ergon Energy/Energex, p 9; Transgrid, p 2
223 Submissions to the consultation paper: ElectraNet, p 3; Ergon Energy/Energex, p 10.
224 Submissions to the consultation paper: Akaysha; Transgrid, p 21.
225 Transgrid submission to the consultation paper, p 23.
226 NER clause 4.2.3(f).
227 AWS submission to the consultation paper, p 10.

4.2.3 The draft rule would clarify that the access standard for responses to disturbances following contingency events is an AEMO advisory matter

Clause S5.2.5.5A of the NER sets out the access standard for the response of Schedule 5.2 plant (generating systems, integrated resource systems, and synchronous condensers) to disturbances following contingency events. The draft rule would clarify that clause S5.2.5.5A is an AEMO advisory matter by adding it to the NER definition of AEMO advisory matter.

The Commission considers that clarifying that S5.2.5.5A would be consistent with the intent of this clause. Clause S5.2.5.5A was separated from clause S5.2.5.5 in the Package 1 rule change to improve the clarity of the rules drafting, but still covers aspects of technical performance that were included in the previous version of clause S5.2.5.5.[228] Clause S5.2.5.5 was an AEMO advisory matter prior to the Package 1 rule change.[229]

The current NER definition of 'AEMO advisory matter' is:[230]

> A matter that relates to *AEMO's* functions under the *NEL* and a matter in which *AEMO* has a role under clause 5.3.4B or in schedules 5.1a, 5.1, 5.2, 5.3 and 5.3a. Advice on the acceptability of *negotiated access standards* under the following clauses are deemed to be *AEMO advisory matters*: S5.1.9, S5.2.5.1, S5.2.5.3 to S5.2.5.5, S5.2.5.7 to S5.2.5.15, S5.2.6.1, S5.2.6.2, S5.3.5, S5.3.11, S5.3a.4.1, S5.3a.4.2, S5.3a.7, S5.3a.8 and S5.3a.13 to S5.3a.16.

Clause S5.2.5.5A meets this definition because it relates to AEMO's power system security functions under the NEL[231] and because it gives AEMO (along with the NSP) discretion on several aspects of the performance standard.[232] Explicitly including clause S5.2.5.5A in the NER definition of 'AEMO advisory matter' would provide more clarity and certainty for connection applicants, NSPs and AEMO.

228 AEMC, *Improving the NEM access standards - Package 1*, final determination, p 50.

229 AEMC, *Improving the NEM access standards - Package 1*, final rule - markup, p 299 (NER Chapter 10 glossary definition of 'AEMO advisory matter').

230 NER Chapter 10 glossary definition of 'AEMO advisory matter'.

231 Section 49 of the NEL.

232 NER clause S5.2.5.5A, for example paragraphs (f)(1), (f)(2), (g)(1) and (i).

5 We have improved the power system stability and protection requirements

Box 16: Key points in this chapter

The draft rule would introduce a new access standard for instability detection and response, which would apply to large IBL with the potential to contribute to instability. This new access standard is important because both IBLs and certain generators can contribute to power system instability; however, at present, there are only access standards applicable to generators, requiring them to detect instability at the connection point and take responsive action. With increasing numbers of large IBL expected to connect in the NEM, the risk of instability may increase. Therefore, requiring such loads to detect and respond to instability would promote the NEO by helping to address that risk and thus support power system security.

The draft instability monitoring access standard would require (draft rule, clause S5.3.14):

- Facilities capable of detecting instability in voltage, reactive power or active power
- Capabilities and control systems to ensure the plant does not cause, exacerbate or contribute to instability
- A process to manage instability upon detection, in a manner agreed with the NSP and AEMO
- In the automatic access standard only, facilities capable of disconnecting units for unstable behaviour (with the exact process to be agreed with the NSP and AEMO)
- For loads that are 100 MW or larger, if required by AEMO or the NSP, access to a phasor measurement unit (PMU)
- As required by AEMO and/or the NSP, capability to exchange instability information with AEMO and the NSP, including information about the plant's contribution to instability and/or a remote tripping signal.

This access standard would only apply to large IBL (30 MW and above) and when AEMO or the NSP consider the load may contribute to instability at its connection point. This differs from AEMO's rule change request, which would have applied to IBL larger than 5 MW per the SSIAG. We have used a higher threshold so that the instability requirements, and the costs of complying with them, are proportionate to the potential stability impact of the load.

In addition, the minimum access standard would only apply when the load can change the voltage at its connection point by more than 1%.

We have made minor changes from AEMO's rule change request for the draft rule regarding the plant's contribution to instability and automatic responses to instability.

The draft rule would also formally define 'primary protection system' and 'back-up protection system' in the NER, in response to Rod Hughes Consulting's *Definitions of protection system requirements* rule change request (which we have consolidated with AEMO's rule change request for Improving Access Standards -Package 2). We have modified the definitions and reduced the number of new definitions compared to the rule change proposal. These new definitions would clarify protection requirements for all connections and promote the NEO by supporting system security and an efficient connections process.

The Commission has decided not to make any changes to the Rules in response to Rod Hughes Consulting's *Conditions for generator protection systems* rule change request, as we consider the existing arrangements and rule drafting are fit for purpose.

In this chapter:

- Section 5.1 discusses the draft rule access standard for instability detection and response by large IBL.
- Section 5.2 discusses the *Definitions of protection system requirements* rule change request.
- Section 5.3 discusses the *Conditions for generator protection systems* rule change request.

Source: AEMC.

5.1 We have made a draft rule to introduce instability detection and response requirements for IBLs

The draft rule would introduce a new access standard for instability detection and response, which would apply to large IBL with the potential to contribute to instability. The new access standard would ensure that new large IBL can detect instability, respond in a way that helps manage instability (which may include disconnection as a last resort), and exchange information with AEMO about instability in the network.[233]

This new access standard is important because both IBLs and certain generators can contribute to power system instability; however, at present, there are only access standards applicable to generators, requiring them to detect instability at the connection point and take responsive action. With increasing numbers of large IBL expected to connect in the NEM, the risk of instability may increase. Therefore, requiring such loads to detect and respond to instability would promote the NEO by helping to address that risk and thus support power system security.

In this section:

- Section 5.1.1 outlines the issue the draft rule seeks to address, which is that the growth of large IBL may create risks for power system stability.
- Section 5.1.2 explains the new access standard for instability detection and response in detail.
- Section 5.1.3 sets out the Commission's rationale for the draft rule, including where it differs from AEMO's proposal.

5.1.1 IBL may contribute to system security risks related to power system stability

Maintaining power system stability is key to providing a secure energy supply for consumers. Stability is the ability of the power system to return to a normal operating state after a disturbance, such as a fault or loss of load.[234] This capability is important to maintain a secure and reliable supply of energy to customers.

AEMO has responsibility for maintaining power system security. The performance standards for generators, loads and HVDC links support AEMO in coordinating the system's response to disturbances and contingency events by requiring appropriate plant responses and providing visibility of those responses. One key aspect of power system stability is managing oscillations and unstable behaviour.

Power system instability occurs when one or more power system quantities - such as voltage, frequency, or active or reactive power - become unstable. This could include:

233 AEMO rule change request overview, p 73.

234 AEMO, Power System Stability Guidelines, v2.0, December 2022, p 5.

- power system quantities straying outside the normal range and not recovering in a timely manner (e.g. voltage collapse or an uncontrolled decrease in frequency)
- oscillations in power system quantities that are not sufficiently damped (that is, they do not settle quickly enough)
- loss of synchronism between different items of plant or different parts of the power system.[235]

Instability is an inherent risk in the power system that needs to be managed. The power system cannot operate stably with large, undamped oscillations, loss of synchronism, or sustained variations in power system quantities. Therefore, instability must be dealt with promptly to avoid disconnecting large areas of the network, including potentially a system black.

Instability can be caused by a wide range of factors relating to various types of plant. However, IBR - including generation, storage and load - may be more likely to contribute to instability because of its power electronic control systems, as discussed in section 2.2. These control systems can cause or contribute to instability because of:

- non-linear behaviour, where the control system has a large response to a small stimulus (although non-linearity is not unique to IBR)
- control system interactions, where multiple IBR may respond to each others' actions in a way that creates undesirable outcomes or a feedback loop
- more generally, any unintended or undesirable interactions with other plant or responses to network conditions.[236]

Because of these characteristics, IBL may contribute to power system instability in the same way as generators.[237] Conventional loads or non-IBL typically do not contribute to instability. The current NEM access standards include requirements for Schedule 5.2 plant to detect and respond to instability, as well as related requirements, which were updated in the Package 1 rule change.[238] However, as noted in AEMO's rule change request, there are currently no requirements for loads to monitor instability in the power system or take any action if instability is detected.[239] As large IBLs, such as data centres, increasingly connect to the NEM (see section 2.1), instability poses an increasing risk to power system security. Thus, it is becoming more important to monitor instability and respond in an effective manner.[240]

To address this issue, the Package 2 rule change request proposed to add a new access standard in Schedule 5.3 that would require large IBLs to detect and respond to instability.[241]

235 Ibid., pp 12-14.

236 Ibid., pp 12-14.

237 AEMO rule change request overview, p 72.

238 NER clause S5.2.5.10.
AEMC, *Improving the NEM access standards - Package 1*, final determination, pp 68-71.

239 AEMO rule change request overview, p 72.

240 The increasing penetration of IBR on the supply side has had a similar effect, and this has been addressed through the *Improving the NEM access standards - Package 1* rule change.

241 AEMO rule change request overview, pp 72-73.

5.1.2 The draft rule would introduce a new access standard for large IBL to detect and respond to instability

The draft rule would create a new access standard in Schedule 5.3 for instability detection and response for large IBLs (30 MW and above) that have the potential to contribute to instability. Introducing this access standard would promote the NEO by addressing the system security risk of large IBLs causing or contributing to instability.

Box 17 provides details of the new access standard for instability detection and response set out in the draft rule, and Figure 5.1 shows when each part of the new access standard would apply.

Box 17: New access standard for instability detection and response by loads

Both the automatic access standard and minimum access standard, outlined below, would only apply to Schedule 5.3 plant that:

- includes a large IBR as per the draft rule definition (an IBL with a nameplate rating of 30 MW or greater), and
- in the view of NSP or AEMO, could reasonably contribute to instability in voltage, reactive power or active power at any of its connection points. (See draft rule, clause S5.3.14(a) and Chapter 10 glossary definition of 'inverter based resource'.)

Where a Schedule 5.3 plant has multiple connection points but is operated as a single integrated facility, this access standard would apply to the whole facility (draft rule, clause S5.3.14(b)).

The automatic access standard would require (draft rule, clause S5.3.14 (c)):

- capability to detect instability in voltage, reactive power and active power at a connection point
- capability to disconnect the IBL for unstable behaviour, with configurable enablement conditions and settings agreed with the NSP and AEMO
- on detection of instability, prompt execution of a hierarchy of response actions based on configurable trigger conditions, thresholds and timeframes agreed with the NSP and AEMO and recorded in the performance standards
- for IBL of 100 MW or larger, access to a PMU to send data to the NSP and AEMO, and capability to receive information about its own contribution to instability from AEMO when available.

The minimum access standard would require (draft rule, clause S5.3.14(d)):

- for IBL that can change the voltage at a connection point by more than 1% from the voltage with the IBL not connected, under normal or planned outage conditions:
  - capability to detect instability in voltage, reactive power and active power at a connection point
  - a process agreed with the NSP and AEMO to manage instability at a connection point promptly on detection, to be recorded in the performance standards
- for IBL of 100 MW or larger, if required by the NSP or AEMO, access to a PMU to send data to the NSP and AEMO, and capability to receive information about its own contribution to instability from AEMO when available.

In addition, wherever this access standard applies, the draft rule would require:

- capabilities and control systems to ensure the operation of the Schedule 5.3 plant does not cause, exacerbate or contribute to instability that would adversely impact other network users (draft rule, clause S5.3.14(e))

- operational arrangements and capabilities to avoid causing, exacerbating or contributing to instability as specified in the PSSG (draft rule, clause S5.3.14(h))
- prioritisation of measures to eliminate the instability over disconnecting plant (draft rule, clause S5.3.14(f))
- capabilities to:
  - send instability detection data to the NSP or AEMO and receive a remote tripping signal from the NSP, if required by the NSP or AEMO (draft rule, clause S5.3.14(i) and (j))
  - receive information from AEMO about the plant's contribution to instability, if required by AEMO (draft rule, clause S5.3.14(c)(4)(ii) and (d)(2)(ii)).

AEMO may also provide further guidance on the expectations for instability detection and response and preventing Schedule 5.3 plant from contributing to instability in the PSSG (draft rule, clause S5.3.14 (g) and (h)).

The instability detection and response access standard would be deemed to be an AEMO advisory matter (draft rule, Chapter 10 definition of 'AEMO advisory matter').

Source: AEMC.

Figure 5.1: Application of the new access standard for detection and response to instability

IBL is 30 MW or larger *and* AEMO/NSP considers it could contribute to instability	IBL is 100 MW or larger	Plant can change voltage at its connection point by more than 1%	Automatic access standard	Minimum access standard
No	N/A	N/A	N/A	N/A
Yes	No	No	Excludes PMU requirement	N/A (minimum access standard is effectively zero)
Yes	Yes	No	Includes PMU requirement	PMU requirement only, at AEMO and NSP's discretion
Yes	No	Yes	Excludes PMU requirement	Excludes PMU requirement
Yes	Yes	Yes	Includes PMU requirement	Includes PMU requirement at AEMO and NSP's discretion

Source: Draft rule, clause S5.3.14.

Note: Application of the access standard for instability detection and response would also be subject to NSP discretion as per the tiering framework. For Tier 2 connections, this access standard would only apply to the extent that the NSP considers appropriate, having regard to the expected impact of the connection on the quality and security of network services to other network users. For Tier 3 connections, it would apply by default.

The key differences between the draft rule and AEMO's proposal are:

- The access standards would only apply to large IBL as per our draft rule definition, which is IBL with a nameplate rating of at least 30 MW, instead of the existing definition in the SSIAG, which is 5 MW and above.[242]
- We have added a requirement for large IBL to have capabilities and control systems sufficient to ensure that its operation does not cause, exacerbate or contribute to instability, and linked this directly to the PSSG so that AEMO can provide further guidance.[243]
- We have aligned the instability response requirements with the equivalent requirements for Schedule 5.2 plant, which were updated in the Package 1 rule change,[244] by omitting AEMO's proposed requirement for disconnection to account for available automated information on the plant's contribution to instability.[245]

5.1.3 The instability monitoring access standard would promote power system security

The new access standard would support power system security

The Commission considers that the draft rule for large IBL to detect and respond to instability would support system security by requiring loads that may contribute to instability to play a role in mitigating it. As outlined above, IBL can contribute to power system instability, and instability that is not managed promptly can result in supply interruptions for consumers. The new access standard for instability detection and response would require relevant new large IBL connections to detect instability and respond appropriately. As outlined by AEMO's rule change request, this would support the stable, reliable and secure operation of the NEM as more large IBL are connected in the NEM.[246]

The new access standard would support system security by:

- minimising IBL behaviour that may contribute to instability, by requiring capabilities and control systems sufficient to ensure the operation of the plant does not cause instability.[247]
- providing visibility of instability at large IBL connection points, including PMU data for loads over 100 MW.[248] This would also help provide a more complete picture of any instabilities across the NEM to NSPs and AEMO, supporting centralised coordination of instability management.
- ensuring that large IBL which is contributing to instability can be disconnected, either by its own systems (in the automatic access standard) or a remote tripping signal (if required by the NSP).[249] Although disconnection of plant is a last-resort measure,[250] it can be an important tool to prevent unstable behaviour from impacting the rest of the system.
- having Schedule 5.3 Participants create clear processes for responding to instability, which are visible to and agreed by the NSP and AEMO, again supporting coordination of instability management.[251]

242 Compare draft rule, clause S5.3.14(a)(1) and AEMO rule change request proposed drafting, p 193 (proposed new clause S5.3.12(a)(1)).
243 Draft rule, clause S5.3.14(e) and (h).
244 NER clause S5.2.5.10.
245 AEMO rule change request proposed drafting, p 193 (proposed new clause S5.3.12(b)(3)(i)).
246 AEMO rule change request overview, p 72.
247 Draft rule, clause S5.3.14(e).
248 Draft rule, clause S5.3.14(c)(1), (c)(4), (d)(1)(i) and (d)(2).
249 Draft rule, clause S5.3.14(c)(2) and (j).
250 Draft rule, clause S5.3.14(f).
251 Draft rule, clause S5.3.14(c)(3) and (d)(1)(ii).

- enabling two-way sharing of instability data between the Schedule 5.3 Participant and the NSP and AEMO, which can be used to determine the most effective response.[252]

In submissions to the consultation paper, many stakeholders agreed that large IBL may need to play a role in managing instability, as power system stability risks evolve with the growth of IBR.[253] Ergon Energy and Energex, SA Power Networks, EPEC and CPU generally supported AEMO's proposed new access standard.[254] ElectraNet suggested that instability detection and response requirements should also be considered for non-IBL.[255]

Other stakeholders, while acknowledging the potential issues that the rule change sought to address, considered that further consultation or investigation was required to design appropriate instability detection and response requirements for loads.[256] For example, Transgrid considered that the proposal was 'premature' because the ways in which IBL may contribute to power system instability are not yet well understood.[257] The Commission considers there is a strong case for introducing instability monitoring requirements now, due to the growth of large IBL and the potential for large IBL to contribute to instability - especially if those contributions may be unpredictable. We also note that the draft rule requirements are high-level and could be supported by further detail in the PSSG, which can be updated more easily than the NER. We welcome further feedback on the costs, benefits and design of the new access standard in response to this draft determination.

The new access standard would only apply to large IBL with the potential to contribute to instability

The new access standard in the draft rule would apply to Schedule 5.3 plant that includes a large IBL, meaning IBL with a nameplate rating of 30 MW or greater, per the tiering framework outlined in Chapter 3 of this draft determination.[258] (Further, it would only apply where the large IBL may contribute to instability, as discussed below.) The Commission considers this threshold is appropriate because only IBL over 30 MW in size are likely to materially contribute to instability. Using this threshold would ensure that the new access standard is not applied to smaller load for which it may be overly onerous or costly to comply with.

Applying the access standard to IBL larger than 30 MW differs from AEMO's rule change request, which proposed to apply it to IBL larger than 5 MW according to the threshold set in the SSIAG.[259] This change is supported by stakeholder feedback on our consultation paper, as several stakeholders considered that the 5 MW threshold set in the SSIAG was too low.[260] The EUAA suggested that the new access standard should only apply to IBL larger than 100 MW and/or IBL that is certain to contribute to instability.[261] Transgrid noted that the size threshold for the new access standard warranted further consideration and may need to be assessed on a case-by-case basis because the impact of an IBL on the network depends on a range of factors including its location, control modes, and other nearby plant.[262]

252 Draft rule, clause S5.3.14(c)(4)(ii), (d)(2)(ii), and (i).

253 Submissions to the consultation paper: Ergon Energy/Energex, p 7; EUAA, p 10; CPU, pp 3-4; EPEC, p 6; NEXTDC, p 8.

254 Submissions to the consultation paper: Ergon Energy/Energex, p 7; SA Power Networks, p 6; EPEC, p 6; CPU, pp 3-4.

255 ElectraNet submission to the consultation paper, p 2.

256 Submissions to the consultation paper: AirTrunk, p 10; Jemena, p 2; AWS, pp 8-9; Transgrid, p 4; SA Power Networks, p 6.

257 Transgrid submission to the consultation paper, p 4.

258 Draft rule, clause S5.3.14(a)(1).

259 AEMO rule change request overview, p 73.
AEMO, System strength impact assessment guidelines, V2.2, July 2024,, p 8.

260 Submissions to the consultation paper: Jemena, p 2; EUAA, pp 10-11; Essential Energy, pp 1-2; Ausgrid, p 3.

261 EUAA submission to the consultation paper, pp 10-11.

262 Transgrid submission to the consultation paper, p 18.

The draft rule would only require access to a PMU for IBL of 100 MW or larger, as per the rule change request.[263] This 100 MW threshold would ensure that the cost of the PMU is commensurate with the potential stability impact of the load. The threshold is also consistent with the instability detection and response access standards introduced for Schedule 5.2 by the Package 1 rule change.[264] For these larger plant, access to a PMU would enable real-time measurement of voltage and current to help detect instability including loss of synchronism.

The draft rule would provide flexibility for large IBL that does not have a material stability impact

The new access standard for instability detection and response would only apply where AEMO or the NSP considers the large IBL may contribute to instability at its connection point.[265] This means that AEMO and NSPs would have discretion to not apply this access standard if the load is not likely to have an adverse stability impact. AEMO's rule change request noted this flexibility was a benefit of its proposal.[266]

In addition, the new minimum access standard (apart from the PMU requirement) would only apply to large IBL that can change the voltage at its connection point by more than 1%.[267] For IBL smaller than 100 MW which do not meet the voltage change threshold, the minimum access standard would effectively be zero. In these cases there would be a wide range for negotiation between the automatic and minimum access standards.

EPEC questioned the 1% voltage change criterion for the minimum access standard, noting there are cases where the automatic access standard would apply but the minimum access standard would not.[268] EPEC considered it may not be appropriate to apply the automatic access standard as the impact of such plant is not likely to be material.[269] However, the Commission considers that the automatic access standard should apply to all large IBL with the potential to contribute to instability, regardless of their impact on the connection point voltage. Under the negotiated access standard framework, connection applicants may propose a standard that is below the automatic access standard and down to the relevant minimum access standard, which may be zero.

We have considered stakeholder feedback on the costs of instability monitoring

Some stakeholders raised concerns about the cost for IBL to comply with the new access standard.[270] For example, TE H2 considered that the proposed access standard was too onerous and would impose significant costs, particularly on smaller plant.[271] Data centre operators noted that data centres, and other IBL, do not necessarily have the same technical capabilities as generators and so applying similar instability response requirements may impose undue costs.[272]

The Commission acknowledges there are costs to comply with the instability detection and response access standard. We consider these costs are relatively low for the large IBL to which

263 Draft rule, clause S5.3.14(c)(4) and (d)(2).
AEMO rule change request proposed drafting, pp 193-194 (proposed new clause S5.3.12(b)(4) and (c)(2)).

264 NER clause S5.2.5.10(a)(3) and (b)(2).

265 Draft rule, clause S5.3.14(a)(2).

266 AEMO rule change request overview, p 72.

267 Draft rule, clause S5.3.14(d)(1).
This is consistent with the rule change request. (See AEMO rule change request proposed drafting, p 194 (proposed new clause S5.3.12(c)(1)).) For the minimum access standard to apply, the large IBL would also need to meet the general condition that AEMO or the NSP considers it may contribute to instability at any of its connection points.

268 This occurs for plant that is a large IBL under 100 MW in size and may contribute to instability, but cannot change the voltage at its connection point by more than 1%.

269 EPEC submission to the consultation paper, pp 6-7.

270 Submissions to the consultation paper: EPEC, p 7; EUAA, pp 10-11.

271 TE H2 submission to the consultation paper, p 2.

272 Submissions to the consultation paper: AirTrunk, p 10; NEXTDC, pp 8-9; AWS, p 8.

this access standard would apply, and are outweighed by the system security benefits in improved monitoring and management of instability.

In addition, increasing the large IBL threshold to 30 MW in the draft rule would mean that instability monitoring costs are only incurred for large projects. For large IBL, we expect that the cost of implementing a real-time monitoring system (which could be an off-the-shelf option) would be reasonable when compared with the total capex for the project. However, these costs could be more significant for a smaller IBL project. Further, many large IBL may install monitoring and operations capability at a similar level regardless of the draft rule, given the commercial importance of maintaining their loads. We also expect that the cost of real-time monitoring for IBL may decrease in the future as data processing and communication become more efficient.

Schedule 5.3 participants may take a low-cost, straightforward approach to responding to instability as the draft rule would provide significant flexibility in this area. For example, the minimum access standard requirement for a process to promptly manage instability could be satisfied by raising an alarm if oscillations are detected, manually contacting AEMO or the NSP, and standing by for further instructions. The Schedule 5.3 Participants would need to agree on and document an appropriate process with the NSP or AEMO as per the negotiated access standard framework.

The draft rule would require large IBLs to avoid causing instability

The draft rule would include a requirement for capabilities and control systems that ensure the operation of the IBL does not cause or exacerbate instability, in addition to the requirements for detecting and responding to instability.[273] It would also link this high-level requirement to the PSSG. That is, Schedule 5.3 plant would need to have operational arrangements and capabilities to prevent it from causing instability as required by AEMO pursuant to the PSSG.[274]

We have added these requirements to AEMO's proposed access standard because they would provide additional benefits for system security. They would also support effective implementation by allowing requirements to be clarified through the PSSG as necessary. While the rule change request noted that IBL may cause or contribute to instability, it only proposed instability monitoring and was silent on preventing IBL causing instability to begin with.[275]

In submissions to the consultation paper, Transgrid noted there were no existing or proposed requirements for IBL to operate stably and AWS noted the lack of "foundational stability requirements".[276] Transgrid asked the Commission to consider introducing stability requirements before or as well as monitoring requirements. EPEC, which was supportive of the proposal overall, noted that the proposed access standard may implicitly assume a stable response to instability. It suggested requiring IBL to demonstrate oscillation rejection capability (ability to operate stably when subjected to forced oscillations of different frequencies).[277]

In determining how to address this gap, the Commission considered whether there are comparable requirements for generators to avoid causing instability. Clause S5.2.5.13 of the NER sets extensive reactive power control requirements for Schedule 5.2 plant, including that they must have sufficient capabilities and control systems to ensure that the plant's operation does not cause instability.[278] While most of the clause S5.2.5.13 requirements are not appropriate or

273 Draft rule, clause S5.3.14(e).

274 Draft rule, clause S5.3.14(h).

275 AEMO rule change request overview, pp 72-73.

276 Submissions to the consultation paper: Transgrid, pp 4, 18; AWS, p 8.

277 EPEC submission to the consultation paper, p 6.

278 Transgrid also drew this comparison with S5.2.5.13(b)(1). Transgrid submission to the consultation paper, p 4.

necessary for loads, the draft rule provision for not causing instability is based on clause S5.2.5.13(b)(1)(iii), which would provide some consistency between Schedule 5.2 and 5.3 requirements.

The draft rule would permit disconnection as a response action without accounting for the plant's contribution to instability

We have designed the draft rule to avoid potentially onerous requirements for large IBL to determine its own contribution to instability, as well as potentially unnecessary automatic disconnections. These concerns were raised in stakeholder feedback to the consultation paper, as well as feedback on the Package 1 draft rule, which considered similar issues.[279]

As outlined above, the draft automatic access standard would require large IBL to be capable of disconnecting the plant on detection of instability. However, the Commission has decided to omit AEMO's proposed requirement for large IBL to consider their own contribution to any instabilities when determining whether to disconnect (or take any other actions) in response to instability.[280] Instead, the automatic access standard would only require the capability to disconnect the IBL for unstable behaviour. Whether, when and how to trigger disconnection would be decided on a case-by-case basis, as part of the hierarchy of response actions to be agreed between the Schedule 5.3 Participant, NSP and AEMO.[281]

The Commission understands that determining the source of instability is technically challenging and it may not be feasible for plant to determine its own contribution. Further, disconnecting automatically on detection of instability may make the power system less secure, because:

- The plant may have been damping oscillations, in which case disconnecting it would make the oscillations worse
- Otherwise, the unnecessary disconnection of large IBL could contribute to a significant loss of load which may have negative system security impacts including customer outages, as discussed in section 4.1.1.

The change from AEMO's proposal to the draft rule addresses the following stakeholder feedback on the potential for automatic disconnection of IBL in response to instability.

- CPU, although supportive of the new access standard, considered that load should not be required to disconnect automatically in case of instability, "as it will be difficult to identify the cause of the instability".[282]
- AWS asked the Commission to consider "[w]hether disconnecting loads during instability events can exacerbate system disturbances" and also noted the complexity of determining the cause of instability.[283]
- AirTrunk noted that disconnection of a data centre for "minor unstable behaviour" would negatively impact the data centre and its customers, and may contradict the need for increased ride-through capability.[284]

Omitting the requirement for plant to account for its own contribution to instability would also make the Schedule 5.3 instability monitoring access standard consistent with its Schedule 5.2

279 AEMC, *Improving the NEM access standards - Package 1*, final determination, pp 70-71.

280 AEMO had proposed an automatic access standard that would require any disconnection of IBL in response to instability to account for available *automated* information on the plant's contribution to the instability. See AEMO rule change request proposed drafting, p 193 (proposed new clause S5.3.12(b)(3)(i)).

281 Draft rule, clause S5.3.14(c)(3).

282 CPU submission to the consultation paper, p 3.

283 AWS submission to the consultation paper, pp 8-9.

284 AirTrunk submission to the consultation paper, p 11.

equivalent.[285] We consider this consistency is important so that loads (Schedule 5.3 plant) are not subject to more onerous requirements than generators or other Schedule 5.2 plant. AEMO noted in its submission that it would support this drafting change to improve consistency with Schedule 5.2 requirements.[286]

5.2 We have made a draft rule to clarify definitions of protection system requirements

Rod Hughes Consulting submitted two rule change requests proposing amendments to clarify the protection system access standards for Schedule 5.2 plant. We have consolidated these requests with AEMO's Package 2 rule change request to improve the NEM access standards.[287]

This section 5.2 discusses the issues raised, proposed solution, and the Commission's draft decision for the *Definitions of protection system requirements* rule change request (March 2023), which proposed new and updated definitions for different types of protection systems and related concepts.

Below, section 5.3 discusses the *Conditions for generator protection systems* rule change request (January 2023) which sought to address a possible drafting inconsistency in the automatic access standard for generator protection systems and proposed a minor change to the minimum access standard.

5.2.1 Rod Hughes Consulting proposed new definitions for several NER terms relating to protection systems

Rod Hughes Consulting submitted the *Definitions of protection system requirements* rule change request to clarify the protection system requirements in Chapter 5 of the NER, with a focus on the requirements for generators. The rule change request proposed new definitions for seven new and existing NER terms relating to protection systems, as well as some drafting changes incorporating the proposed new terminology.[288]

The proponent considers that a lack of explicit definitions may be causing disagreement amongst industry participants and delays in connection negotiations, and/or inconsistent application of the Rules. For example, the proponent considers that the distinction between primary, back-up, and breaker fail protection systems is unclear. Therefore, parties may have different interpretations of how much duplication is expected across different types of protection.[289]

Rod Hughes Consulting considered that these definitional changes would improve clarity in NER Schedules 5.1 and 5.2.[290]

The issue being addressed by the draft rule

The issue that the *Definitions for protection systems* rule change request seeks to address is that are no formal definitions for some key terms and concepts used in the access standards for generator protections systems. Specifically, the rule change request noted that:

285 The Package 1 final rule also omitted AEMO's proposed requirements for Schedule 5.2 and Schedule 5.3a plant disconnections to account for the plant's contribution to instability, following similar stakeholder feedback on the draft rule about the difficulty of identifying the plant's contributions and the risk that automatic disconnections may exacerbate disturbances. See AEMC, *Improving the NEM access standards - Package 1*, final determination, pp 70-71, and NER clause S5.2.5.10.

286 AEMO submission to the consultation paper, p 9.

287 See AEMC, *Improving the NEM access standards - Package 2*, consultation paper, section 1.4.

288 Rod Hughes Consulting, *Definitions of protection system requirements* rule change request, pp 8-10.

289 Ibid., p 1.

290 Ibid., pp 1, 12.

- the lack of NER definitions for 'primary' or 'back-up' protection systems is leading to confusion or misinterpretation in the industry
- the phrase 'must have sufficient redundancy to ensure' is unclear when used in clauses such as S5.1.9 and S5.2.5.9.[291]

Rod Hughes Consulting considered that this lack of explicit definitions may be causing differences of interpretation amongst industry participants and delays in connection negotiations, and/or inconsistent application of the Rules. For example, it considered that the distinction between primary, back-up, and breaker fail protection systems is unclear. Therefore, clauses using these phrases may be subject to multiple interpretations regarding how much duplication of protection equipment is required across primary, back-up and breaker fail protection systems. The proponent considers these unclear requirements are leading to disagreement and uncertainty in industry and "potential mis-application of the intent of the NER".[292]

The rule change request also noted the term 'primary protection system' is contradictory because all protection systems are considered secondary equipment.[293] This is because 'secondary equipment' is defined in the NER as:[294]

> Those assets of a *Market Participant's facility* which do not carry the *energy* being traded, but which are required for control, protection or operation of assets which carry such *energy*.

Proposed solution

To address the issues outlined above, Rod Hughes Consulting proposed to add or update several NER definitions relating to protection systems, and redraft some of the related clauses to use different terminology. This would include:[295]

- defining a new term *main protection system* to be used in place of 'primary *protection system*'
- defining the term *back-up protection system*
- updating the definition of *breaker fail protection system* to be more detailed and specific
- defining a new term *independent alternative main protection system* to be used instead of the 'sufficient redundancy' phrasing in clauses S5.1.9 and S5.2.5.9
- defining the terms *protection element*, *protection function*, and *control function*.

Clauses S5.1.9 and S5.2.5.9 would be redrafted to use the 'independent alternative main protection system' concept, which the proponent considered would clarify the requirements for redundancy in primary (or main) protection systems.[296]

The rule change request included proposed drafting of the new definitions as set out in Table 5.1 below.

291 Ibid., pp 2-4.

292 Ibid., p 1.

293 Ibid., p 5.

294 NER Chapter 10 glossary definition.
Note: the term 'secondary equipment' only appears twice in the NER (other than in the glossary definition) - in Schedule 5.10 Information requirements for Primary Transmission Networks Service Providers (clause 5.2A.5) and in the Chapter 10 definition of 'power system operating procedures'.

295 Rod Hughes Consulting, *Definitions of protection system requirements* rule change request, pp 8-9.

296 Ibid., p 10.

5.2.2 The draft rule would formally define primary and back-up protection systems

The draft rule would introduce new definitions for the terms 'primary protection system' and 'back-up protection system' only. These definitions would be simplified compared to the rule change request, based on the Commission's analysis and stakeholder input. The draft rule definitions are set out in Box 18 and further explanation is provided in Table 5.1 below.

Although Rod Hughes Consulting raised issues relating to Schedule 5.2 only, the new definitions would apply throughout the NER.

Box 18: Draft rule definitions of primary and back-up protection systems

The draft rule would define 'primary protection system' as (draft rule, Chapter 10 glossary definition):

> A *protection system* that is designed to be the initial response to a fault.

The draft rule would define 'back-up protection system' as (draft rule, Chapter 10 glossary definition):

> A *protection system* that is designed to operate when the relevant *primary protection system(s)* fail to clear a fault in the applicable *fault clearance time*.

The Commission has decided not to progress the other definitions and terminology changes proposed in the rule change request.

Source: AEMC.

The Commission's rationale for the draft rule

The Commission considers that clear definitions from primary and back-up protection systems would better support system security and an efficient connections process. However, we have modified the definitions proposed by Rod Hughes Consulting following stakeholder feedback and technical analysis. The draft rule definitions include the minimum detail necessary to clarify the requirements for the types of protection systems. This approach would maintain flexibility and minimise complexity by avoiding overly detailed, prescriptive definitions.

The draft rule would only include definitions for primary and back-up protection systems, and not the other definitions proposed by Rod Hughes Consulting, nor the terminology changes to 'main protection system' and 'independent alternative main protection system'. The Commission considers that these other proposed changes would not promote the NEO because they would:

- Provide little or no benefits for system security or for streamlining the connections process.
- Reduce flexibility and increase complexity – potentially increasing the costs of compliance with the access standards.

Further information is provided in Table 5.1.

Stakeholder submissions to the consultation paper provided mixed views on this rule change request and the draft rule seeks to balance those views.

A number of stakeholders supported the proposal in full or with very minor changes.[297] Others supported the intent, but considered that further technical work and consultation was required.[298]

297 Submissions to the consultation paper: SA Power Networks, p 4; EUAA, p 8; EPEC, p 4.

298 Submissions to the consultation paper: Vestas, p 2; AWS, p 6.

Transgrid, Ergon Energy andEnergex, and ENA acknowledged some of the clarity issues that the rule change sought to address, but did not support the proposed approach and recommended further work.[299] ElectraNet and CPU did not support the proposal, with CPU suggesting the issues could be resolved outside the NER if necessary.[300]

A few stakeholders also raised concerns that the proposed definitions were too specific and may restrict the design of protection systems unnecessarily.[301] Transgrid considered that "several of the proposed definitions could significantly alter protection system design requirements and introduce substantial additional costs" as a result of being too prescriptive.[302] Transgrid and AWS suggested any definitions that were introduced should be based on "functional requirements" rather than technical characteristics.[303] The Commission has taken this feedback into account by including fewer and less detailed definitions in the draft rule.

Table 5.1, below, discusses further stakeholder feedback on specific definitions and the Commission's consideration of this feedback.

299 Submissions to the consultation paper: Transgrid, p 5; Ergon Energy/Energex, pp 4-5; ENA, p 4.

300 Submissions to the consultation paper: ElectraNet, p 3; CPU, p 2.

301 Submissions to the consultation paper: Transgrid, pp 12-13; ElectraNet, p 3; AWS, p 6.

302 Transgrid submission to the consultation paper, p 13.

303 Submissions to the consultation paper: Transgrid, p 13; AWS, p 6.

Table 5.1: Draft decision for each of the amendments proposed in the rule change request

Term	Rod Hughes Consulting proposal	Draft rule	Commission's rationale
Primary protection system	Change the term 'primary protection system' to 'main protection system' for consistency with industry terminology, and to avoid contradiction with the defined term 'secondary equipment'	No change - retain the term 'primary protection system'	The Commission considers that changing the NER term for 'primary protection system' is not necessary, as both terms are used interchangeably in industry and are well understood.
	Create a new definition for 'main protection system': A *protection system* that is the intended and preferred system to clear a fault in order to minimise the number of required circuit breakers to clear the fault as close as possible to the fault.	Create a new definition for 'primary protection system': A *protection system* that is designed to be the initial response to a fault. (Draft rule, Chapter 10 glossary definition)	The Commission agrees with Rod Hughes Consulting that creating definitions for primary and back-up protection systems would improve clarity. It would help clarify the roles of primary and back-up protection and the level of duplication (or redundancy) required. We have simplified the proposed definitions to include the minimum amount of information needed for a clear definition. This also removes a number of phrases from the proposed definitions that Transgrid identified as imprecise or inaccurate, such as: • 'as close as possible to the fault', • the reference to back-up protection sharing common modes of failure with primary protection. Transgrid stated it would support NER definitions for primary and back-up protection systems based on functional requirements. The draft rule definitions would be appropriate for all instances where these terms are used in the NER.
Back-up protection system	Create a new definition for 'back-up protection system': A *protection system* that operates in consequence of a *main protection system* having failed to clear the fault in its expected time. The back-up protection system will have time and/or measurand grading to the *main protection system*. A *back-up protection system* may be itself a *main protection system* for other fault scenarios. A *back-up protection system* is not an *independent alternative main protection system* as it may share common modes of failure to the *main protection system* (e.g. auxiliary supply) and/or may not be as sensitive and/or as fast as the *main protection system*	Create a new definition for 'back-up protection system': A *protection system* that is designed to operate when the relevant *primary protection system(s)* fail to clear a fault in the applicable *fault clearance time*. (Draft rule, Chapter 10	

Term	Rod Hughes Consulting proposal	Draft rule	Commission's rationale
	so as to clear all faults in a similar time frame as expected to be cleared by the *main protection system*. Examples of *back-up protection systems* include *breaker fail protection systems* as well as other *main protection systems* located at other points in the power system with different time and/or measurand settings.	glossary definition)	
Breaker fail protection system	Create a new definition for 'breaker fail protection system': A *protection system* that, upon detecting failure of its monitored circuit breaker to clear the fault following operation of the *breaker fail protection system's* respective *independent alternative main protection system*, operates to directly open other required circuit breakers to clear the fault independently of any other *protection function* operation.	No change - retain the existing definition of 'breaker fail protection system', which is: A *protection system* that protects a *facility* against the non-operation of a circuit breaker that is required to open to clear a fault. (NER Chapter 10 glossary definition)	In submissions to the consultation paper, Transgrid and EPEC noted that the proposed alternative definition may be restrictive as it would include specific details about the design and implementation of breaker fail protection. For example, Transgrid considered the proposed definition would preclude the use of remote back-up systems for breaker fail protection. The Commission considers the existing definition of 'breaker fail protection system' is fit for purpose. In addition, the draft rule definition of 'back-up protection system' would help address the concerns raised by Rod Hughes Consulting about the distinction between back-up and breaker fail protection.
Independent alternative main protection system	Introduce a new term and change Rules wording to clarify what is required for 'sufficient redundancy' in primary/main protection systems. (S5.2.5.9: Primary protection systems must have 'sufficient redundancy' to clear faults correctly with any single protection element out of service.) 'Independent alternative main protection system' would be defined as:	No change	The Commission considers the existing wording of S5.2.5.9 (and other similar clauses) makes the intent clear while allowing for engineering judgement. The NSP and Schedule 5 participant may determine how much redundancy is appropriate on a case-by-case basis depending on the risk to the power system. This is consistent with stakeholder feedback on Rod Hughes Consulting's *Conditions for generator protection systems* rule change proposal.

Term	Rod Hughes Consulting proposal	Draft rule	Commission's rationale
	A *main protection system* that operates with similar measurand value sensitivity and speed of operation as another *main protection system* such that it is generally expected that both would be able to operate in approximately the same time for the same fault.		
Protection element	Create a new definition for 'protection element': Any of the facilities, equipment, physical and virtual connections of the protection system including: CT cores, VT windings, Trip coils, devices providing protection functions, Auxiliary/tripping d.c. batteries, Battery charger, Auxiliary a.c. auxiliary supply, Wiring, Communication systems.	No change	The Commission has decided not to include definitions for protection element, protection function and control function in the draft rule. Based on the rule change request, stakeholder feedback, and our own analysis, we have not found evidence of a problem with the existing use of these terms. Introducing new definitions would be unnecessarily prescriptive. Transgrid and CPU questioned the need for these terms to be defined and identified issues with the proposed definition of 'protection element'.
Protection function	Create a new definition for 'protection function': A function that is intended to operate on the basis of a fault or other excessive operating condition of the power system.	No change	
Control function	Create a new definition for 'control function': A function associated with the normal operation in absence of a power system fault that may be required to manage, monitor or control the power system performance and/or correct an abnormal condition of the power system.	No change	

Source: Rod Hughes Consulting, *Definitions of protection system requirements* rule change request, pp 8-9. Submissions to the consultation paper: Transgrid, pp 13, 26; EPEC, p 4; CPU, p 2.
Note: The terms 'primary protection system' and 'back-up protection system' are used frequently in the Chapter 5 Schedules but not explicitly defined.
'Protection element' appears 4 times and the phrase 'control and protection functions' appears twice in the Chapter 5 Schedules. None of these terms are explicitly defined.

5.3 The draft rule would not change the access standard for generator protection systems

The Commission's draft rule would not implement the changes by Rod Hughes Consulting in the *Conditions for generator protection systems* rule change request, which was consolidated with Package 2.

This section 5.3 discusses the issues raised, proposed solution and the Commission's draft decision for this rule change request. The rule change request sought to address a possible drafting inconsistency in the automatic access standard for generator protection systems and proposed a minor change to the minimum access standard.

5.3.1 Rod Hughes Consulting proposed clarifications to the Schedule 5.2 protection systems access standards

The *Conditions for generator protection systems* rule change request aims to clarify how the NSP and AEMO can apply the access standard for generator protection systems. Rod Hughes Consulting proposed to:

- remove NER clause S5.2.5.9(b), part of the automatic access standard for protection systems that impact on power system security, which it considers to be redundant due to a drafting inconsistency
- amend the minimum access standard to clarify that AEMO or the NSP may require additional redundancy for plant connecting at the minimum access standard, if necessary for system security.[304]

The issues raised in the rule change request

In the *Conditions for generator protection systems* rule change request, Rod Hughes Consulting raised two separate issues.

First, Rod Hughes Consulting considered there was a drafting inconsistency in clause S5.2.5.9 of the NER, which sets out the access standards that apply to Schedule 5.2 plant for protection systems that impact on power system security. Paragraph S5.2.5.9(a) sets out the automatic access standard, which is outlined in Box 19 below. Paragraph S5.2.5.9(b) provides that the requirements in sub-paragraphs (a)(2) and (a)(3) are part of the automatic access standard if AEMO or the NSP consider they are necessary to prevent certain adverse impacts on the power system or other Network Users. In the proponent's view, the requirements in sub-paragraphs (a)(2) and (a)(3) are always part of the automatic access standard by default, and so the intent and effect of paragraph (b) are not clear.[305]

The second issue raised relates to the minimum access standard, set out in clause S5.2.5.9(c) of the NER. The minimum access standard includes less onerous requirements for breaker fail protection systems and redundancy in primary protection systems, without explicitly giving AEMO or the NSP discretion as to the level of redundancy needed. Rod Hughes Consulting considers that this minimum access standard could result in risks to grid stability and system security because:[306]

304 Rod Hughes Consulting, *Conditions for generator protection systems* rule change request, pp 1-2.

305 Ibid., pp 1-2.

306 Ibid., pp 2-3.

- plant connecting under the minimum access standard may not have sufficient redundancy to ensure its protection systems clear faults as intended
- there is no obligation either on the generator, AEMO or the NSP to assess the likelihood or impact of a non-redundant primary protection system failing to clear a fault
- there is no ability for AEMO or the NSP to require redundancy in protection systems at a higher level than the minimum access standard, if they consider it necessary.

Box 19: Current arrangements for protection systems

Clause S5.2.5.9 of the NER sets out the automatic and minimum access standards that apply to Schedule 5.2 plant for protection systems that may impact power system security. The overall intent is that a generator (or integrated resource system or synchronous condenser) must be fitted with sufficient protection equipment to clear any faults that occur within that plant's equipment or its protection zone.

The automatic access standard requires primary and back-up protection systems to clear faults in a certain time. It also requires a certain level of redundancy in the primary protection system, and a breaker fail protection system, if AEMO or the NSP requires it. The minimum access standard includes less onerous protection requirements with a limited level of redundancy in some cases.

As a high-level summary, the automatic access standard for Schedule 5.2 plant requires the following (NER clause S5.2.5.9(a)):

1. primary protection systems to disconnect any faulted element in the generating system or integrated resource system and in protection zones that include the connection point within the applicable fault clearance time
2. sufficient redundancy in each primary protection system to ensure that point 1 is achieved even if any single protection element (including a communications facility upon which that protection system depends) is out of service
3. breaker fail protection systems to clear any faults that are not cleared by the primary protection system in the applicable fault clearance time.

The minimum access standard (NER clause S5.2.5.9(c)) differs from the automatic access standard in that:

1. the applicable fault clearance times may be longer
2. redundancy in the primary protection systems is not required
3. breaker fail protection systems are only required where the relevant minimum access standard fault clearance time for the primary protection system is less than 10 seconds.

Broadly similar protection system requirements also apply to Schedule 5.3 plant (loads) and Schedule 5.3a plant (HVDC links) (NER clauses S5.3.3 and S5.3a.6).

NSPs have obligations under clause S5.1.9 of the NER to provide protection systems to disconnect faults that occur anywhere on the NSP's transmission or distribution system. The NSP is also responsible for setting the fault clearance times for protection zones in its network, according to the requirements set out in clause S5.1.9.

Source: AEMC.

Proposed solution

To address the first issue, Rod Hughes Consulting proposed to remove paragraph S5.2.5.9(b). It considers paragraph (b) is redundant and can be removed without changing the meaning of the clause. Rod Hughes Consulting suggests this change would clarify that the automatic access standard is as described in paragraph S5.2.5.9(a) in all cases, which it considered to be the correct interpretation.[307]

To address the second issue, Rod Hughes Consulting proposed adding a provision for AEMO to require additional redundancy and/or breaker fail protection systems, as part of the minimum access standard, if it considers the absence of these systems may have adverse impacts. The proposed change would allow AEMO or the NSP to increase the redundancy requirements of the minimum access standard to those of the automatic access standard if necessary on a case-by-case basis.[308] The rule change request included the following proposed drafting:[309]

> In relation to a minimum access standard under this clause S5.2.5.9, the Generator must provide redundancy in the primary protection systems under paragraph (a)(2) and provide breaker fail protection systems under paragraph (a)(3) if AEMO or the Network Service Provider consider that a lack of these facilities could result in:
>
> 1. a material adverse impact on power system security of quality of supply to other Network Users; or
> 2. a reduction in inter-regional or intra-regional power transfer capability, through any mechanism including:
> 3. consequential tripping of, or damage to, other network equipment and facilities of other Network Users, that would have a power system security impact; or
> 4. instability that would not be detected by other protection systems in the network.

5.3.2 We have decided not to progress this proposal for the draft rule

The draft rule would not make any changes to the NER stemming from the *Conditions for generator protection systems* rule change request. This is because the Commission considers that:

- Retaining the existing arrangements, including rule drafting, would continue to support system security and provide flexibility, while promoting regulatory certainty.
- The proponent's concerns about the minimum access standard can be resolved through the existing negotiated access standard framework.

The Commission's rationale for the draft decision

The draft rule would retain clause S5.2.5.9(b) of the NER because the Commission considers it is not a drafting inconsistency. Rather, it provides important flexibility that allows NSPs to set appropriate performance standards without necessarily using a formal negotiation process.

We have heard a range of views from stakeholders in submissions to the consultation paper. Ergon Energy and Energex, SA Power Networks, Vestas, and EPEC supported the proposed

307 Ibid., pp 1-2.

308 Ibid., p 2.

309 Ibid., p 2.

removal of clause S5.2.5.9(b) while Transgrid, ElectraNet, and Akaysha opposed it.[310] AEMO and AWS were open to the change without having a strong view.[311] To some extent, this substantiates Rod Hughes Consulting's concern that clause S5.2.5.9 is unclear and could be interpreted in different ways.

However, the Commission's view is that clause S5.2.5.9(b) serves the purpose of allowing NSPs to apply the automatic access standard flexibly where appropriate, without entering a formal negotiation process. This view is consistent with feedback we received from Transgrid and Akaysha that this flexibility enables NSPs to set protection requirements that are commensurate with the risk depending on the characteristics of each connection.[312] Therefore, removing S5.2.5.9(b) could lead to unreasonable costs of compliance with the automatic access standard, or connection delays and increased negotiation costs.

We consider the existing drafting of clause S5.2.5.9(a) and (b) makes the intent sufficiently clear while providing flexibility, but we welcome further stakeholder feedback in response to this draft determination.

The Commission has also determined not to progress the change to the minimum access standard proposed by Rod Hughes Consulting. We note that Ergon Energy and Energex and Vestas supported the proposed change, while SA Power Networks, Akaysha, AEMO and AWS appeared open to the change.[313] EPEC suggested an alternative approach of setting requirements for a negotiated access standard, and Transgrid recommended adding mandatory back-up protection to the minimum access standard where primary protection systems are not duplicated.[314]

Despite this, we consider the concern that was raised regarding the minimum access standard can be resolved through the existing negotiated access standard framework. This is because, in general, a performance standard below the automatic access standard, down to and including the minimum access standard, is only permitted if it does not adversely affect power system security.[315] Therefore, it is not necessary to explicitly specify that AEMO or NSP can require additional redundancy if a connection applicant proposes to connect at the minimum access standard. This is consistent with feedback provided by CPU and ElectraNet.[316] The existing negotiated access standard framework empowers NSPs and AEMO to require redundancy up to the level of the automatic access standard for any and all connections as necessary for system security.

310 Submissions to the consultation paper: Ergon Energy/Energex, p 5; SA Power Networks, p 4; Vestas, p 2; EPEC, p 4; Transgrid, p 14; ElectraNet, p 3; Akaysha, p 2.

311 Submissions to the consultation paper: AEMO, p 11; AWS, p 6.

312 Submissions to the consultation paper: Transgrid, pp 5, 14-15; Akaysha, p 2.

313 Submissions to the consultation paper: Ergon Energy/Energex, p 5; Vestas, pp 2-3; SA Power Networks, pp 4-5; Akaysha, pp 2-3; AEMO, p 12; AWS, p 6.

314 Submissions to the consultation paper: EPEC, p 5; Transgrid, p 15.

315 NER clause 5.3.4A.

316 Submissions to the consultation paper: CPU, p 3; ElectraNet, p 3.

6 We have improved the system strength access standards applicable to loads and HVDC links

Box 20: Key points in this chapter

The Commission has made a draft rule to improve the system strength access standards that apply to large IBLs and HVDC links in Schedules 5.3 and 5.3a of the NER, respectively.

System strength is the measure of a power system's ability to maintain a stable voltage waveform and is critical for a secure power system. It is important because it supports the power system's ability to return to stable operating conditions following a disturbance, such as a physical fault. As the power system evolves with the influx of IBR, including IBLs such as data centres, it becomes more likely that voltage waveforms will be impacted by that IBR and network disturbances. This is because grid-following inverters do not create a voltage waveform in the same way as a synchronous machine, thereby posing risks to system strength.

By ensuring the system strength framework adapts to increased IBR penetration, this will support the stable operation of HVDC links, and enable large IBL connections. Without it, the transition slows or becomes more expensive.

In light of this, the Commission's draft rule better aligns the system strength access standards framework with the technical characteristics of IBLs and HVDC links. This would promote regulatory consistency across Schedules 5.2, 5.3, and 5.3a of the NER, and support efficient investment in system strength services, maintaining power system security and reliability in accordance with the NEO.

In this chapter:

- details how the draft rule limits the application of short circuit ratio requirements for loads and allows flexibility to agree to higher ratios under clause S5.3.11 of the NER
- details how the draft rule allows HVDC link operators to procure system strength from third parties under clause S5.3a.7 of the NER.

Note: For a more detailed description of the importance of system strength, see AEMC, Improving the NEM access standards - Package 2, Consultation paper, 8 May 2025.

6.1 We have made a draft rule to limit the application of short circuit ratio requirements for loads and allow flexibility to agree to higher ratios

The Commission has developed a draft rule to:

- Limit the application of short circuit ratio requirements under clause S5.3.11 of the NER to IBL classified as large IBL (meaning IBLs with a nameplate rating of 30 MW or greater per the classification framework outlined in Chapter 3).[317] This differs from the current arrangement, under which the short-circuit ratio requirements apply to Schedule 5.3 plant that includes any IBR component, regardless of size. The purpose of this is to ensure clause S5.3.11 is applied in a clear, transparent way that recognises larger IBLs are more likely to pose an adverse system strength impact.
- The draft rule also provides flexibility to lower the short circuit ratio minimum access standard in S5.3.11 on a case-by-case basis (rather than maintaining it at 3.0), allowing the NSP and AEMO discretion to agree on a 'higher' minimum short circuit ratio, having regard to the

317 Draft rule, clause S5.3.11(a). See also draft rule, clause S5.3.1a(a1)(iii)(A), which stipulates that clause S5.3.11 does not apply to Tier 1 connections.

expected three phase fault levels at the connection point.[318] By enabling NSPs and AEMO to lower the minimum access standard in some circumstances, this accommodates the needs and performance capabilities of different load technologies and reduces the compliance burden in stronger networks.

6.1.1 The issue being addressed by the draft rule

The regulatory framework for applying the short circuit ratio access standard to IBLs needs improving

Currently, the short circuit ratio access standard in clause S5.3.11 of the NER applies to Schedule 5.3 plant that includes any IBR component, regardless of size. The Commission notes that AEMO's SSIAG goes further to provide guidance on the application of short circuit ratio requirements as follows:[319]

> AEMO considers that the size of plant (other than a production unit) or IBR should be determinative of the need for a system strength impact assessment. Hence, the key criterion for classifying plant (other than a production unit) as an IBL or an IBR as an LIBR is a minimum capacity of 5 MW or 5 MVA.

This presents issues in two ways. First, the regulatory framework is causing confusion among connecting parties and potentially leading to the inconsistent application of the system strength requirements in clause S5.3.11 across Schedule 5.3 plant types. Second, applying this access standard indiscriminately to IBLs may capture load with small IBR components for which the cost of the short circuit ratio requirements could far outweigh any system benefits.[320]

The minimum access standard is not flexible enough to accommodate and adapt to new technologies

Clause S5.3.11 indicates that the minimum access standard is "electrical plant must have plant capability sufficient to operate stably and remain connected at a short circuit ratio of 3.0, assessed in accordance with the methodology prescribed in the system strength impact assessment guidelines."

In distribution networks where the grid is relatively strong, there may be no need to require the plant to withstand a short circuit ratio of 3.0, if the lowest they will ever encounter is a higher short circuit ratio (such as 5.0, as depicted in Box 21 below). By inflexibly requiring a short circuit ratio of 3.0 in the minimum access standard, this could lead to unreasonable minimum compliance requirements in stronger parts of the grid and, in turn, unnecessary compliance costs.

Further, some IBLs may require more system strength than others. For instance, some hydrogen production technologies employ thyristor-based converters, whereas others use IGBT technology. Thyristor-based technology typically requires a higher short circuit ratio to enable commutation of the thyristors. Consequently, they may not be able to operate at a short circuit ratio of 3.0, as currently required in the minimum access standard for clause S5.3.11.[321]

318 Draft rule, clause S5.3.11(b)-(c).

319 AEMO, SSIAG, section 2.2(d). Under clause 4.6.6(a)(6) of the NER, AEMO must make system strength impact assessment guidelines that identify IBRs that may have a general system strength impact.

320 AEMO rule change request overview, p 73.

321 AEMO rule change request overview, p 73.

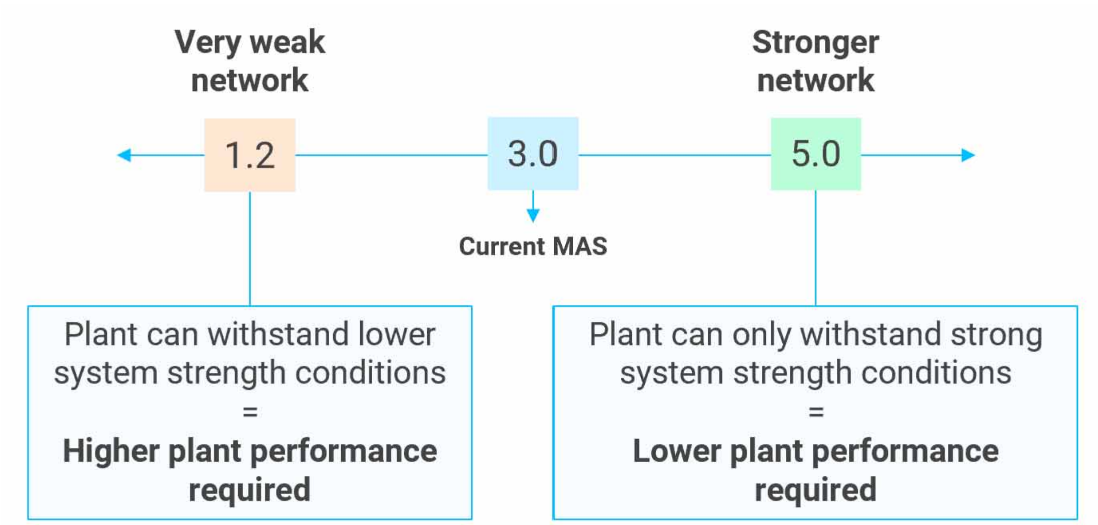
Box 21: Explainer: What a short circuit ratio of 3.0 represents

System strength refers to the ability of the power system to maintain and control the voltage waveform at any location in the power system, both during stable operation and following a disturbance. Networks are responsible for providing system security services, including system strength, to meet minimum fault-level requirements and to maintain an efficient level of system strength.

IBR, which includes IBL, are also responsible for reducing its impact on system strength. This is assessed based on adverse system strength impacts through a numerical short circuit ratio.

IBLs are currently required to be able to operate stably and remain connected at a short circuit ratio level of 3.0 (withstand short circuit ratio capability, clause S5.3.11 of the NER).

If IBL plant can withstand a short circuit ratio <3.0, this represents higher plant performance in a weaker part of the network. The Chapter 5 negotiation framework facilitates achieving a floor short-circuit ratio of 1.2 (SSIAG, section 3.4.3). If IBL plant can only withstand a higher short circuit ratio (such as 5.0), this represents lower plant performance as the plant can only withstand strong system strength conditions (see diagram).



Source: AEMC

6.1.2 Detailed description of the draft rule and the Commission's rationale

Short circuit ratio requirements in clause S5.3.11 would only apply to large IBL

The Commission has made a draft rule to clarify that clause S5.3.11 of the NER would only apply to Schedule 5.3 plant that includes any large IBL.[322] Limiting the short circuit ratio requirement to large IBLs promotes the NEO by better targeting those most likely to have a material adverse impact on system strength and power system security. Further, by applying this access standard only to large IBLs, compliance costs will be better aligned with and more commensurate with system risks.

AEMO's rule change request proposed limiting the short circuit ratio requirements to large IBL rather than all IBL.[323] AEMO sought to use the definition of large IBL provided in the SSIAG, which currently stipulates that:[324]

322 Draft rule, clause S5.3.11(a). See also draft rule, clause S5.3.1a(a1)(iii)(A).

323 AEMO rule change request overview, p 73.

> The key criterion for classifying plant (other than a production unit) as an IBL or an IBR as an LIBR is a minimum capacity of 5 MW or 5 MVA.

Rather than using this definition, the Commission has made a more preferable draft rule that would use the definition of large IBL under the classification tiering framework outlined in Chapter 3 of this draft determination. This means that under the draft rule, IBL would be classified as large IBL if it has a nameplate rating 30 MW or more (Tier 1 connection).

We consider that this approach best addresses stakeholder feedback outlined in submissions to the consultation paper:

- Several stakeholders tended to agree that the short circuit ratio requirements should only apply to large IBLs.[325]
- Many stakeholders submitted that the 5 MW threshold for classifying large IBL in the SSIAG was far too low, and that applying short circuit ratio requirements to small IBL was not commensurate with the risks they may pose.[326] The Commission has addressed this concern through the tiering framework outlined in Chapter 3, which would classify IBLs with a nameplate rating of 30 MW or greater as large IBL.

We also consider that matters about who should be subject to obligations are a matter for the rules, rather than guidelines.

Some stakeholders were concerned that limiting the short circuit ratio requirements in clause S5.3.11 to large IBL may have unintended consequences.[327] In light of this feedback, the Commission examined whether to apply this access standard to smaller IBLs.

- The Commission considered whether clause S5.3.11 should also apply to all Tier 1 connections, or to the extent there is an aggregate impact, as we have done for the disturbance ride through access standards in the draft rule.
  - For Tier 1 connections, the new disturbance ride through access standards would apply only to the extent that the NSP considers appropriate, having regard to the expected **aggregate impact** of all Tier 1 connections on its network on the quality and security of network services to other Network Users.[328]
- The Commission decided against this approach because:
  - Individual small IBLs are not expected to have significant impacts on system strength in the transmission network, considering both the size of connection and expected network connection locations. Small IBLs may have an aggregate impact in a distribution network if several are connected in similar locations, but this will likely be a local distribution network issue rather than at the transmission level. The relevant DNSP is best positioned to forecast such issues and propose efficient solutions for the distribution network.
  - Encouraging DNSP to make decisions about system strength and develop local solutions appears to be the most pragmatic approach. This is consistent with obligations held by NSPs under the Schedule 5.1 system standards, and would promote DNSPs sending the right locational signals for smaller IBL connections.[329]

324 SSIAG, section 2.2(d).

325 Submissions to the consultation paper: SA Power Networks, p 3; ENA, p 2; EUAA, p 6; EPEC, p 4; AEMO, p 9; AWS, p 4.

326 Submissions to the consultation paper: CPU, p 2; EPEC, p 3; EUAA, p 6; Essential Energy, p 2; Ausgrid, p 3; Jemena, p 2; Next DC, p 3; Transgrid, p 10.

327 Submissions to the consultation paper: Total Energies, p 2; Hydro Tasmania, p 3; Alinta Energy, p 1.

328 Draft rule, clause S5.3.1a(a1)(2). See also Chapter 3 of this draft determination.

329 See for instance NER clauses S5.1.8 and S5.1a.3.

- Requiring a distribution connected Tier 1 IBL to undergo the system strength remediation scheme (SSRS) outlined in the SSIAG is unlikely to be feasible or efficient, as it may be too onerous for small IBLs.
- Remediation at the system strength node on the transmission network is unlikely to resolve system strength issues in the distribution network. Therefore, requiring Tier 1 connections to be subject to system strength remediation charges would not be appropriate or effective. A local solution negotiated with the DNSP would be more suitable where a need is identified.

We also note that only large IBL are liable for the system strength charge under AEMO's SSIAG, and it is appropriate to align those who are liable for the charge together with the access standard application.[330]

The draft rule allows flexibility in the minimum access standard

Under the draft rule, the minimum access standard provides that the Schedule 5.3 IBL plant:[331]

> have plant capability sufficient to operate stably and remain connected at a short circuit ratio of 3.0, **or a reasonable higher value agreed with the Network Service Provider and AEMO having regard to expected three phase fault levels at the connection point**, assessed in accordance with the methodology prescribed in the system strength impact assessment guidelines.

The Commission considers that providing flexibility for NSPs and AEMO to set the short circuit ratio above 3.0, requiring lower plant performance, promotes efficient outcomes.

- In relatively strong parts of the network, large IBLs may never experience conditions approaching an SCR of 3.0. In these circumstances, requiring a uniform minimum capability may impose unnecessary design and compliance costs without delivering commensurate system security benefits.
- Allowing a lower minimum access standard, where supported by system strength studies and agreed by AEMO and the NSP, enables the access standards to reflect local network conditions and plant technology characteristics. This may be particularly relevant for certain load technologies (for example, thyristor-based technologies) that require higher fault levels to operate.

The Commission considers that this flexibility promotes the NEO by:

- supporting efficient investment by avoiding over-specification of plant capability
- reducing unnecessary barriers to connection
- maintaining system security through technical assessments to ensure the reasonable application of clause S5.3.11.

Stakeholders broadly supported this approach,[332] as flexibility for a lower MAS comes from a need to accommodate different load technologies, and reduce the compliance burden in stronger networks. For instance:

330 AEMO, System strength impact assessment guidelines V2.2, 1 July 2024.

331 Draft rule, clause S5.3.11(b).

332 Submissions to the consultation paper: Transgrid, p 1; SA Power Networks, p 3; ENA, p 2; EUAA, p 7; EPEC, p 4; AEMO, p 16; CPU, p 2.

- SA Power Networks submitted that a blanket application of onerous technical requirements without consideration of the likely risk and impact on the network could significantly deter future load connections and investment in the NEM.[333]
- The EUAA submitted that "...flexibility is needed to agree to higher short circuit ratio requirements, which we understand already occurs between the NSP and consumer. As AEMO pointed out, the required short circuit ratio can change drastically dependent on the location within an NSP's network based on whether the network is weak or strong in that location, pointing to the NSP as the source of truth".[334]

Stakeholders have concerns with the current system strength framework

Across many submissions to the consultation paper, the Commission observed that stakeholders have concerns about the current system strength framework, particularly its methodologies and compliance requirements. We have summarised these below, for AEMO to consider when updating the SSIAG:

- ENA submitted: "while we agree that flexibility to specify a higher short circuit ratio may be appropriate in some circumstances, addressing the broader issues with the SSIAG methodology for demonstrating withstand SCR is crucial for meaningful progress". Further, they expressed concern with the methodology's appropriateness for demonstrating an ability to withstand the short circuit ratio for large loads. If a Schedule 5.3 large IBL participant proposes a higher short circuit ratio requirement (representing lower plant performance), ENA is concerned that demonstrating compliance may be difficult[335]
- Transgrid submitted: "the assessment methodologies were developed mainly considering generators and integrated resource providers and may not be readily suitable for loads. Therefore, we recommend that there needs to be greater clarity for loads in SSIAG and how it is assessed".[336]
  - Specifically, Transgrid noted that the SSIAG is silent on what is meant by "potentially susceptible to control instability", which forms part of the NER definition for IBR.
  - Transgrid is also seeking greater guidance on the methodology for demonstrating the ability to withstand short circuit ratio.
- Next DC submitted that the methodology for calculating system strength charges in the SSIAG needs re-evaluating to properly account for loads. They suggest there are limited self-remediation options available to loads in order to avoid being subject to a system strength charge.[337]
- ElectraNet recommended that the SSIAG should define a minimum short circuit ratio stability margin. They submitted that "For PLL-based inverters, when defining the minimum SCR, also require demonstration of a minimum damping ratio at the plant's maximum active-power transfer".[338]
- AWS submitted that they support flexibility in the minimum access standard. However, AWS would like to see clear guidelines that establish clear criteria for assessing appropriate short circuit ratio values at different connection points.[339]

333 SA Power Networks submission to the consultation paper, p 3.
334 EUAA submission to the consultation paper, p 7.
335 ENA submission to the consultation paper, p 4.
336 Transgrid submission to the consultation paper, pp 10-12.
337 NextDC submission to the consultation paper, p 4.
338 Electranet submission to the consultation paper, p 2.
339 AWS submission to the consultation paper, p 5.

The Commission also notes that stakeholders raised concerns about the modelling capabilities for loads and the types of modelling required under the SSIAG to demonstrate compliance with the short circuit ratio access standard.[340] In summary, stakeholders would like to engage in broad industry collaboration to clarify which modelling is required to demonstrate compliance not only with clause S5.3.11, but also with the broader suite of access standards in Schedule 5.3 of the NER. To address this feedback, the transitional arrangements in the draft rule require AEMO to update the PSMG and the SSIAG in consultation with industry, per the rules consultation procedures in the NER.[341]

6.2 We have made a draft rule to allow for HVDC link operators to procure system strength from third parties

The Commission has developed a draft rule that enables HVDC links, like generators, to procure system strength from third parties in order to meet the short circuit ratio requirements under clause S5.3a.7 of the NER.

The Commission considers that the draft rule is likely to contribute to the achievement of the NEO by promoting regulatory consistency and clarity across the technical access standards in Chapter 5 of the NER.

Further, enabling HVDC links to procure system strength from third parties would allow for more efficient solutions that best utilise existing provisions of system strength, thus avoiding duplicative assets and encouraging more efficient and cooperative investment outcomes. It could also reduce both the costs and the time required to have a connection application approved by the relevant NSP, thereby streamlining the connection process.

6.2.1 The issue being addressed by the draft rule

Schedule 5.3a Participants, such as HVDC link operators, are required to meet the minimum access standard requirement in clause S5.3a.7 that stipulates "electrical plant must have plant capability sufficient to operate stably and remain connected at a short circuit ratio of 3.0, assessed in accordance with the methodology prescribed in the system strength impact assessment guidelines.[342]

HVDC link operators do not have the explicit ability to procure system strength services from third parties to meet this requirement if they are unable to do so. Conversely, generators and Integrated Resource Providers (IRPs) (both Schedule 5.2 Participants), whose plant is also required to operate stably and remain connected at a short circuit ratio of 3.0,[343] can procure services required to meet this standard from an NSP, system strength provider, or another registered participant, provided there is agreement among those parties and AEMO.[344] Accordingly, HVDC link operators must always self-remediate under the current framework.

This may create inefficiencies. System strength is a shared network service that is often most efficiently provided through coordinated, network-level solutions. Requiring HVDC links to internalise the solution may lead to asset duplication, higher capital costs, and longer connection timeframes, even where system strength could be procured more efficiently from existing

340 See Chapter 2, which provides a detailed outline of the concerns raised by stakeholders on the modelling capabilities of loads. This is a broader discussion that is relevant across the suite of Schedule 5.3 access standards.

341 NER rule 8.9; Draft rule, clause 11.XXX.6.

342 NER clause S5.3a.7.

343 NER clause S5.2.5.15. Note, this applies to Schedule 5.2 Participants only to the extent they have asynchronous production units.

344 NER clause S5.2.5.15(e)(1)-(2).

providers. As such, AEMO's rule change request noted these HVDC links should not be treated differently from Schedule 5.2 plant.

6.2.2 Detailed description of the draft rule and the Commission's rationale

The draft rule amends clause S5.3a.7 to permit HVDC link owners to procure system strength services to meet the SCR requirement, consistent with the approach for generators and IRPs. It provides that HVDC links can:[345]

- reach agreement with the NSP for the Schedule 5.3a Participant to undertake investment in its plant to achieve plant capability sufficient to operate stably and remain connected at a short circuit ratio of 3.0, or
- procure from the NSP, the System Strength Service Provider (SSSP) or another Registered Participant, services to enable the plant to operate stably and remain connected at a short circuit ratio of 3.0 but calculated using a three phase fault level at the connection point that excludes any contribution from the facilities providing the service.

The draft rule is consistent with AEMO's rule change proposal, which recommended that the procurement option ought to be aligned across Schedules 5.2 and 5.3a Participants.

The Commission considers that aligning HVDC links with generators and IRPs would promote efficient investment, reduce unnecessary connection costs, and better support the long-term interests of consumers in accordance with the NEO, while maintaining system security through the existing assessment framework:[346]

- Allowing HVDC link operators to procure system strength services enables more efficient solutions that make use of existing system strength resources, rather than requiring duplication of assets.
- This may reduce overall system costs and facilitate timely connection of HVDC infrastructure, including generator and load connections supported by HVDC technology.
- Aligning the HVDC framework with that for generators and IRPs promotes consistency across plant categories. This improves regulatory certainty and transparency for proponents and NSPs.

Stakeholders broadly supported this change in their submissions to the consultation paper

Across the submissions to the Commission's consultation paper, stakeholders tended to support this proposal for HVDC links to procure system strength services from third parties.[347]

- Transgrid's submission recognised that, to date, it has not been a problem that HVDC links cannot explicitly procure system strength services from third parties in order to meet the short circuit ratio requirements. However, this change will benefit future HVDC link connections, where owners may face the challenge of not being able to meet the short circuit ratio access standard alone. Further, Transgrid believes that IBR/HVDC link owners procuring system strength support from a third party should not be considered as the primary option. However, it may be considered if other options, including additional investment by the Schedule 5.3a participant or an arrangement with the NSP/SSSP, are not viable. Finally, Transgrid's submission noted that HVDC link includes two interface points with the connecting network and the system strength at the two interface points may be significantly different. They

345 Draft rule clause S5.3a.7(e)-(f).

346 See AEMO rule change request, proposed rule drafting, pp 206-207 (proposed amended clause S5.3a.7(e)-(f)).

347 Submissions to the consultation paper: Akaysha, p 2; EUAA, p 5.

suggest connecting parties take this into consideration when applying the current approach for generating systems and integrated resource systems to HVDC.[348]

- Hydro Tasmania strongly supports the proposal, as they consider this flexibility will encourage more efficient and cooperative investment outcomes, particularly where existing SSSPs and HVDC developments are co-located.[349]
- Alinta Energy submitted they are supportive of the proposed measures to allow HVDC links to procure system strength from third parties and consider this will ultimately lead to competitive and efficient remediation services for these assets.[350]

Some stakeholders sought clarity from the Commission on the operation of the system strength framework for HVDC links, particularly with respect to procuring services to meet short circuit ratio requirements.

- EPEC advised that a more mature assessment methodology be considered in the SSIAG for HVDC links, especially with respect to the system strength charge.[351] The Commission agrees and encourages AEMO to consider this when updating its SSIAG.
- Hydro Tasmania asked for clarification on several aspects of the proposal to ensure its practical implementation aligns with its stated intent:[352]
  - They are unclear as to how AEMO and TNSPs plan to monitor, record and enforce third-party provision, and any subsequent impacts on system strength envelopes.
    - The Commission notes that compliance and enforcement would be achieved through the connection agreement, which must record the proposed performance standards with respect to the applicable technical requirements in the NER.[353] Further, under section 7.5.3 of the SSIAG, HVDC links must demonstrate compliance with the minimum access standard in NER S5.3a.7(b),or if the procedures in NER 5.3.4A have been followed, the negotiated access standard. This would apply to any third party provision of such system strength services.
    - In circumstances where the third party may be unable to comply with the access standard (in turn compromising the S5.3a plant's ability to maintain a short circuit ratio of 3.0), AEMO may use operational constraints to maintain transient stability and, in turn, maintain system strength.[354]
    - Finally, any breaches of this access standard could be enforced under rule 4.15 of the NER if the HVDC link operator is a registered participant.[355]
  - They also asked for clarity on whether the proposed rule changes would allow both existing and new HVDC links to procure third-party ESS to meet ongoing operating requirements.
    - The Commission notes that the draft rule would not apply retroactively to existing HVDC link connections. However, if an HVDC link is altered in accordance with clause 5.3.12 of the NER, and that alteration relates to a performance standard made under S5.3a.7, the HVDC link operator would be required to demonstrate compliance with the current version of S5.3a.7.

348 Transgrid submission to the consultation paper, pp 9 -10.
349 Hydro Tasmania submission to the consultation paper, p 3.
350 Alinta Energy submission to the consultation paper, p 1.
351 EPEC submission to the consultation paper, p 3.
352 Hydro Tasmania submission to the consultation paper, p 3.
353 NER clause 5.3.7(b).
354 See AEMO's Power System Stability Guidelines, version 2.0, 2022.
355 See NER rule 4.15.

- Akaysha asked the Commission to consider whether a separate procurement process needs to be considered within the NER.[356] The Commission does not recommend prescribing a procurement process in the NER. Currently, neither the NER nor SSIAG contain a prescriptive procurement process for Schedule 5.2 Participants. The Commission also notes that this access standard falls within AEMO's advisory matters, and as such, AEMO and the relevant NSP can provide any necessary procedural advice for procuring such services from third parties.

356 Akaysha submission to the consultation paper, p 2.

7 We have made further NER improvements to promote power system security and stability

Box 22: Key points in this chapter

The Commission has made a draft rule to improve flexibility and transparency in Chapter 5 of the NER, strengthening regulatory clarity and supporting power system security and stability as the NEM evolves. The draft rule modernises key elements of the Chapter 5 framework to better align with the technical characteristics of contemporary plant and the increasing complexity of the power system. In doing so, it promotes regulatory consistency, enhances system resilience and supports efficient investment and operation.

Collectively, these reforms strengthen the security and reliability of the power system while maintaining proportionate and transparent regulatory settings. This advances the long-term interests of consumers with respect to the safety, security, reliability and efficient operation of electricity services, consistent with the NEO.

In this chapter:

- Section 7.1 explains that the draft rule allows under frequency load shedding (UFLS) to be delivered through fast ramp down capability in addition to disconnection in blocks. This enables more precise and proportionate demand-side frequency response, reducing the risk of over-shedding and supporting system stability during disturbance events.
- Section 7.2 outlines how the draft rule ensures that Schedule 5 plant may be assessed or tested, regardless of registration status. By aligning compliance and testing powers with actual system impact rather than participant category, the draft rule closes regulatory gaps and strengthens assurance that all material plant performs in accordance with agreed standards.
- Section 7.3 outlines that the draft rule permits AEMO to extend the timeframe for future access standards reviews where there are matters of material complexity or material changes in circumstances. This supports more robust technical analysis and stakeholder engagement, improving the durability and integrity of access standards settings.

7.1 We have made a draft rule to allow UFLS through fast ramp down in addition to disconnection in blocks

The Commission has made a draft rule that would permit relevant Schedule 5.3 Participants to satisfy their automatic interruptible load obligations through fast ramp-down capability, where the plant has the requisite technical functionality.[357] This differs from the current framework, which contemplates load shedding being achieved through disconnection in discrete blocks.[358]

The draft rule promotes the NEO by improving the efficiency and precision of demand-side frequency response. By enabling technically capable loads to provide fast, proportional reductions in consumption rather than binary disconnection, the draft rule facilitates a more calibrated response to underfrequency events. This may reduce the risk of frequency overshoot, minimise unnecessary load shedding, and limit secondary impacts on voltage and system stability. In doing so, the draft rule supports the secure operation of the power system.

357 Draft rule, clause S5.3.10.

358 NER clause S5.3.10.

The draft rule would also promote allocative and productive efficiency by recognising the differing technical capabilities of modern loads, including IBLs. Rather than prescribing a single mode of compliance (block disconnection), the framework allows participants the option to utilise the most efficient and technologically appropriate method available to their plant. This would reduce unnecessary disruption to end-use consumers and industrial processes while maintaining the required security outcome.

Further, the draft rule remains consistent with the overarching purpose of the UFLS scheme as an emergency mechanism designed to mitigate the risk of cascading outages and power system collapse following multiple non-credible contingency events.

7.1.1 The issue being addressed by the draft rule

Under clause S5.3.10, Schedule 5.3 Participants who are registered with AEMO and have an expected peak demand above 10 MW must provide automatic interruptible load in accordance with clause 4.3.5 of the NER. Interruptible load is “a load which is able to be disconnected, either manually or automatically initiated, which is provided for the restoration or control of the power system frequency by AEMO to cater for contingency events or shortages of supply”.[359] The level of automatic interruptible load must be a minimum of 60% of their expected demand, or such other minimum interruptible load level as may be periodically determined by the Reliability Panel, to be progressively automatically disconnected following the occurrence of a power system underfrequency condition described in the power system security standards.[360]

In practice, disconnection occurs in blocks, meaning that interruptible load is not shed all at once, nor as a continuously variable amount. Instead, it is pre-configured into discrete blocks of load, and each block may be disconnected at specific frequency thresholds. This framework was developed in the context of a power system dominated by synchronous generation and relatively predictable contingency sizes. In that environment, block-based disconnection provided a robust and effective emergency control mechanism.

However, the generation mix and demand profile of the NEM are changing, with the increased penetration of IBR, which includes IBL. In this evolving context, reliance solely on discrete block disconnection may present limitations:

- Due to the configuration of most load blocks, it is possible that more load will be shed than was specified by AEMO, possibly leading to further frequency instability, and could even trigger the need for over-frequency generation shedding.[361]
- Full block disconnection may unnecessarily interrupt industrial or IBL processes where a temporary and rapid reduction in demand could achieve the required security outcome with less disruption. As noted in AEMO’s rule change request, some loads may be more flexible with the ability to ramp down their load in an emergency rather than disconnection.[362]

Accordingly, the Commission considers that the existing interruptible load framework may not fully accommodate the capabilities of modern large loads to provide fast, proportional demand reduction. This may limit the precision and efficiency of the overall frequency control regime as the power system continues to transition.

359 NER Chapter 10 glossary definition of ‘interruptible load’.

360 NER clause 4.3.5. The Commission notes that load shedding may be applied or determined in accordance with AEMO’s and participating jurisdictions’ procedures, per NER clause S5.3.10.

361 The Commission notes that TNSPs must use best endeavours to minimise any load shed in excess of the amount directed, per section 3.1 of AEMO’s 2019 Manual Load Shedding Standard.

362 AEMO rule change request overview, 4 April 2024, p 71.

7.1.2 Detailed description of the draft rule and the Commission's rationale

To address the issues outlined above, the Commission has made a draft rule that would introduce an automatic and minimum access standard in clause S5.3.10 of the NER:

- The minimum access standard requires Schedule 5.3 plant to provide automatic interruptible load in accordance with clause 4.3.5 of the NER (meaning disconnection in blocks), which is consistent with the current rule.[363]
- The automatic access standard requires Schedule 5.3 plant to provide automatic interruptible load that is capable of being disconnected in blocks, and capable of fast reduction of active power consumption (meaning fast ramp down).[364]

The draft rule also introduces general requirement for the connection agreement to record the nature of the load shedding capability, including any quantities of active power available for fast reduction and the corresponding rates of reduction.[365]

The draft rule promotes the NEO by introducing efficient load shedding options that would support power system security

The minimum access standard maintains the existing requirement for Schedule 5.3 plant to provide automatic interruptible load through disconnection in blocks. This preserves a clear and robust baseline security mechanism, consistent with clause 4.3.5 of the NER and the established UFLS framework.

The automatic access standard builds on this baseline by requiring capable plant to provide both:

- disconnection in blocks; and
- fast reduction of active power consumption (fast ramp-down capability).

The Commission understands that some modern loads have the technical capability to reduce consumption rapidly without full disconnection. Enabling this functionality allows for a more proportionate response to underfrequency events. This may improve the efficiency of the power system response, reduce the risk of over-shedding, and potentially limit the extent of load reduction required from affected users.

The automatic access standard is designed to incentivise the provision of fast ramp-down capability where it is technically feasible and efficient to do so. However, consistent with the access standards negotiation framework, it is not mandatory. A Schedule 5.3 plant that is only technically capable of disconnection in blocks may meet the relevant access standard on that basis. The draft rule therefore preserves flexibility while maintaining an appropriate security baseline.

The Commission has considered stakeholder feedback

Stakeholders tended to agree with AEMO's rule change proposal[366] and some provided detailed feedback, which has been considered by the Commission in developing the draft rule:

- Transgrid and Hydro Tasmania both supported the inclusion of fast ramp-down capability alongside block disconnection, submitting that it would improve flexibility, operational efficiency and system resilience during under frequency events. Both stakeholders encouraged

363 Draft rule, clause S5.3.10(c).
364 Draft rule, S5.3.10((b)(1)-(2).
365 Draft rule, clause S5.3.10(d).
366 Submissions to the consultation paper: Ergon/Energex, p 9; Transgrid, p 4; Hydro Tasmania, pp 4-5; EPEC, p 7.

the Commission to incentivise the deployment and use of fast reduction capability through the automatic access standard.[367] The Commission has reflected this shared view in the draft rule by incorporating drafting that promotes fast ramp-down capability where technically feasible.

- EUAA, NEXTDC and CPU supported the availability of fast ramp-down capability, emphasising that it should remain optional and flexible rather than mandated. EUAA submitted that the discretion to ramp down should rest with the consumer, while NEXTDC supported voluntary implementation, including through existing commercial demand response mechanisms. CPU noted that block disconnection may be preferable in some events and endorsed flexibility for both approaches.[368] The Commission agrees with this shared view and has reflected it in the draft rule, which incentivises but does not require fast ramp-down capability.
- ElectraNet and ENA submitted that greater clarity may be required regarding the meaning of 'fast reduction', including appropriate ramp-down rates and performance expectations, given the dynamic nature of under frequency events.[369] The Commission has not prescribed a definition of fast reduction in the draft rule. Instead, it considers that flexibility should be maintained for connecting parties to negotiate plant-specific capabilities through the access standards framework. To support transparency and operational certainty, the draft rule requires the connection agreement to record the nature of the load shedding capability, including the quantities of active power available for fast reduction and the corresponding rates of reduction.[370] The Commission welcomes feedback on this approach.
- AirTrunk and AWS supported flexible load reduction, including fast ramp-down, but emphasised that participation must recognise the technical capabilities of participating plant, and must not compromise the protection requirements for plant and equipment.[371] The Commission considers that these concerns are addressed through the draft rule's design. Fast ramp-down is incentivised through the automatic access standard but is not mandatory. Where plant cannot meet that standard due to technical or operational constraints, compliance may be achieved through block disconnection under the minimum access standard. In addition, the requirement to document the nature, quantity and rate of any fast reduction capability in the connection agreement provides clarity and coordination with AEMO and the relevant NSP. Together, these elements preserve flexibility while maintaining system security and connection integrity.

7.2 We have made a draft rule to ensure equipment may be assessed or tested, regardless of registration status

The Commission has made a draft rule to allow all Schedule 5 Participants the right to request testing or assessment of Schedule 5 plant, if there are reasonable grounds to believe that plant may not comply with the NER or an applicable connection agreement. Currently, only registered participants that are party to the connection agreement may request testing, and similarly, only plant belonging to a registered participant may be subject to this right of testing.

By extending testing and assessment to all Schedule 5 plant, regardless of registration status, the Commission has acknowledged that any Schedule 5 plant may contravene the NER or connection agreement and have an adverse power system security impact. This will contribute to the NEO, as

367 Submissions to the consultation paper: Transgrid, p 20; Hydro Tasmania, pp 4-5.
368 Submissions to the consultation paper: EUAA, p 11; NEXTDC, p 10; CPU, p 4.
369 Submissions to the consultation paper: ElectraNet, p 2; ENA, p 6.
370 Draft rule, clause S5.3.10(d).
371 Submissions to the consultation paper: AirTrunk, p 11; AWS, p 9.

it promotes the safety, security, and reliability of the power system, because it addresses the possible system security impact of all Schedule 5 plant.

7.2.1 The issue being addressed by the draft rule

Currently, if a Registered Participant has a connection agreement with another Registered Participant, and reasonably believes that the other party's equipment might not be complying with the Rules or the connection agreement, it may request testing or assessment of that equipment.[372] Similarly, clause 5.8.1 of the NER provides that, as part of the commissioning phase, a registered participant must ensure that any of its new or replaced equipment is inspected or tested to ensure compliance with Australian Standards, the Rules, and the connection agreement.[373] The Commission understands that this right of testing is usually exercised by an NSP during the process for connection and commissioning of new registered Schedule 5 plant, including generators and IRPs, loads and HVDC links.

Moreover, clause 5.7.3(a) of the NER sets out the requirements for connecting parties to provide evidence to the relevant NSP and AEMO to demonstrate compliance with the performance standards set out in their connection agreement. Clause 5.7.3(d) then allows for AEMO to request testing of a generator or IRP if it believes that the relevant plant does not meet one or more of the applicable performance standards.

As expressed in AEMO's rule change request, plant belonging to a Schedule 5 Participant, regardless of registration status, may contravene the NER or performance agreement and have an adverse power system security impact, and as such, testing and assessment requirements should apply.[374] The Commission's view is that the current testing regime is structured around traditional connection and registration constructs. As the NEM evolves, that structure may not fully capture all plant capable of materially affecting system security, potentially creating gaps in assurance, monitoring and enforcement. Further, this regulatory asymmetry may increase system security risks as the number of non-registered plant connected to the NEM continues to grow.

7.2.2 Detailed description of the draft rule and the Commission's rationale

To address the issues noted above, the Commission has made a draft rule that would:

- Amend clause 5.7.2(a) so that both Registered Participants and Schedule 5 Participants may request testing of equipment owned or operated by a Registered Participant or Schedule 5 Participant, if there is a reasonable belief that the equipment might not be complying with the Rules or the applicable connection agreement, rather than this only applying to Registered Participants.[375]
  - The Commission notes that the final rule for *Improving the NEM access standards - Package 1* amended clause 5.7.2 to add 'assessment', which would allow investigation (short of testing) to examine the cause of a switching surge (for example).[376] Under the draft rule, this would apply for all Schedule 5 Participants.
  - Consistent with the current framework, the cost of tests or assessments must be borne by the requesting party, unless the equipment is found to be non-compliant, in which case the

372 NER clause 5.7.2(a).

373 NER clause 5.8.1(a).

374 AEMO rule change request overview, 4 April 2024, p 71.

375 Draft rule, clause 5.7.2(a).

376 AEMC, Improving the NEM access standards - Package 1, Final determination, May 2025.

owner of that equipment is liable for the costs.[377] The purpose of this is to deter frivolous requests.[378]

- Amend clause 5.7.3(a)-(c) so that all Registered Participants must provide evidence to any relevant NSP with which it has a connection agreement and AEMO that its plant complies with that agreement, rather than just generators and IRPs.[379]
- Amend clause 5.7.3(d)-(f) (including inserting new clause 5.7.3(f1)-(f2)) so that AEMO can request all Schedule 5 plant to conduct tests to demonstrate compliance with applicable performance standards, if there is reasonable belief that the plant may be non-compliant. It would also allow AEMO to give a direction to such non-compliant plant, which may require that plant to operate at a particular level, pattern or profile of active power, or in another particular mode, until evidence of compliance is produced.[380]
- Introduce a new clause 5.8.1A so that testing new or replacement equipment under rule 5.8, as part of the commissioning phase, applies to all Schedule 5 participants, rather than only registered participants. Commissioning requirements surrounding testing will only be extended to Schedule 5 plant with a nameplate rating of 30 MW or greater.[381]

The draft rule would promote the NEO by closing regulatory gaps and promoting system security

The draft rule would promote the NEO by strengthening the testing, assessment and compliance framework so that it better reflects the modern NEM and the system security risks that may arise from Schedule 5 plant, regardless of registration status. Specifically, the draft rule:

- Removes reliance on registration status as the trigger for testing rights.
- Ensures that any Schedule 5 plant capable of affecting the power system can be scrutinised.
- Aligns the framework with actual system impact, rather than historical participant categories.

This would reduce the risk that materially non-compliant plant could avoid scrutiny due to technical registration boundaries. Further, the draft rule strengthens AEMO's ability to manage emerging risks. Earlier detection and remediation of non-compliance improves power system security and reliability, directly promoting the security limb of the NEO.

The Commission has considered stakeholder feedback

Stakeholders generally supported extending testing and assessment powers to all Schedule 5 plant capable of materially affecting system security, noting that registration status does not necessarily reflect system impact,[382] and some provided detailed feedback which has been addressed by the Commission:

- SA Power Networks submitted that they agree with testing being extended to non-registered Schedule 5 Participants, provided there is an appropriate size threshold based on risk and impact assessment.[383] The Commission has addressed this feedback through new clause 5.8.1A in the draft rule, which would limit testing new or replacement equipment under rule 5.8 as part of the commissioning phase to Schedule 5 plant with a nameplate rating of 30 MW or greater.

377 NER clause 5.7.2(d).

378 Draft rule, clause 5.7.3(d).

379 Draft rule, clause 5.7.3(a)-(c).

380 Draft rule, clause 5.7.3(d)-(f).

381 Draft rule, clause 5.8.1A. The Commission notes this is consistent with the tiering framework for classifying Schedule 5.3 participants. For more information, see Chapter 3 of this draft determination.

382 Submissions to the consultation paper: Transgrid, p 24; SA Power Networks, p 7; Vestas, p 4.

383 SA Power Networks submission to the consultation paper, p 7.

- ElectraNet generally supports this proposal, but expressed concern on whether enforcement can be achieved.[384] The Commission notes that rule 4.15 of the NER sets out the legal obligations on Registered Participants to ensure their plant complies with its agreed performance standards and to manage, report and rectify any breaches. Further, the draft rule would require connection agreements with non-registered participants to include terms and conditions that provide reasonable assurance from the connection applicant of ongoing compliance with the performance standards, in a manner consistent with good electricity practice.[385] This could materially improve compliance outcomes for unregistered Schedule 5 Participants by leveraging private contractual arrangements as a practical enforcement mechanism.[386]
- EUAA submitted: "AEMO or the NSP need to be certain that non-registered schedule 5 plant contribute to instability, not just "consider" that it will. Using a word like "consider" will effectively make the rule compulsory as the uncertainty of the wording encourages conservatism in decision-making".[387] The Commission's view is that the current requirement for the requesting party to hold a 'reasonable' belief that a Schedule 5 plant may be non-compliant addresses this feedback.
- AirTrunk expressed concern that the proposed extension of the 'right of testing' could have unintended consequences. While the costs of compliance testing are borne by the requesting party (where the results demonstrate that the plant meets the relevant requirements), the actual full cost of downtime resulting from 'testing' will greatly outweigh the direct testing costs.[388] The Commission appreciates AirTrunk's concerns and welcomes further stakeholder feedback on this matter.

7.3 We have made a draft rule allowing AEMO to extend the timeframe for future access standards reviews

The Commission has made a draft rule allowing AEMO to extend future technical reviews due to complexity or material changes.[389]

Allowing AEMO to extend the timeframe for publication of a final report by up to three months, where there are matters of material complexity or a material change in circumstances, reduces the risk of incomplete analysis or conclusions based on outdated assumptions. This flexibility would enable more comprehensive modelling, validation and risk assessment, supporting technically sound outcomes that enhance system security and stability.

Importantly, the extension power is constrained by procedural safeguards. AEMO must publish a notice of extension at least one month before the expiry of the original 12-month period, clearly identifying the matters of complexity or material change and outlining how it intends to address them, including through stakeholder engagement.[390] This requirement promotes transparency, accountability and regulatory certainty, which are critical to maintaining investor confidence and facilitating efficient operational and investment decisions.

384 ElectraNet submission to the consultation paper, p 3.
385 Draft rule, clause 5.3.7(b)(1)-(2).
386 For more information, see section 3.4.2 of this draft determination.
387 EUAA submission to the consultation paper, p 12.
388 AirTrunk submission to the consultation paper, p 12.
389 Draft rule, clause 5.2.6A(e1).
390 Draft rule, clause 5.2.6A(e1).

7.3.1 The issue being addressed by the draft rule

As discussed in Chapter 1, AEMO must periodically review some or all of the technical requirements set out in schedules 5.2, 5.3, and 5.3a of the NER to assess whether they need updating.[391] Pursuant to clause 5.2.6A of the NER, AEMO is required to complete each review within 12 months of publishing the approach paper.

While conducting their first review, AEMO observed that this12-month time limit can inhibit the necessary analysis and consultation needed to develop fit-for-purpose rule change proposals that give effect to the review criteria. This is because the reviews require a large volume of matters to be evaluated, many of which are highly technical and require extensive consultation.[392]

7.3.2 Detailed description of the draft rule and the Commission's rationale

To address AEMO's concerns, the Commission has made a draft rule allowing AEMO to extend future technical reviews due to complexity or material changes. Under the draft rule:

- the time for publication of the final report under paragraph may be extended by AEMO for an additional period of up to 3 months by publishing a notice of extension if AEMO considers that there are matters of material complexity or a material change in the circumstances requiring an extension
- AEMO must publish a notice of extension no later than one month prior to the end of the 12 month period which sets out the matters of complexity or material change in the circumstances, and how AEMO plans to address it, including its plan for engaging stakeholders on those matters.[393]

The draft rule would promote the NEO, particularly the security and reliability limbs, by improving the quality, transparency and robustness of AEMO's future technical reviews.

Allowing AEMO to extend a review by up to three months where there are matters of material complexity or a material change in circumstances:

- Reduces the risk of incomplete or premature conclusions.
- Enables deeper technical analysis where system security risks are novel or evolving.
- Supports more accurate modelling, validation and risk assessment.

The Commission considers this would improve the technical integrity of review outcomes, which in turn strengthens system security and stability over the long term.

The Commission has considered stakeholder feedback

Stakeholders tended to agree with proposal,[394] and some provided detailed feedback which has been addressed by the Commission:

- Transgrid submitted that the 12-month time limit does inhibit the necessary analysis and consultation needed to develop fit-for-purpose rule change proposals. They also submitted that they agree "AEMO should publish a notice when an extension is needed, outlining the reasons as they may relate to complexity/difficulty, or a material change in circumstances. We strongly believe in proactive engagement with all stakeholders at every stage of any review

391 NER clause 5.2.6A.

392 AEMO rule change request overview, 4 April 2024, p 75.

393 Draft rule, clause 5.2.6A(e1).

394 Submissions to the consultation paper: SA Power Networks, p 7; CPU, p 5; AWS, p11; EPEC, p 8; SA Power Networks, p 7.

undertaken by each of the major market bodies, including AEMO and the AEMC".[395] This has been addressed in the draft rule.

- Gridmo submitted that "the proposed amendment does not cap the additional time of the extension and could be used several times for arbitrary extensions. We acknowledge the pace of grid connection requirements in Australia, but question if changing from 12 months to 18 months...".[396] Similarly, EPEC submitted that the Rule should ensure the work will be finished in a reasonable timeframe.[397] The Commission had addressed this feedback, as the draft rule would only allow AEMO to seek an extension for up to three months.
- SA Power Networks, Vestas, and EUAA expressed that the progress of the extension should be transparent, well-documented, and easily accessible to ensure accountability and maintain stakeholder confidence.[398] This would be achieved through the notice requirement under the draft rule.

395 Transgrid submission to the consultation paper, p 25.

396 Gridmo submission to the consultation paper, p 3.

397 EPEC submission to the consultation paper, p 8.

398 Submissions to the consultation paper: SA Power Networks, pp 7-8; Vestas, p 1; EUAA, p 13.

8 The draft rule would promote the National Electricity Objective

Box 23: Key points in this chapter

The draft rule would address the system security impacts of large IBL and improve the NEM access standards. Accordingly, the Commission is satisfied that the draft rule would promote the NEO through:

- Promoting efficient investment and regulatory certainty through a clear and transparent framework for classifying large IBL.
- Enhancing system security and reliability by introducing new disturbance ride-through access standards to mitigate cascading outages and system black events.
- Improving power system stability and quality of supply through strengthened access standards and clearer technical definitions.
- Supporting efficient system strength outcomes by making requirements fit-for-purpose for IBLs and HVDC links.
- Promoting system security and regulatory clarity through targeted improvements to Chapter 5 of the NER.

The Commission has made a more preferable draft rule because we consider it would better contribute to the achievement of the NEO than the rule change requests. The key differences between the draft rule and the rule change requests include:

- Establishing a framework for classifying large IBL connecting to the distribution network, to better support the transparent and proportionate application of new and existing access standards.
- Introducing new disturbance ride-through access standards for IBL to address the system security risk of large load disconnections in a more effective, clear and predictable way.
- Making incremental reforms to promote compliance with performance standards for non-registered Schedule 5 Participants.
- Creating a smaller, simplified set of protection system definitions, to improve clarity while retaining more flexibility than the *Definitions of protection system requirements* proposal.
- Not implementing the *Conditions for generator protection systems* proposal, as we consider it would not promote the NEO.

In this chapter:

- Section 8.1 explains that the Commission must make decisions that promote the NEO
- Section 8.2 discusses other relevant factors that the Commission takes into account
- Section 8.3 sets out the Commission's rationale for the draft rule against our NEO assessment criteria.

8.1 The Commission must act in the long-term interests of energy consumers

The Commission can only make a rule if it is satisfied that the rule will or is likely to contribute to the achievement of the relevant energy objectives.[399] For this rule change, the relevant energy objective is the NEO. The NEO is:[400]

> to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to—
>
> (a) price, quality, safety, reliability and security of supply of electricity; and
>
> (b) the reliability, safety and security of the national electricity system; and
>
> (c) the achievement of targets set by a participating jurisdiction—
>
> (i) for reducing Australia's greenhouse gas emissions; or
>
> (ii) that are likely to contribute to reducing Australia's greenhouse gas emissions.

The targets statement, available on the AEMC website, lists the emissions reduction targets to be considered, as a minimum, in having regard to the NEO.[401]

8.2 We must also take these factors into account

8.2.1 We have considered whether to make a more preferable rule

The Commission may make a rule that is different, including materially different, to a proposed rule (a more preferable rule) if it is satisfied that, having regard to the issue or issues raised in the rule change request, the more preferable rule is likely to better contribute to the achievement of the NEO.[402]

For this rule change, the Commission has made a more preferable draft rule. Our reasons are set out in section 8.3 below.

8.2.2 We have considered how the rule would apply in the Northern Territory

In developing the draft rule, the Commission noted that, while most of the amendments relate to rules in the NER that do not currently apply to the Northern Territory, some amendments may relate to rules currently in effect in that jurisdiction. The Commission has considered how it should apply to the Northern Territory according to the following questions:

- **Should the NEO test include the Northern Territory electricity systems?** For this rule change request, the Commission is still considering whether the reference to the "national electricity system" in the NEO includes the local electricity systems in the Northern Territory or only the national electricity system.
- **Should the rule be different in the Northern Territory?** The Commission is still considering whether a uniform or differential rule would be appropriate and would welcome submissions on this. The Commission will continue to consult with the Northern Territory Government.

See Appendix D for more detail on the legal requirements for our decision.

399 Section 88(1) of the NEL.

400 Section 7 of the NEL.

401 Section 32A(5) of the NEL.

402 Section 91A of the NEL.

8.3 How we have applied the legal framework to our decision

The Commission must consider how to improve the NEM access standards against the legal framework.

We identified the following criteria to assess whether the proposed rule change, no change to the rules (business-as-usual), or other viable, rule-based options are likely to better contribute to achieving the NEO:

- **Safety, security and reliability** — This criterion was selected to consider the secure, safe, and reliable operation of the power system at least cost. The operational security of the power system depends on whether the connecting plant and equipment can operate within the technical access standards contained in the NER and not present significant system security risks. Improving access standards can ensure alignment with the secure operation of the power system and improve power system resilience.
- **Innovation and flexibility** — This criterion was selected because innovation and flexibility are important principles to utilise when improving the NEM access standards contained in the NER. This is true both from the perspective of process innovations and innovations in finding solutions to system security issues uncovered through the application of the access standards to network user customers. Innovation and flexibility are promoted when the draft rule accommodates a range of technologies including evolving technologies, adapts to changing power system needs or needs that are location dependent, and supports timely investment.
- **Implementation considerations** — This criterion was selected to assess matters such as timing, interrelationships with other reforms and processes, and benefits or adverse consequences for industry and consumers. Further, we consider that the cost and complexity of implementation and ongoing regulatory and administrative costs to all market bodies, participants and consumers must be balanced. This includes being clear on the roles of market bodies and participants, supporting efficient investment and operational decisions, and promoting transparency and predictability.

These assessment criteria reflect the key potential impacts – costs and benefits – of the rule change request, for impacts within the scope of the NEO.

The Commission's draft rule is largely consistent with the proposed amendments to the access standards in AEMO's rule change request and also incorporates some of the amendments proposed by Rod Hughes Consulting. However, this draft rule is a more preferable rule, as the Commission has incorporated stakeholder feedback, and technical analysis to more effectively address the issues raised in the rule change request and achieve the intended policy outcomes, as explained below. This will better support the assessment criteria listed above than the proposed rule by increasing the likelihood that these criteria may be met.

Some of the key differences between the draft rule and AEMO's rule change request include:

- Establishing a clear and transparent framework for classifying large IBLs that seek connection at the distribution level, because unlike for transmission connections, the application of the Schedule 5.3 access standards to distribution connections is unclear and needs modernising. By introducing a structured tiering approach under Schedule 5.3, the Commission's draft rule would provide greater certainty as to how the access standards apply to emerging load technologies connecting to distribution networks, ensuring that technical requirements are proportionate to a load's characteristics and its potential impact on power system security.

- Introducing new disturbance ride-through access standard requirements for IBLs. These standards would address voltage and frequency disturbances, as well as post-fault active power recovery, and are designed to mitigate the risk of cascading outages and sudden load disconnection during credible contingency events. This would have the effect of strengthening the resilience of the power system in an environment of increasing inverter based participation.
- Introducing targeted, incremental reforms that would promote compliance with access standards recorded in connection agreements for non-registered Schedule 5 Participants, including loads, generators, and integrated resource systems. Under clause 4.14(n) of the NER, AEMO is required to establish and maintain a formal register of the performance standards applicable to Registered Participants' plant. The draft rule would extend the application of this clause to all Schedule 5 Participants. Further, the draft rule would require connection agreements with non-Registered Participants to include terms and conditions that provide reasonable assurance from the connection applicant of ongoing compliance with the performance standards, in a manner consistent with good electricity practice. This could materially improve compliance outcomes for unregistered Schedule 5 Participants by leveraging private contractual arrangements as a practical enforcement mechanism.

The key differences between the draft rule and Rod Hughes Consulting's rule change requests include:

- Introducing a smaller, simplified set of protection system definitions, to improve clarity while retaining more flexibility than the *Definitions of protection system requirements* proposal.
- Not making the changes proposed in the *Conditions for generator protection systems* rule change request. We consider the existing arrangements will continue to support system security while the proposed changes would not promote the NEO.

The rest of this section explains why the draft rule best promotes consumers' long-term interests compared to other options, as assessed against the criteria.

8.3.1 The draft rule for classifying load would promote a clear regulatory framework that supports investment and system security

The IBL classification framework would support system security by clarifying when the Schedule 5.3 access standards apply

The Commission considers that a clear classification framework for large IBL is necessary to support the appropriate application of the Schedule 5.3 access standards, which would in turn promote power system security and stability. In particular, the framework is intended to ensure that loads with the potential to materially affect power system stability are subject to access standards commensurate with their system impact, and that such plant operates in a predictable and grid-supportive manner. By providing greater clarity on when and how the Schedule 5.3 access standards apply, the draft rule would also support AEMO's system planning and operational functions, contributing to the maintenance of a safe, secure and reliable power system.

A technology-neutral classification framework would support innovation and flexibility

The Commission seeks to develop regulatory standards that support innovation and accommodate new and emerging technologies. The draft framework classifies plant based on technical characteristics, including the use of power electronic equipment, rather than targeting specific end uses or industries. This promotes technology neutrality and avoids locking the NER to particular technologies, such as data centres or hydrogen electrolysers, that may evolve over time.

This approach is also intended to ensure that the regulatory framework remains adaptable as new forms of IBL emerge and as operational practices change.

A clear, consistent and predictable framework would support efficient implementation of the draft rule

In developing the draft rule, the Commission has sought to promote predictability and stability for grid participants by clearly articulating which types of plant the Schedule 5.3 access standards apply to, and the manner in which they apply. At the same time, the framework seeks to avoid unnecessary prescription, recognising the importance of proportionate regulation that targets material system security risks and avoids imposing undue compliance costs where risks are low. The Commission has also sought to align the draft changes to Schedule 5.3 in a manner consistent with Schedule 5.2 to the extent appropriate and practicable.

Additionally, the Commission's draft rule makes targeted, incremental reforms that would promote compliance with access standards recorded in connection agreements for non-registered Schedule 5 Participants, including loads, generators, and integrated resource systems. These reforms would also improve visibility for AEMO and the AER on the performance standards agreed upon between NSPs and non-registered Schedule 5 Participants, thereby supporting the effective implementation of new and existing access standards.

See Chapter 3 for more information.

8.3.2 The draft rule would enhance system security by introducing disturbance ride-through and stability access standards for IBL

The Commission considers that the disturbance ride-through and instability detection and response access standards included in the draft rule would promote the NEO for the reasons set out below.

The draft rule would introduce disturbance ride-through access standards for IBL

The new disturbance ride-through access standards would support system security and stability

The draft rule disturbance ride-through access standards would mitigate system security risks by requiring new large IBL connections to have an appropriate level of ride-through capability. Improving the ride-through capability of large IBL would reduce the likelihood and severity of aggregate large load disconnections, which could have significant impacts on consumers such as disruption of supply. It would also enable AEMO and NSPs to manage these system security risks at a lower cost to consumers. In designing the draft rule, we have set the access standards at a level we consider to be commensurate with the risk to system security. Accordingly, the new access standards would be aligned with the NEM system standards and would only apply to IBL.

The draft rule would provide flexibility in applying the new disturbance ride-through access standards

The draft rule would incorporate flexibility by using the IBL classification framework, as well as the existing negotiation framework, so that the new access standards are only applied to loads to the extent necessary for system security. We have set less onerous minimum access standards to provide a range for negotiation, including no MAS for frequency disturbance ride-through, and discretion for AEMO and NSPs to use a lower MAS for voltage disturbance ride-through on a case-by-case basis. This flexibility would enable the draft rule to better accommodate IBLs of different types and sizes, minimising barriers to connection and supporting efficient investment in data centres and other infrastructure.

The new disturbance ride-through access standards are designed to support a clear and efficient connections process

The Commission has considered how connection applicants would be impacted by the new access standards. In designing the new access standards, we have sought to promote regulatory certainty and consistency by setting clear technical standards that are numerically formulated wherever possible. In addition, the draft rule aims to minimise the costs and regulatory burden of complying with the new access standards by aligning them with international large load ride-through requirements and the existing technical capabilities of IBLs such as data centres. This would promote an efficient and predictable connections process for applicants and NSPs, to support investment in data centres and other infrastructure.

See section 4.1 for more information.

Information provision on the ride-through capability of loads would complement the disturbance ride-through access standards to enhance system security

The draft rule would also enable AEMO and NSPs to manage system security risks in a more targeted and efficient way by improving visibility of large loads' ride-through capability. This would avoid unnecessary costs where AEMO and NSPs may otherwise have to make conservative assumptions about loads' capabilities. The draft rule would give AEMO and NSPs better access to information about how large loads respond to disturbances by:

- For IBL where the disturbance ride-through access standards apply, recording the plant capability in its performance standards (with a copy provided to AEMO by default)[403]
- For all Schedule 5.3 plant connections, enabling NSPs (in consultation with AEMO) to request information about the plant's ride-through capability.

This enhanced information provision would support AEMO and NSPs in maintaining system security at an efficient cost to consumers.

See section 4.1.5 for more information.

The draft rule would introduce an access standard for instability detection and response by large IBL

Creating a new access standard for instability monitoring would support power system security

The draft rule would introduce an instability monitoring access standard for large IBL to help manage the impacts that IBL may have on system stability. This is important because instability in the power system can lead to plant disconnections and supply disruption to consumers if it is not managed effectively. As discussed in Chapter 5, IBL or other plant with power electronic control systems may contribute to oscillations or other unstable behaviour, but there is a currently a gap in the access standards with no stability requirements that apply to loads.

The new access standard would support the effective management of instability to maintain power system security by requiring relevant Schedule 5.3 Participants to:

- monitor instability and exchange instability information with AEMO and the NSP, to inform appropriate responses to instability
- agree with the NSP and AEMO on a process for responding to instability, and document it in the performance standards, which would support any centralised, coordinated response to instability

403 The draft rule would expand AEMO's register of performance standards to non-registered Schedule 5 Participants as noted in section 8.3.1 and discussed further in section 3.4.

- have capabilities and control system sufficient to ensure the plant's operation does not cause, exacerbate or contribute to instability, in accordance with any detailed requirements that AEMO may set out in the PSSG.

The draft rule would limit the application of the new access standard to large IBLs (30 MW and above) that AEMO or the NSP considers could contribute to instability. There would be additional materiality thresholds for the application of the MAS, and the PMU requirements in both the AAS and MAS. This approach, would appropriately target those loads that could have a material adverse impact on power system stability and security, avoiding unnecessary costs for smaller loads (and non-IBL).

The draft rule would allow flexibility in applying and meeting the instability monitoring access standard

The new access standard would enable flexible approaches to managing instability by incorporating AEMO and NSP discretion, using the existing negotiation framework, and focussing on high-level requirements which AEMO may expand on in the PSSG. Further, the draft rule would not prescribe automatic disconnection in response to instability or detection of an IBL's own contribution to any instability. This flexibility (along with the materiality thresholds) would support the efficient implementation of the draft rule by avoiding unnecessary costs, especially for smaller and lower-impact connections. It would also give connection applicants an opportunity to innovate and evolve their approach to complying with the new access standard.

See section 5.1 for more information.

8.3.3 The draft rule would clarify the disturbance ride-through requirements for generators

The draft rule for clarifying and restricting the scope of credible contingency events would improve regulatory certainty and transparency

The draft rule would clearly define the set of credible contingency events captured by the access standards for disturbance ride-through of Schedule 5.2 plant. Both the minimum and automatic access standards would include credible contingency events used by the NSP in its network planning, while the automatic access standard would also include non-credible contingency events that AEMO is likely to reclassify as credible.

Clarifying the scope of credible contingency events for the automatic and minimum access standards in this way would provide a more predictable and consistent foundation for access standard negotiations. This would reduce interpretive ambiguity, support a more efficient and timely connections process, lower regulatory risk for connection applicants, and promote investment confidence.

Separating the automatic and minimum access standards would provide greater flexibility and preserve the integrity of the access standards negotiation framework. This would reduce unreasonable costs and barriers to connection for applicants that may be unable to meet the automatic access standard.

The draft rule would also require NSPs, in consultation with AEMO, to publish a dynamic, non-exhaustive, and non-binding list of events likely to be reclassified. This list would provide guidance for consistent and predictable connection negotiations, but would not be prescriptive, so AEMO and NSPs could continue to use engineering judgement as required.

The Commission considers that the draft rule strikes an appropriate balance between clarity and flexibility. It would enhance transparency and predictability in the connection process, while continuing to support system security in a changing power system.

See section 4.2 for more information.

Clarifying that the response to disturbances following contingency events is an AEMO advisory matter would improve consistency and certainty

The draft rule would clarify that clause S5.2.5.5A (the access standard for the responses of Schedule 5.2 plant to disturbances following contingency events) is an AEMO advisory matter. The Commission considers that deeming S5.2.5.5A to be an AEMO advisory matter is consistent with the intent of the clause and that it remains appropriate for AEMO to be consulted on the disturbance response of Schedule 5.2 plant. Making this clarification would improve regulatory consistency and certainty for connection applicants, NSPs and AEMO.

See section 4.2.3 for more information.

8.3.4 The draft rule would support power system security through clearer technical definitions of protection requirements

New definitions for protection systems would support power system security by clarifying the existing requirements while maintaining flexibility

The draft rule would support system security by introducing new definitions for ‘primary protection system’ and ‘back-up protection system’. These definitions would clarify the existing protection requirements, and we consider those existing requirements remain appropriate for supporting system security.

The draft rule would introduce a smaller, simplified set of definitions compared to the rule change request. We consider this approach would better contribute to the NEO, compared to the existing rules or the rule change request. Clear definitions would better support system security and an efficient connections process. At the same time, the draft rule would maintain flexibility and minimise complexity by avoiding overly detailed, prescriptive definitions.

See section 5.2 for more information.

We considered other changes to protection requirements but found they would not promote the NEO

The Commission has decided not to progress the *Conditions for generator protection systems* rule change request because the proposed changes would not contribute to the NEO. In our view, the existing arrangements are fit for purpose because they support system security while allowing flexibility, which enables NSPs to set proportionate, appropriate protection requirements for each new connection. We consider that the proposed changes would not promote the NEO because:

- the proposed change to the AAS for generator protection systems would reduce flexibility and potentially increase costs, with little or no benefits for system security
- the existing negotiation framework allows AEMO and NSPs to impose performance requirements as needed for system security, up to the level of the AAS.

See section 5.3 for more information.

8.3.5 The draft rule would support efficient system strength outcomes by making requirements fit-for-purpose for IBLs and HVDC links

The Commission considers that the draft rule to improve the system strength access standards for large IBLs and HVDC links would promote the NEO for the reasons set out below.

The draft rule would improve the application of short circuit ratio requirements for IBLs

Limiting short circuit ratio requirements to large IBL would support system security at a more efficient cost

The draft rule would limit the application of the short circuit ratio access standard in clause S5.3.11 to large IBLs (30 MW and above), rather than all IBLs regardless of size. This would better target those loads most likely to have a material adverse impact on system strength and power system security.

By aligning compliance obligations with the scale of system risk, the draft rule would reduce unnecessary costs for smaller loads, avoid over-specification of plant capability in stronger parts of the network, and promote efficient investment. At the same time, it would maintain appropriate safeguards for system security by retaining the short circuit ratio requirement for large IBLs.

Increased flexibility would accommodate a range of technologies and local system needs

The draft rule would provide flexibility for AEMO and the relevant NSP to agree to a higher short circuit ratio minimum access standard, having regard to expected three-phase fault levels at the connection point. This flexibility would enable this access standard to reflect local system strength conditions and the technical characteristics of different load technologies. It would reduce unnecessary compliance burdens in strong network areas, lower barriers to efficient connection, and support timely investment.

See section 6.1 for more information.

The draft rule would promote the efficient provision of system strength for HVDC links

The draft rule would enable HVDC link operators to procure system strength services from third parties to meet the SCR requirement under clause S5.3a.7, aligning their treatment with that of generators and IRPs. This would promote more efficient, coordinated and network-level solutions for system strength, avoiding duplication of assets and reducing connection costs and timeframes. System strength is a key factor to be considered in the secure operation of the power system.

By aligning the application of system strength requirements across Schedules 5.2 and 5.3a, the draft rule would also improve regulatory consistency and transparency. Greater clarity would reduce uncertainty for proponents and NSPs, facilitating efficient connection decisions and investment planning.

See section 6.2 for more information.

8.3.6 The draft rule would promote system security and regulatory clarity through targeted improvements to the NER

The draft rule would support system security and flexibility by allowing UFLS through fast ramp down

The draft rule would promote system security by improving the efficiency and precision of demand-side frequency response. By encouraging technically capable loads to provide fast, proportional reductions in consumption rather than binary disconnection, the draft rule would facilitate a more proportionate response to underfrequency events. This could support secure power system operation by reducing the risk of frequency overshoot and limiting secondary impacts on voltage and system stability. It would also minimise unnecessary load shedding and reduce unnecessary disruption to end-use consumers and industrial processes, as well as the costs associated with that disruption. This means that system security needs could be met in a more efficient way.

The draft rule also provides flexibility to recognise the differing technical capabilities of modern loads, including IBLs. Rather than prescribing a single mode of compliance (block disconnection), the framework allows participants to utilise the most efficient and appropriate method considering the characteristics of their plant and the needs of the power system. The draft rule would incentivise load shedding by fast ramp down, but would not mandate it, in order maintain flexibility for plant that is only capable of block disconnection.

Finally, the draft rule would support transparency and operational certainty by requiring the quantity and rate of fast reduction capability to be recorded in the plant's performance standards.

See section 7.1 for more information.

The draft rule would promote system security by ensuring all Schedule 5 plant may be assessed or tested

By extending testing and assessment to all Schedule 5 plant, regardless of registration status, the Commission has acknowledged that any Schedule 5 plant may contravene the NER or performance agreement and have an adverse power system security impact. The draft rule would support appropriate and proportionate use of the right of testing because it applies to plant larger than 30 MW where there are reasonable grounds to believe it is non-compliant, and requires the requesting party to cover costs unless a non-compliance is found. This would support the safe, secure and reliable operation of the power system by addressing the possible system security impact of all Schedule 5 plant in an efficient manner. It would also support the effective implementation of the other parts of the draft rule (and existing access standards) by promoting compliance of plant with its performance standards.

See section 7.2 for more information.

The draft rule promotes transparency and appropriate system security outcomes by allowing AEMO to extend the timeframe for future access standards reviews

Allowing AEMO to extend the timeframe for publication of a final report by up to three months, where there are matters of material complexity or a material change in circumstances, would promote the NEO by reducing the risk of incomplete analysis or conclusions based on outdated assumptions. This flexibility would enable more comprehensive modelling, validation and risk assessment, supporting technically sound outcomes that would enhance the safety, security and reliability of the grid under the NEO.

Importantly, the extension power is constrained by procedural safeguards. AEMO must publish a notice of extension at least one month before the expiry of the original 12-month period, clearly identifying the matters of complexity or material change and outlining how it intends to address them, including through stakeholder engagement. This requirement promotes the NEO by ensuring transparency, accountability and regulatory certainty, which are critical to maintaining investor confidence and facilitating efficient operational and investment decisions.

See section 7.3 for more information.

A International disturbance ride-through standards for large loads

In response to system security concerns related to the influx of large loads (predominantly data centres), many international jurisdictions have either set or are proposing disturbance ride-through standards for large loads. Jurisdictions that have already set disturbance ride-through standards for large loads include:

- Energinet (Denmark)[404]
- RTE (Réseau de Transport d'Électricité, France)[405]

Jurisdictions that have proposed or are consulting on new standards include:

- AESO (Alberta Electric System Operator, Canada) - applying only to transmission-connected data centres[406]
- ERCOT (Texas, USA)[407]
- EirGrid (Ireland)[408]
- Fingrid (Finland)[409]

This appendix summarises the disturbance ride-through standards that have been set or are currently being proposed in these six jurisdictions.

404 Energinet, Technical Regulation 3.4.3 Requirements for Transmission-Connected Demand Facilities, Revision 1, September 2024.

405 RTE, Article 8.3.5 - Cahier des Charges des capacités constructives d'une Installation de consommation, version 1.0, February 2024.

406 AESO, AESO Connection Requirements for Transmission-Connected Data Centres, Draft for Stakeholder Review, August 2025.

407 ERCOT, Nodal Operating Guide Revision Request - Large Electronic Load Ride-Through Requirements, November 2025.

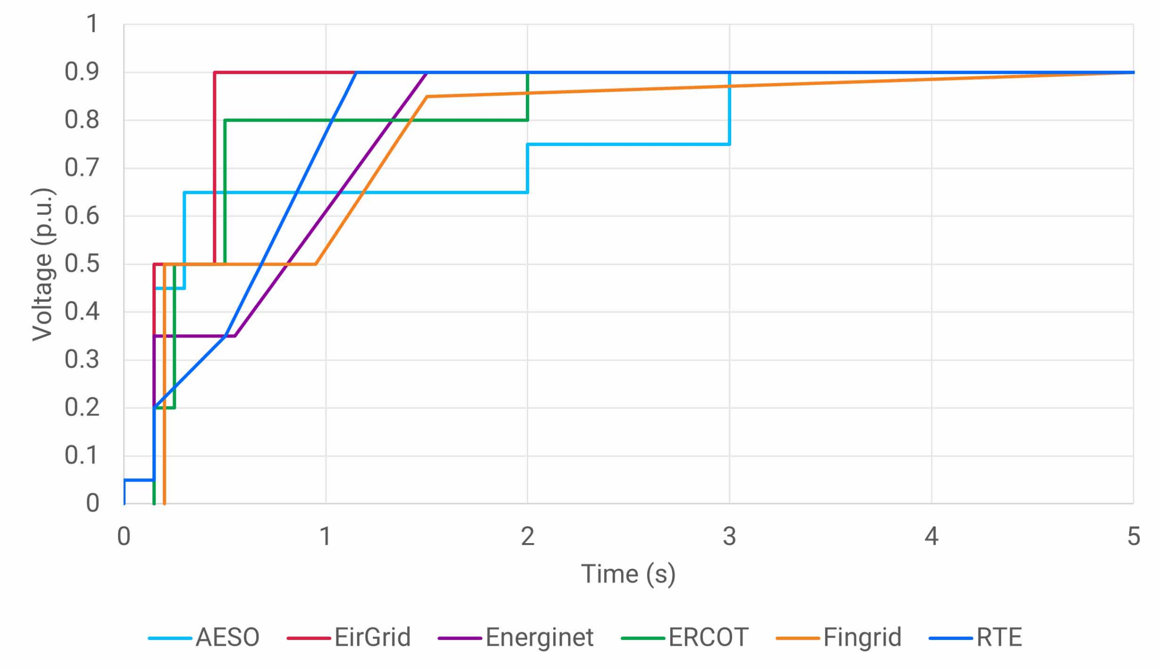
408 EirGrid, Grid Code Modification Proposal Form - MPID 345 Fault Ride Through, RoCoF and Post Fault Active Power Recovery for Demand Facilities, November 2025.

409 Fingrid, Draft for comments: KJV2026 Grid code specification for demand connections, June 2025.

A.1 Low voltage ride-through (LVRT)

All six of the jurisdictions considered in this appendix have instituted or are considering low voltage ride-through standards for large loads. A comparison of the LVRT standards in each jurisdiction is shown in Figure A.1.

Figure A.1: Low voltage ride-through standards in international jurisdictions



Source: AESO, AESO Connection Requirements for Transmission-Connected Data Centres, Draft for Stakeholder Review, August 2025, p 14.
EirGrid, Grid Code Modification Proposal Form - MPID 345 Fault Ride Through, RoCoF and Post Fault Active Power Recovery for Demand Facilities, November 2025, p 7.
Energinet, Technical Regulation 3.4.3 Requirements for Transmission-Connected Demand Facilities, Revision 1, September 2024, p 7.
ERCOT, Nodal Operating Guide Revision Request - Large Electronic Load Ride-Through Requirements, November 2025, p 5.
Fingrid, Draft for comments: KJV2026 Grid code specification for demand connections, June 2025, p 36.
RTE, Article 8.3.5 - Cahier des Charges des capacités constructives d'une Installation de consommation, version 1.0, February 2024, p 26.

For very deep disturbances (0 – 0.05 p.u. voltage), jurisdictions have largely settled on a ride-through requirement of 150 ms (with the exception of Fingrid, which requires a 200 ms ride-through). After the initial 150 ms, there is some divergence in the standards, with RTE and Energinet imposing more onerous ride-through requirements for deeper disturbances (<0.5 p.u.), while EirGrid and ERCOT have less demanding requirements.

All jurisdictions allow a temporary reduction in active power consumption during LVRT events, though the framing of this reduction varies across jurisdictions. For example, AESO require facilities to be in constant current control mode during LVRT events, while also prioritising reactive current over active current. Fingrid allows for active current limitations when voltage falls below 0.9 p.u. and current blocking when voltage falls below 0.5 p.u.. For other jurisdictions, such as EirGrid and Energinet, there is no explicit allowance for temporary reduction in active power, but it is implied through post fault active power recovery requirements.

A.2 Post-fault active power recovery

All six of the jurisdictions surveyed have requirements for post fault active power recovery, where large loads automatically return to near their pre-disturbance consumption after the voltage has recovered from the disturbance. The requirements are described in terms of the following parameters:

- **Voltage recovery level:** the conditions for the voltage at the point of connection to be considered to have recovered from the disturbance.
- **Active power recovery level:** the minimum proportion of pre-disturbance active power consumption that the load is required to be restored to post disturbance.
- **Active power recovery time:** the maximum amount of time for the load to recover to the required active power recovery level.

A comparison of the post fault active power recovery standards in each jurisdiction is shown in Table A.1.

Table A.1: Post-fault active power recovery requirements in international jurisdictions

Jurisdiction	Voltage recovery level	Active power recovery level	Active power recovery time
AESO	0.9 - 1.1 p.u.	May restore to 100%	Configurable between 1 s and 10 s (with 1 s as the default)
EirGrid	At least 0.9 p.u.	90%	Up to 0.5 s
Energinet	At least 0.9 p.u.	80%	Up to 5 s
		90%	Up to 20 s
		95%	Up to 30 s
ERCOT	At least 0.9 p.u.	90%	Up to 1 s
Fingrid	0.9 - 1.1 p.u.	90%	Up to 0.5 s (for data centres)
		70%	Up to 1 s (for facilities classed as 'Other Industry')
		90%	Up to 1 s (for all other facilities)
RTE	At least 0.9 p.u. for 300 ms	90%	Up to 1 s at a ramp rate of 0.5 Pmax / s

Source: AESO, AESO Connection Requirements for Transmission-Connected Data Centres, Draft for Stakeholder Review, August 2025, p 15.
EirGrid, Grid Code Modification Proposal Form - MPID 345 Fault Ride Through, RoCoF and Post Fault Active Power Recovery for Demand Facilities, November 2025, p 5.
Energinet, Technical Regulation 3.4.3 Requirements for Transmission-Connected Demand Facilities, Revision 1, September 2024, pp 7-8.
ERCOT, Nodal Operating Guide Revision Request - Large Electronic Load Ride-Through Requirements, November 2025, p 5.
Fingrid, Draft for comments: KJV2026 Grid code specification for demand connections, June 2025, pp 38-40.
RTE, Article 8.3.5 - Cahier des Charges des capacités constructives d'une Installation de consommation, version 1.0, February 2024, p 26.

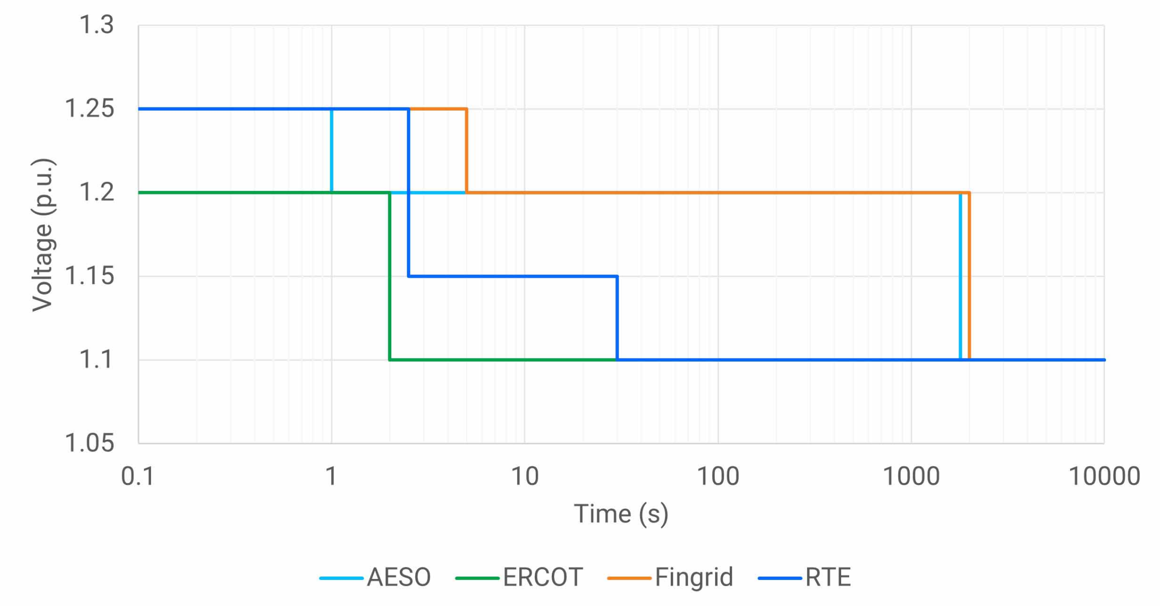
In addition, several jurisdictions have explicit requirements for multiple low voltage ride-through. For example, AESO proposes that data centres must ride through multiple voltage deviations at the point of connection, "which may occur in the transmission system due to various reasons, including trip and auto reclose events on a single transmission line and multiple faults on transmission lines during severe storms".[410] Fingrid proposed to require that facilities to ride through ten 100-millisecond bolted faults over a period of 90 seconds.[411]

410 AESO, AESO Connection Requirements for Transmission-Connected Data Centres, Draft for Stakeholder Review, August 2025, p 14.

A.3 High voltage ride-through (HVRT)

Four of the six jurisdictions surveyed have explicit high voltage ride-through standards for large loads (AESO, EirGrid, Fingrid and RTE). A comparison of the HVRT standards in each jurisdiction is shown in Figure A.2.

Figure A.2: High-voltage ride-through requirements in international jurisdictions



Source: AESO, AESO Connection Requirements for Transmission-Connected Data Centres, Draft for Stakeholder Review, August 2025, p 15.
ERCOT, Nodal Operating Guide Revision Request - Large Electronic Load Ride-Through Requirements, November 2025, p 5.
Fingrid, Draft for comments: KJV2026 Grid code specification for demand connections, June 2025, p 35.
RTE, Article 8.3.5 - Cahier des Charges des capacités constructives d'une Installation de consommation, version 1.0, February 2024, pp 23-24.

411 Fingrid, Draft for comments: KJV2026 Grid code specification for demand connections, June 2025, p 37.

A.4 Frequency ride-through

Five of the six jurisdictions surveyed have explicit frequency and RoCoF ride-through standards for large loads (AESO, Eirgrid, Fingrid and RTE). A comparison of the frequency and RoCoF ride-through standards in each jurisdiction are shown in Table A.2.

Table A.2: Frequency and RoCoF ride-through standards in international jurisdictions

Frequency (Hz)	AESO (see note)	EirGrid	ERCOT (see note)	Fingrid	RTE
Up to 52	N/A	60 minutes	N/A	N/A	N/A
Up to 51.5	299 seconds	90 minutes	299 seconds	30 minutes	30 minutes
49 - 51	Continuous				
Down to 47.5	299 seconds	90 minutes	299 seconds	30 minutes	30 minutes
Down to 47	N/A	20 seconds	N/A	N/A	N/A
RoCoF	5 Hz/s over a 500-ms rolling window	1 Hz/s over a 500-ms rolling window	N/A	2 Hz/s	2 Hz/s over a 500-ms rolling window

Source: AESO, AESO Connection Requirements for Transmission-Connected Data Centres, Draft for Stakeholder Review, August 2025, pp 16-17.
EirGrid, Grid Code Modification Proposal Form - MPID 345 Fault Ride Through, RoCoF and Post Fault Active Power Recovery for Demand Facilities, November 2025, p 6.
ERCOT, Nodal Operating Guide Revision Request - Large Electronic Load Ride-Through Requirements, November 2025, p 3.
Fingrid, Draft for comments: KJV2026 Grid code specification for demand connections, June 2025, p 32.
RTE, Article 8.3.5 - Cahier des Charges des capacités constructives d'une Installation de consommation, version 1.0, February 2024, p 8.
Note: Note that AESO and ERCOT are 60 Hz systems and the requirements in this table are converted to 50 Hz to facilitate a comparison.

A.5 Other ride-through standards

There are a number of other ride-through standards that are being considered by other jurisdictions, including:

- **Phase jump ride-through:** requirements for large loads to ride through voltage angle phase jumps of ≤25° (AESO), ≤20° (Energinet) and ≤30° (Fingrid).[412]
- **Volts per Hz ride-through:** AESO requires that facilities ride through disturbances with a Volts per Hz (V/Hz) ratio of 1.1 p.u. for 45 seconds and 1.18 p.u. for 2 seconds.[413]
- **Transient overvoltage ride-through:** AESO requires that facilities ride through transient overvoltages of up to 1.8 p.u. (measured as instantaneous phase-to-phase or phase-to-earth voltage).[414]
- **Sub-synchronous oscillation rejection:** Fingrid requires that facilities do not amplify (negative damping) power system oscillations in the 0.2 – 45 Hz range.[415]

412 AESO, AESO Connection Requirements for Transmission-Connected Data Centres, Draft for Stakeholder Review, August 2025, p 17. Energinet, Technical Regulation 3.4.3 Requirements for Transmission-Connected Demand Facilities, Revision 1, September 2024, p 6. Fingrid, Draft for comments: KJV2026 Grid code specification for demand connections, June 2025, p 33.

413 AESO, AESO Connection Requirements for Transmission-Connected Data Centres, Draft for Stakeholder Review, August 2025, p 17.

414 Ibid., p 15.

415 Fingrid, Draft for comments: KJV2026 Grid code specification for demand connections, June 2025, p 34.

B There are several work programs that are interrelated with this rule change

The Commission notes that several work programs are underway that are relevant to this rule change, led by AEMO and the Energy and Climate Change Ministerial Council (ECMC), described below. These will be monitored by the Commission to ensure any overlaps or interdependencies are appropriately managed.

B.1 AEMO's work programs

The connections reform initiative (CRI) was established by AEMO and the Clean Energy Council (CEC) to address concerns with delays and increasing complexity in connections to the NEM.[416] While the CRI is predominantly focused on Schedule 5.2 plant, such as generating systems, the following work streams may be expanded to consider Schedule 5.3 load connections:

- **Early Assessment Framework (EAF) Guideline –** this is an optional service which, enables non-project specific pre-assessment and certification of OEM models. It aims to improve model robustness and reduce duplication of assessment across connection projects. The draft guideline was recently published on AEMO's website and is available at AEMO | Early Assessment Framework. The framework is already being trialled with a number of OEMs.
- **Pre-application support services guideline –** this guideline introduces an optional phase between connection enquiry and connection application which enables early collaboration between proponents, AEMO and NSP, identification and resolution of issues and enhances investment certainty. The guideline was recently published on AEMO's website and is available at AEMO | Pre-application.
- **Commissioning guideline** -– This resource provides clear direction for proponents commissioning generating systems, integrated resource systems, or synchronous condensers into the National Electricity Market (NEM). Note it considers hybrid systems and a principles-based approach, which can be applied to large loads, but specific guidance for loads has not yet been developed.
- **Automatic Access Standards –** Development of guidance to support consistent interpretation and application of the requirement for a negotiated access standard to be 'as close as practicable to the Automatic Access Standard'. It is expected that this will be published by June 2026.

Other relevant work being progressed by AEMO includes:

- **Large Inverter Based Load interim guidance –** following the publication of this draft determination, AEMO intends to publish guidance to NSPs / developers / OEMs on assessment of large IBLs, including performance expectation and modelling requirements. It is intended that initial guidance will be pragmatic and support a consistent assessment approach across NSPs. This guidance does not intend to presuppose the outcome of this rule change process. Rather, it is intended to support industry while the Commission's rule change process is underway.
- **SSIAG update –** AEMO is progressing a number of updates to the SSIAG, including updates to reflect the treatment of IBL pending the outcome of this rule change process. The consultation paper is currently planned for publication in June 2026.

416 For more information, see AEMO's website.

- **General Power System Risk Review (GPSRR) Approach Consultation –** AEMO has commenced the 2026 GPSRR and has selected four priority risks for assessment. One of these is the increase in large load connections, which may change how the power system is operated. PSCAD studies on load cycling are underway and will feed into the Draft Report, scheduled for publication in mid-May 2026.
- **Guide to Registration Exemptions and Production Unit Classifications (REPUC) –** this review aims to improve efficiencies in exemption policies and processes, primarily considering notifiable exemptions and exemption thresholds. It will cover the exemption of back-up generation for data centre facilities. It will undergo a rules consultation process, with a consultation paper targeted for publication in June 2026.

B.2 ECMC work programs

In March 2025, the ECMC tasked DCCEEW to lead a sub-working group, in consultation with the market bodies and jurisdictions, to investigate the implications for Australia's energy system presented by the projected growth in data centres being established in Australia.

The working group is investigating options to minimise system impacts, maximise potential system/market benefits and whether existing regulatory frameworks remain appropriate. A final report with key findings was considered by the ECMC on 16 December 2025.[417] The ECMC made the following recommendations to be progressed by relevant officials ahead of the next ECMC meeting:

- review cost recovery arrangements to ensure data centres cover network upgrade and connection costs
- explore options to ensure new load growth is efficiently integrated into the grid, including developing a framework to facilitate demand flexibility and ensuring new firmed generation enters the market as data centre energy demand increases
- advance reforms for grid connections
- improve AEMO's visibility of data centre energy use.

The Commission is working closely with the working group to progress these recommendations.

Ministers also welcomed the Australian Government's plan to develop national principles for data centre development aligned with national interests, including energy usage, and committed to work with industry to encourage adoption of the principles once finalised.[418]

417 DCCEEW, Energy and Climate Change Ministerial Council meetings and communiques, 16 December 2025 Communique.

418 For more information about the data centre principles, see the Department of Industry, Science and Resources' website.

C Rule making process

A standard rule change request includes the following stages:

- a proponent submits a rule change request
- the Commission initiates the rule change process by publishing a consultation paper and seeking stakeholder feedback
- stakeholders lodge submissions on the consultation paper and engage through other channels to make their views known to the AEMC project team. In this instance we formed a TWG which met 3 times between the consultation paper and draft determination and was invaluable in helping us form our draft decision
- the Commission publishes a draft determination and draft rule (if made)
- stakeholders lodge submissions on the draft determination and engage through other channels to make their views known to the AEMC project team
- the Commission publishes a final determination and final rule (if made).

You can find more information on the rule change process on our website.[419]

C.1 The process to date

On 8 May 2025, the Commission published a notice advising of the initiation of the rule making process and consultation in respect of three rule change requests, and the consolidation of those rule change request:[420] The rule change requests are:

- *Improving the NEM access standards - Package 2*, submitted by AEMO
- *Conditions for generator protection systems*, submitted by Rod Hughes Consulting
- *Definitions of protection system requirements*, submitted by Rod Hughes Consulting.

A consultation paper identifying specific issues for consultation on the consolidated rule request was also published. Submissions closed on 19 June 2025. The Commission received 29 submissions as part of the first round of consultation. The Commission considered all issues raised by stakeholders in submissions. Issues raised in submissions are discussed and responded to throughout this draft rule determination.

We extended the time for making the draft determination from August 2025 to 12 March 2026 because the consolidated rule request raised issues of sufficient complexity and difficulty. After receiving submissions on this draft determination, we will consider the best approach to finalise this consolidated rule request in a timely manner. Given the complexity of the issues we are considering, the date for the final determination may need to be extended.

C.2 AEMO proposed amendments to the NER to support the projected increase of large loads

AEMO's Package 2 rule change request proposed several amendments to the technical requirements for connecting to the NEM, especially in schedule 5.3, which contains the access standards for load connections.

419 See our website for more information on the rule change process: https://www.aemc.gov.au/our-work/changing-energy-rules.

420 This notice was published under sections 93 and 95 of the NEL.

C.2.1 The proposal addressed the potential system security impacts of large loads, as well as other minor issues with Chapter 5 of the NER

AEMO's Package 2 rule change request is one of two requests it submitted in April 2024 after completing its first review of the technical requirements for connecting to the NEM (Access Standards Review), which it must complete every five years. The focus of the Package 2 rule change request is the projected increase of large loads connecting to the power system and their potential to adversely impact power system security. AEMO noted that large loads, including new hydrogen electrolysers, smelters, and data centres to support artificial intelligence (AI) technologies, have the potential to scale up to several hundred megawatts (MW) within the next few years. The proponent was particularly concerned with how large loads would behave during a power system disturbance or instability and how this would impact power system security, supply to consumers, and the costs of managing power system security risks.

The rule change request also included other proposals for changes to Chapter 5, in relation to system strength requirements for HVDC links, disturbance ride-through requirements for generators and integrated resource systems, testing and commissioning for schedule 5.2, 5.3 and 5.3a plant, and an extension of time for AEMO to complete future access standards reviews. These proposals arose from AEMO's broader access standards review, but had not been sufficiently consulted on to be included in the fast-tracked Package 1 rule change process.

C.2.2 AEMO proposed improvements to the NEM access standards in areas including system strength, disturbance ride-through, and stability

In the Package 2 rule change request, AEMO proposed a number of changes to address the impacts that large loads may have on system security. AEMO proposed to:

- **Improve the ride-through capability of large loads to promote system security,** by:
  - Requiring schedule 5.3 participants to cooperate with NSPs in the design of protection systems and settings to maximise ride-through capability where possible. See section 4.1.
  - Increasing the visibility of loads' ride-through capability for NSPs and AEMO. See section 4.1.5.
- **Address the potential system stability impacts of large IBL** by creating a new access standard for detection and response to instability for large IBL. See section 5.1.
- **Limit the application of short circuit ratio requirements** for customer loads to large IBLs, and allow flexibility to agree to larger short circuit ratio thresholds for those loads. See section 6.1.
- **Allow for the fast ramp-down of loads** to facilitate under-frequency load shedding. See section 7.1.

In addition, AEMO proposed to:

- **Clarify the disturbance ride-through access standards for generators and integrated resource systems** by defining and restricting the scope of credible contingency events in relation to the automatic and minimum access standards for schedule 5.2 plant. See section 4.2.
- **Support efficient investment in and operation of HVDC links** by allowing schedule 5.3a participants to procure system strength services from a third party to meet short circuit ratio requirements. See section 6.2.
- **Support compliance with the schedule 5.2, 5.3 and 5.3a access standards** by expanding testing and commissioning arrangements to all schedule 5 participants, including those that are not Registered Participants. See section 7.2.

- **Enable deeper analysis and consultation in future reviews of the NEM access standards** by extending the time for AEMO to complete these reviews if there are complex issues or a material change in circumstances. See section 7.3.

C.3 Rod Hughes Consulting proposed a rule to clarify NER definitions relating to protection systems

Rod Hughes Consulting submitted the *Definitions of protection system requirements* rule change (ERC0361) in March 2023.[421] This rule change request seeks to update some NER definitions and add new definitions to improve clarity in the access standards for generator protection systems.

C.3.1 The proposal addressed the potential confusion or inconsistency that may result from protection terms not being formally defined

Rod Hughes Consulting considers that:

- the distinction between primary, back-up, and breaker fail protection systems is unclear because some of these terms are not explicitly defined in the NER,
- provisions requiring redundancy in primary protection systems, such as clause S5.1.9(d) and clause S5.2.5.9(a)(2), lack clarity on the level of redundancy required
- as a result of these and other issues, it may be unclear to participants how much duplication of protection equipment is required across primary, back-up and/or breaker fail protection systems.

The proponent considers that this lack of clarity could result in differing interpretations or confusion amongst industry participants, and inconsistent application of the rules.

C.3.2 It proposed to do so by adding and updating several NER definitions relating to protection systems

Rod Hughes Consulting proposed amendments to the NER that would:

- add or update several definitions for types of protection systems and related terms
- use the term ‘main protection system’ instead of ‘primary protection system’
- clarify the requirements for redundancy in protection systems by introducing the concept of an ‘independent alternative main protection system’, which would also be explicitly defined.

It considers that this rule change would support power system security by clarifying the protection systems requirements and ensuring that new connections meet those requirements, without building in more redundancy than necessary. This would also help to reduce the cost of new connections, and the time and cost of negotiating performance standards.

See section 5.2 for more information.

C.4 Rod Hughes Consulting also proposed a rule to clarify the access standards for generator protection systems

Rod Hughes Consulting submitted the *Conditions for generator protection systems* rule change request (ERC0355) in January 2023.[422]

421 Rod Hughes Consulting rule change request, 23 March 2023.

422 Rod Hughes Consulting rule change request, 10 January 2023.

C.4.1 The proposal addressed an apparent drafting inconsistency in the schedule 5.2 access standards

Rod Hughes Consulting considers there is a drafting inconsistency in clause S5.2.5.9, which sets out the requirements that apply to generators for protection systems that impact on power system security. Specifically, clause S5.2.5.9(b) contains a provision for AEMO or the NSP to require certain additional redundancy in a generator's protection systems as part of the automatic access standard, if necessary to maintain power system security. However, the proponent considers this is inconsistent with the automatic access standard because the automatic access standard includes that additional redundancy by default.[423]

In addition, Rod Hughes Consulting considers that the minimum access standard in clause S5.2.5.9 did not provide enough discretion for AEMO or the NSP to require additional redundancy if necessary for system security.

C.4.2 It proposed to do so by updating the automatic access standard and minimum access standard to improve clarity and better support system security

Rod Hughes Consulting proposed to delete clause S5.2.5.9(b) to remove the inconsistency it had identified. It considers this would clarify that the additional redundancy referred to in S5.2.5.9(b) is always part of the automatic access standard. Streamlining the automatic access standard in this way would support an efficient connections process and would not adversely impact power system security. Connection applicants would still be able to negotiate an access standard without the additional redundancy, subject to approval by the NSP and AEMO, since the additional redundancy is not required in the minimum access standard.

The rule change request also proposed adding a new provision to the minimum access standard, similar to the existing clause S5.2.5.9(b). The new provision would allow AEMO or the NSP to require the same additional redundancy currently referred to in S5.2.5.9(b) as part of the minimum access standard, if necessary to prevent certain adverse power system security impacts. Rod Hughes Consulting considers that this change would give AEMO and the NSP greater ability to assess the impacts of proposed non-redundant protection system design. This would, in the proponent's view, allow AEMO and the NSP to enforce the need for redundant protection systems where necessary to mitigate risks to power system security.

See section 5.3 for more information.

423 NER clause S5.2.5.9(b).

D Legal requirements to make a rule

This appendix sets out the relevant legal requirements under the NEL for the Commission to make a draft rule determination.

D.1 Draft rule determination and draft rule

In accordance with section 99 of the NEL, the Commission has made this draft rule determination for a more preferable draft rule in relation to the rule proposed by AEMO and Rod Hughes Consulting.

The Commission's reasons for making this draft rule determination are set out in Chapter 8.

A copy of the more preferable draft rule is attached to and published with this draft determination. Its key features are described in Chapters 3-7.

D.2 Power to make the rule

The Commission is satisfied that the more preferable draft rule falls within the subject matter about which the Commission may make rules.

The more preferable draft rule falls within section 34 of the NEL as it relates to the activities of persons (including Registered Participants) participating in the national electricity market or involved in the operation of the national electricity system.[424] Additionally, the more preferable draft rule falls within the matters set out in schedule 1 to the NEL as it relates to item 11, being the operation of generating systems, transmission systems, distribution systems or other facilities.

D.3 Commission's considerations

In assessing the rule change request the Commission considered:

- its powers under the NEL to make the draft rule
- the rule change request
- submissions received during first round consultation
- stakeholder input received at the TWG meetings held between October and December 2025 as well as through bilateral meetings
- the Commission's analysis as to the ways in which the draft rule will or is likely to contribute to the achievement of the NEO
- the application of the draft rule to the Northern Territory.

There is no relevant Ministerial Council on Energy (MCE) statement of policy principles for this rule change request.[425]

The Commission may only make a rule that has effect with respect to an adoptive jurisdiction if satisfied that the proposed rule is compatible with the proper performance of AEMO's declared network functions.[426] The more preferable draft electricity rule is compatible with AEMO's declared network functions because they would not affect those functions.

424 Section 34(1)(a)(iii) of the NEL.

425 Under s. 33 of the NEL and s. 73 of the NGL the AEMC must have regard to any relevant MCE statement of policy principles in making a rule. The MCE is referenced in the AEMC's governing legislation and is a legally enduring body comprising the Federal, State and Territory Ministers responsible for energy. On 1 July 2011, the MCE was amalgamated with the Ministerial Council on Mineral and Petroleum Resources. In December 2013, it became known as the Council of Australian Government (COAG) Energy Council. In May 2020, the Energy National Cabinet Reform Committee and the Energy Ministers' Meeting were established to replace the former COAG Energy Council.

426 Section 91(8) of the NEL.

D.4 Making electricity rules in the Northern Territory

The NER, as amended from time to time, apply in the Northern Territory, subject to modifications set out in regulations made under the Northern Territory legislation adopting the NEL.[427] Under those regulations, only certain parts of the NER have been adopted in the Northern Territory.

As the more preferable draft rule relates to parts of the NER that apply in the Northern Territory, the Commission is required to assess Northern Territory application issues, described below.

Test for scope of "national electricity system" in the NEO

Under the National Electricity (Northern Territory) (National Uniform Legislation) Act 2015 (NT Act), the Commission must regard the reference in the NEO to the "national electricity system" as a reference to whichever of the following the Commission considers appropriate in the circumstances having regard to the nature, scope or operation of the proposed rule:[428]

1. the national electricity system
2. one or more, or all, of the local electricity systems[429]
3. all of the electricity systems referred to above.

Test for differential rule

Under the NT Act, the Commission may make a differential rule if it is satisfied that, having regard to any relevant MCE statement of policy principles, a differential rule will, or is likely to, better contribute to the achievement of the NEO than a uniform rule.[430] A differential rule is a rule that:

- varies in its term as between:
  - the national electricity systems, and
  - one or more, or all, of the local electricity systems, or
- does not have effect with respect to one or more of those systems

but is not a jurisdictional derogation, participant derogation or rule that has effect with respect to an adoptive jurisdiction for the purpose of s. 91(8) of the NEL.

A uniform rule is a rule that does not vary in its terms between the national electricity system and one or more, or all, of the local electricity systems, and has effect with respect to all of those systems.[431]

The Commission has decided to make a differential rule so that the draft rule does not have effect in the Northern Territory and no amendments to the NER as applied in the Northern Territory (NT NER) will need to be made as a result of the draft rule.

Most of the amendments in the draft rule relate to rules in the NER that do not currently apply to the Northern Territory, relevantly Chapter 4 and Schedules 5.2, 5.3, 5.3a and 5.5. However, some of the amendments in the draft rule relate to rules currently in effect in the Northern Territory, including certain amendments in Chapter 5 and 10.

Given the potential consequences of adopting the draft rule (in whole or parts) in the NT NER and the complexities of implementation, the Commission has determined to make a differential rule that disapplies the entirety of the final rule from adoption into the NT NER.

427 These regulations under the NT Act are the National Electricity (Northern Territory) (National Uniform Legislation) (Modifications) Regulations 2016.

428 Clause 14A of Schedule 1 to the NT Act, inserting section 88(2a) into the NEL as it applies in the Northern Territory.

429 These are specified Northern Territory systems, listed in schedule 2 of the NT Act.

430 Clause 14B of Schedule 1 to the NT Act, inserting section 88AA into the NEL as it applies in the Northern Territory.

431 Clause 14 of Schedule 1 to the NT Act, inserting the definitions of 'differential Rule' and 'uniform Rule' into section 87 of the NEL as it applies in the Northern Territory.

Such a differential rule will, or is likely to, better contribute to the achievement of the NEO than a uniform or differential rule that applies parts of the rule.

D.5 Civil penalty provisions and conduct provisions

The Commission cannot create new civil penalty provisions or conduct provisions. However, it may recommend to the Energy Ministers' Meeting that new or existing provisions of the NER be classified as civil penalty provisions or conduct provisions.

The NEL sets out a three-tier penalty structure for civil penalty provisions in the NEL and the NER.[432] A Decision Matrix and Concepts Table,[433] approved by Energy Ministers, provides a decision-making framework that the Commission applies, in consultation with the AER, when assessing whether to recommend that provisions of the NER should be classified as civil penalty provisions, and if so, under which tier.

The draft rule amends provisions that are currently classified as civil penalty provisions, listed in Table D.1. The Commission does not propose to recommend to the Energy Ministers' Meeting any changes to the classification of those provisions, for the reasons noted in Table D.1.

The Commission will continue to consult on these recommendations with stakeholders, including the AER.

432 Further information is available at https://www.aemc.gov.au/regulation/energy-rules/civil-penalty-tools

433 The Decision Matrix and Concepts Table is available at: https://web.archive.org.au/awa/20210603104757mp_/https://energyministers.gov.au/sites/prod.energycouncil/files/publications/documents/Final%20-%20Civil%20Penalties%20Decision%20Matrix%20and%20Concepts%20Table_Jan%202021.pdf

Table D.1: Amended civil penalty provision recommendations

Clause	Description of proposed amendment	Current classification	Reason to retain tier
4.3.5(a)	The draft rule amends this provision to provide for automatic interruptible load to be progressively automatically disconnected or reduced following the occurrence of a power system under-frequency condition.	Tier 1	The Commission proposes to recommend that this remain a Tier 1 civil penalty provision. Compliance with this provision is necessary to ensure appropriate supply security and reliability, and failure to comply with this provision could result in consumer harm.
5.7.2(h) and (i)	The proposed amendment enables the testing of non-registered schedule 5 plant to be requested in a similar manner to the approach for the right of testing of registered schedule 5 plant, including as part of commissioning.	Tier 3	The Commission proposes to recommend that this remain a Tier 3 civil penalty provision, noting that the nature of the obligations will not change, but those obligations would apply more broadly to Schedule 5 Participants as well as Registered Participants. These provisions relate to administrative requirements for the conduct of testing and the provision of test reports.
5.7.3(a)	The proposed amendment extends the obligation to provide evidence of compliance with applicable technical requirements and the relevant connection agreement (including the performance standards) to Registered Participants other than Generators.	Tier 3	The Commission is considering whether to recommend that this be reclassified as a Tier 2 civil penalty provision. This obligation relates to the provision of information to confirm that connection agreements (including applicable performance standards) are being adhered to. This is important for efficient market operation for the long-term interests of consumers, including ensuring that Network Service Providers are made aware of any potential issues relating to compliance with performance standards prior to a significant adverse system event. The Commission would welcome stakeholder views on this proposal.
5.7.3(c)	The proposed amendment extends the requirements where a test demonstrates non-compliance to Registered	Tier 1	The Commission proposes to recommend that this remain a Tier 1 civil penalty provision, noting that the substantive nature of the

Clause	Description of proposed amendment	Current classifica-tion	Reason to retain tier
	Participants other than Generators or Integrated Resource Providers.		obligations will not change, but those obligations would apply more broadly to all Registered Participants. Compliance with the provision is necessary to ensure appropriate supply security and reliability, and failure to comply with this provision could result in consumer harm. Where a test demonstrates that a relevant plant does not comply with the relevant connection agreement or one or more performance standards, it is vital that this be addressed. It is vital that parties comply with their performance standards and any associated terms and conditions of connection agreements to ensure that the security of the NEM is not compromised. In the worst circumstances, non-compliance with connection agreements can have severe adverse effects and significant costs on other network users and consumers.
5.7.3(d)	The proposed amendment extends that the ability of AEMO to request that Schedule 5 Participants conduct tests of relevant schedule 5 plant if AEMO reasonably believes that it does not meet one or more performance standards in respect of an AEMO advisory matter.	Tier 2	The Commission proposes to recommend that this remain a Tier 2 civil penalty provision, noting that it will apply more broadly to Schedule 5 participants. This obligation relates to efficient market operation for the long term interests of consumers, including to ensure that AEMO can request testing of plant to ensure compliance with relevant performance standards.
5.8.5(c)	The proposed amendment extends the obligation to submit commissioning test results demonstrating that a new or replacement item of equipment complies with the Rules or connection agreement or both. The proposed amendment extends the obligation to a Relevant Schedule 5 Participant.	Tier 1	The Commission proposes to recommend that this remain a Tier 1 civil penalty provision, noting that the nature of the obligation will not change, but the obligation would apply more broadly to Relevant Schedule 5 Participants as well as Registered Participants. Compliance with the provision is necessary to ensure appropriate supply security and reliability and failure to comply with this provision

Clause	Description of proposed amendment	Current classifica-tion	Reason to retain tier
			could result in consumer harm. It is vital that new or replacement equipment be properly tested and that the relevant Network Service Provider be provided with the commissioning test results demonstrating compliance. In the worst circumstances, non-compliance with connection agreements or the Rules can have severe adverse effects and significant costs on other network users and consumers.
S5.3.1(a1)	The proposed amendment inserts a new subparagraph (2A) which requires the Schedule 5.3 Participant to submit to AEMO and the relevant NSP, information about the capability of the equipment to remain connected to the power system and continue operating during and after one or more frequency or voltage disturbances.	Tier 2	The Commission proposes to recommend that this remain a Tier 2 civil penalty provision, noting that the nature of the provision will not change, but its scope will be expanded. This obligation relates to efficient market operation for the long-term interests of consumers, including ensuring that appropriate information is submitted to AEMO and the relevant Network Service Provider regarding the capability of new or additional equipment to be connected to a network.

Abbreviations and defined terms

AC	Alternating current
Access standards	Technical requirements for connection to the NEM contained in Chapter 5 of the NER
Access Standards Review	AEMO review of technical requirements for connection (NER clause 5.2.6A), April 2024
AWS	Amazon Web Services
AI	Artificial intelligence
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AESO	Alberta Electric System Operator
BESS	Battery energy storage systems
CEC	Clean Energy Council
Commission	See AEMC
CPU	CitiPower, Powercor and United Energy
CRI	Connections reform initiative
CUO	Continuous uninterrupted operation
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DC	Direct current
DNSP	Distribution network service provider
EAF	Early Assessment Framework
ECMC	Energy and Climate Change Ministerial Council
ERCOT	Electric Reliability Council of Texas
EMT	Electromagnetic transient
ENA	Energy Networks Australia
EUAA	Energy Users Association of Australia
EPEC	EPEC Group
FCAS	Frequency control ancillary services
FOS	Frequency Operating Standard
GPSRR	General Power System Risk Review
HVDC	High voltage direct current
IBL	Inverter based load
IBR	Inverter based resource
IEEE	Institute of Electrical and Electronics Engineers Inc.
IGBT	Insulated-gate bipolar transistor
IRP	Integrated Resource Provider
IT	Information technology
kV	Kilovolts
Large IBL	Large inverter based load (>30 MW)
LIBR	Large inverter based resource

LOR	Lack of Reserve
MSL	Minimum System Load
MVA	Megavolt-amperes
MW	Megawatts
NECA	National Electricity Code Administrator
NEL	National Electricity Law
NEO	National Electricity Objective
NER	National Electricity Rules
NERC	North American Electric Reliability Corporation
NSCAS	Network Support and Control Ancillary Services
NSP	Network Service Provider
NT Act	National Electricity (Northern Territory) (National Uniform Legislation) Act 2015
OEM	Original equipment manufacturer
PLL	Phase-locked loop
PMU	Phasor measurement unit
Proponent	The individual / organisation who submitted the rule change request to the Commission
PSCAD	Power Systems Computer Aided Design
PSMG	Power System Model Guidelines
PSSE	Power System Simulator for Engineering
PSSG	Power System Stability Guidelines
p.u.	Per unit
PV	Photovoltaic
REPUC	Guide to Registration Exemptions and Production Unit Classifications
RERT	Reliability and Emergency Reserve Trader
RMS	Root-mean-square
RoCoF	Rate of change of frequency
RTE	Réseau de Transport d'Électricité (the electricity transmission system operator for France)
SSIAG	System Strength Impact Assessment Guidelines
SSSP	System Strength Service Provider
TNSP	Transmission network service provider
TWG	Technical working group
TWh	Terawatt-hours
UFLS	Under frequency load shedding
UPS	Uninterruptible power supply
VPP	Virtual Power Plant