

27 June 2025

Ms Anna Collyer  
Chair  
Australian Energy Market Commission  
Level 15, 60 Castlereagh Street  
Sydney NSW 2000

Dear Ms Collyer,

**Submission to the AEMC on the Access Standards Package 2 Rule Change Request**

The Australian Energy Market Operator (AEMO) welcomes the opportunity to make this submission to Australian Energy Market Commission's (AEMC) consultation paper on its Access Standards Package 2 rule change request.

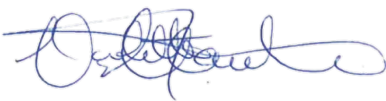
AEMO's rule change proposal followed its 2022-23 review of the National Electricity Market (NEM) access standards and aims to streamline the connection process, improve the resilience of the NEM, support efficient investment in and operation of the NEM and better accommodate new and evolving technologies.

A significant part of the package 2 proposal focuses on some initial improvements to the load access standards to provide for appropriate light-handed access standards in response to emerging risks associated with some large loads, while proposing to relax other load access standards (in particular relating to system strength). AEMO maintains support for its proposed rule changes, subject to detailed comments set out in the attached submission.

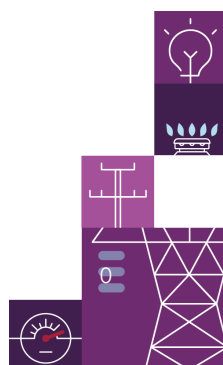
The AEMC's consultation paper poses broad questions regarding the connection of new large loads. These considerations are timely given the possible growth in new large loads like data centres. AEMO is keen to facilitate the efficient and secure connection of these large loads, which have the potential to deliver substantial economic benefits.

AEMO remains committed to working collaboratively with the AEMC and stakeholders to improve the NEM's access standards. We look forward to our further engagement on this rule change as it progresses.

Yours sincerely,



Violette Mouchaileh  
**Executive General Manager – Policy and Corporate Affairs**



**AEMO submission**

**AEMC access standards package 2 consultation  
paper**

**June 2025**

## Overview

AEMO appreciates the opportunity to make this submission on the AEMC's Improving the NEM access standards – Package 2 consultation paper (the consultation paper), which considers AEMO's April 2024 rule change request.<sup>1</sup>

The energy transition is well underway and represents the biggest transformation of the National Electricity Market (NEM) since it was formed. As well as the shift from coal to firming renewables and low emissions sources, generation and storage capacity will need to increase significantly to meet future demand, and facilitate a two-way flow of electricity across the networks.<sup>2</sup> To effectively support the transition, the NEM's access standards need to be fit for purpose, clear and well understood. In particular, the access standards must support the ongoing secure and reliable supply of electricity, while not being so onerous as to deter beneficial investment.

It is necessary to consider the access standards that should apply to prospective large loads, given the technological evolution driving the development of large data centres and hydrogen electrolyzers.

AEMO seeks to facilitate the efficient and secure connection of these large loads, which have the potential to deliver substantial economic benefits. New connection requirements should be measured and capable of flexible application where appropriate based on the connection point and power system conditions.

As the AEMC notes, new large loads have at times been observed to cause disruptions in electricity systems overseas. Internationally, studies of these disruptions are being undertaken by energy market bodies to understand the risks of new large loads and consider whether regulations need to be introduced. Similar disruptions, should they occur in Australia, have the potential to undermine system security and cause supply interruptions to electricity consumers.

Given this, AEMO's rule change proposal acknowledged that more analysis is needed to determine any further necessary access standards for large loads. As an initial step, AEMO proposed some new additional light-handed and flexible access standards for loads. AEMO is also proposing other access standards for loads be relaxed. AEMO maintains its support for these rule changes.

The consideration of access standards for large loads will continue in AEMO's large loads access standards review.<sup>3</sup> Depending on the outcomes of the large loads review, AEMO may propose a further access standard rule change.

AEMO's rule change proposal also included amendments to other parts of the rules. AEMO still supports these amendments – subject to a few clarifications noted in this submission. AEMO agrees it is appropriate to consider the rule changes proposed by Rod Hughes Consulting as part of this package.

Part 1 of this submission considers the aspects of the rule change relating to access standards for large loads. Part 2 of this submission considers the other rule changes discussed in the consultation paper.

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<sup>1</sup> AEMC, Consultation paper, National Electricity Amendment (Improving the NEM access standards - Package 2) Rule 2025, May 2025.

<sup>2</sup> AEMO, 2024 Integrated System Plan for the National Electricity Market, p. 6.

<sup>3</sup> AEMO is progressing its Schedule 5.3 large loads access standards review following on from its access standards review to further consider the access standards for new large loads. For further details on our large loads review please see the following [PowerPoint Presentation](#).

# 1 Accommodating the connection of new loads into the National Electricity Market

## 1.1 Approach to considering rule changes

The efficient connection of new large loads has the potential to contribute to the National Electricity Objective (NEO)<sup>4</sup> through the provision of their services (such as more electricity efficient computation facilitated by data centres and reducing greenhouse gas emissions facilitated by hydrogen electrolyzers). There is also the potential for large loads to provide demand response, network support or system security services.

While AEMO's rule change proposal highlights there are potential system security risks associated with new large load connections, AEMO also considers that it is important to ensure that there are no unnecessary barriers to their connection (and the benefits they will deliver). The focus needs to be on developing an efficient process that facilitates the connection of large loads whilst appropriately managing risks when necessary. AEMO submits that the limited changes to load access standards proposed in package 2 represent a balanced set of initial risk management options, which can be applied flexibly as appropriate to the nature and circumstances of an individual connection.

The AEMC's proposed assessment criteria and rationale are very relevant to the consideration of AEMO's rule change proposal, being:<sup>5</sup>

- Safety, security and reliability,
- Innovation and flexibility, and
- Implementation considerations.

In relation to risk mitigation, AEMO considers this is likely to be most efficiently achieved by allocating responsibility for management of a risk to the entity best placed to control that risk. For example, in response to a disturbance on the power system, a large load may disconnect and switch to an uninterruptible power supply (UPS) to provide continuity of its operation. However, this action could exacerbate the impact of the disturbance. In such a circumstance, it might be more appropriate for the large load to ensure that it will ride-through the disturbance, minimising any further impact on customers, rather than placing the burden on the rest of the market (where this doesn't otherwise negatively impact the large load).

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<sup>4</sup> The [NEO](#) guides both the AEMC and AEMO in considering whether and how the National Electricity Rules require amendment to efficiently accommodate future connections to the national electricity market power system.

<sup>5</sup> AEMC, Consultation paper National Electricity Amendment (Improving the NEM access standards - Package 2) Rule 2025, May 2025, p. 55.

## 1.2 Amending the NER to address the influx of large loads

### AEMC questions

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*Do stakeholders have any reflections or data and information they wish to share with the AEMC regarding the prospective growth of large loads connecting to the NEM, including from international experience?*

*Do stakeholders agree with AEMO that the expected growth of large loads may present a risk to power system security?*

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Across the world, many electricity system operators are seeing significant increases in the connection of large Power Electronic Loads (PELs) which use software controls to manage their electricity consumption. These include data centres and hydrogen electrolyzers – which differ in their nature to existing large loads (such as aluminium smelters). Data centres have high reliability requirements and typically have their own uninterruptible power supplies to ensure their continuing operation. Hydrogen electrolyzers could be very large asynchronous loads. The common issues that international electricity system operators are encountering are outlined in the next section.

#### 1.2.1 Ability to ride through voltage and frequency disturbances

Significant network disruptions can occur when large loads are not able to ride through disturbances. A disturbance may be caused by a generator or network element tripping. These disturbances can cause other plant to trip across an electricity network, with escalating consequences. When loads disconnect, all else being equal, the frequency and voltage of the electricity system will be disturbed. This can be exacerbated where multiple similar loads trip when exposed to similar network conditions. Stable frequency is an important part of maintaining a secure power system. Uncontrolled changes in frequency can damage assets and cause cascading failure (blackouts). Significant frequency disturbances, caused by data centres, have been observed overseas:

- In Texas, frequency disturbances are being caused by frequent reductions in load of greater than 100 MW due to the loads not riding through disturbances (as illustrated in Figure 1 below).<sup>6</sup>
- In Virginia: The consultation paper outlines an incident in Virginia where a fault led to 1500 MW of data centres disconnecting and switching to UPS in July 2024. A further event in February this year in Virginia caused the loss of 1800 MW of data centre load during a protection reclosing cycle.<sup>7</sup>
- In Ireland, three disconnections caused significant frequency disruptions.<sup>8</sup>

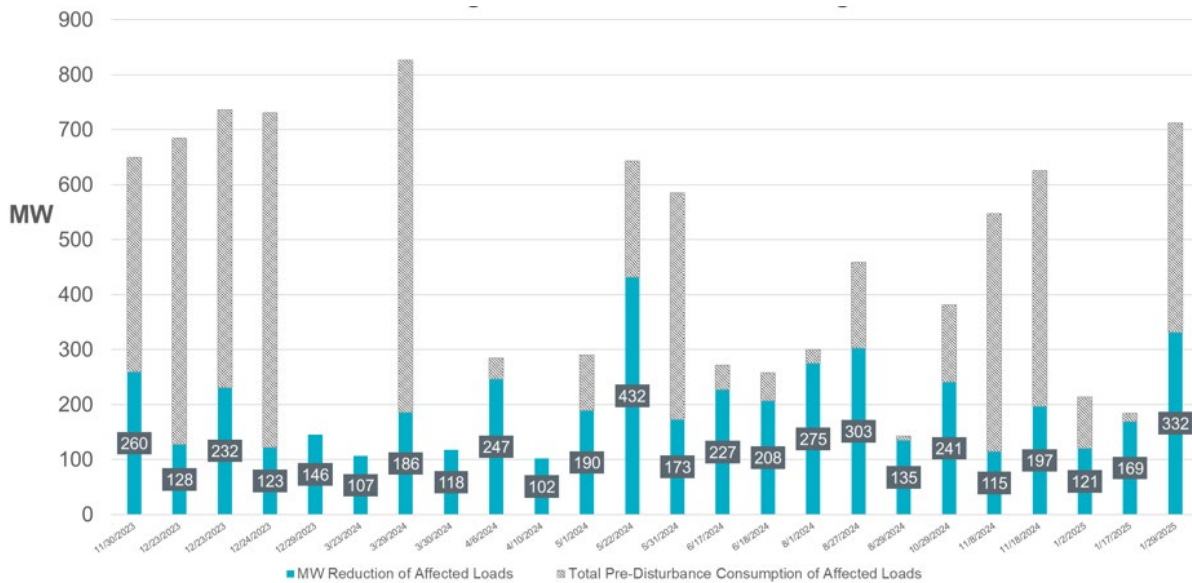
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<sup>6</sup> ERCOT, [ERCOT Large Load Loss/Reduction Events 2020-2024](#), March 2025

<sup>7</sup> Dominion Energy, [Navigating Large Load Events: Dominion Energy's Strategy](#), March 2025.

<sup>8</sup> EirGrid Group, [EirGrid Experience with Large Loads Interconnection](#), March 2025.

**Figure 1 Loss of large loads due to ride-through events in Texas<sup>9</sup>**



## 1.2.2 Ride-through access standards

Given the sorts of issues observed in section 1.2.1, many electricity system operators without existing ride through requirements for large loads are considering and consulting on their application.<sup>10</sup> For instance:

- The North American Electricity Reliability Corporation (NERC) has established a task force to address reliability impacts from large load integration.<sup>11</sup>
- The Electric Reliability Council of Texas (ERCOT) has established a large loads task force, and is consulting on ride through requirements for loads 75MW or higher.<sup>12</sup>
- EirGrid has also proposed new fault ride through requirements for large energy users.<sup>13</sup>

Whilst the current focus of regulators is on the ride through requirements of data centres, similar issues may be caused by hydrogen production facilities.<sup>14</sup>

Currently there is no NER requirement that loads be able to ride through network disturbances. Also, AEMO is not proposing a ride through requirement in this current rule change. AEMO will undertake further detailed consideration of whether prospective loads of certain size or characteristics should be required to ride through certain disturbances in the Australian context given the experiences outlined in section 1.2.1. This will be an area of focus of the large loads review being undertaken by AEMO.

The current rule change proposal is to:

<sup>9</sup> ERCOT, [Large Loads – Impact on Grid Reliability and Overview of Revision Request Package](#), August 2023.

<sup>10</sup> NESO (Britain), Energinet (Denmark), and AESO (Alberta, Canada) already have load ride through requirements.

<sup>11</sup> NERC Activities and Plans to Address Reliability Impacts from Large Load Integration, April 2025.

<sup>12</sup> ERCOT, [Large Loads – Impact on Grid Reliability and Overview of Revision Request Package](#), August 2023.

<sup>13</sup> EirGrid Group, [EirGrid Experience with Large Loads Interconnection](#), March 2025

<sup>14</sup> To this end, the German transmission system operator has recently introduced ride through requirements for hydrogen electrolyzers. ESIG, [International Large Load Performance Specifications](#), March 2025, slide 4.

- Allow NSPs to request a connecting load to provide information about its ride through capability, and record it in the performance standards,<sup>15</sup> and
- Encourage design and protection settings to maximise the ability of loads to remain connected, while maintaining safe and stable operation of the plant within safety margins consistent with good electricity industry practice.

AEMO considers that these requirements are uncontroversial and do not require any additional capital investment on the part of connection applicants. The potential growth in large loads in Australia and the instances of large loads not riding through disturbances overseas justifies these light-handed requirements that allow for better understanding of the risks and facilitates benefits to both the load (less downtime) and the power system (less impact from power system disturbances).

### 1.3 The definition of large loads

#### The AEMC's questions

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*The AEMC wants to hear from stakeholders about how large loads should be considered in the context of its rule change review. To this end, the AEMC has posed several question relating to defining large loads, including:*

*To what extent do stakeholders think that the Commission should consider the definition of 'large loads' in the context of this rule change?*

*If it is considered, should large loads be defined based on the relevant access standard, or should a large load be more holistically defined in the NER?*

*Alternatively, should we consider whether to apply guiding principles and timing for AEMO to produce a proposed definition, which is currently being considered in AEMO's Large Loads Review?*

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#### 1.3.1 AEMO's rule change proposal

Whilst AEMO agrees that defining large loads in the context of the application of prospective access standards is an important consideration, its rule change proposal did not propose, and does not require, a definition of large loads.

It is AEMO's intention to engage with stakeholders on how large loads should be defined for the application of specific access standards as part of the large loads review, in considering standards relating to fault ride-through performance.

Defining large load thresholds for the application of NER schedule 5.3 standards more broadly could be beneficial in terms of providing certainty for connection applicants, but has the drawback of enshrining limits that may prove too high or too low in different circumstances. For most of the access standards package 2 changes to schedule 5.3, AEMO therefore proposed to retain the existing NSP discretion on application, with AEMO input where appropriate.

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<sup>15</sup> There are options regarding how this obligation could be met, including by recording the international standards applying to the data-centre equipment.

### Detailed considerations relevant to defining large loads

For the existing schedule 5.3 access standards and the package 2 changes, a single NER definition of large loads is unlikely to be workable. Different application thresholds may need to be considered for each technical requirement, and the unique circumstances of the load itself will influence its potential impact and risk considerations. Specific circumstances include:

- The energy needs of the large load.
- The proportion of the load that is inverter based.
- Where the large load will connect, including its connection voltage, location relative to constraints, and potential interactions with other load and generation.
- System strength in the surrounding network.
- The operating and business model of the large load, the reliability and security of supply required and the flexibility to adjust demand based on price or power system conditions.
- The number of metered connection points that may service the large load.
- Whether the large load will have its own battery energy storage system (BESS), embedded generation, or back-up generation.
- The sensitivity of the plant to disruptions in the electricity system.
- The number, capacity and voltage of connection points and whether a definition of large loads should relate to connection points or connected plant.

Each access standard is targeted towards managing a specific risk. The nature of these risks might warrant a different definition of large loads to which the relevant standard should apply. AEMO's rule change request considers the requirements that should apply to assist in managing risks associated with system strength, ride through capability and oscillations. These risks differ:

- **System strength** risks are location specific and are managed, in large part, by system strength service providers through the provision at system strength nodes. Further, only the asynchronous part of a load causes system strength issues.
- **Ride through capability** risks will differ depending on the size of the connected plant and the nature of surrounding generation, loads and interconnectors to other NEM regions. Any size threshold for large loads should also consider how these factors are accommodated.
- **Unstable operation** implications can differ in their severity depending on the nature of electrically connected plant and its potential interaction with others. A challenge with unstable operation is determining the contribution of plant (or lack thereof) to instability in the NEM. This requires technologies that can detect instability at connection points.
- **The combined risk** and cumulative impact of multiple large loads, may together have a compounding effect. For instance, oscillations may exacerbate the impact of disturbances in the NEM by causing protection systems to trip the plant, leading to further frequency and voltage disturbances. Likewise, ride through capability and system strength support the maintenance of a stable voltage and synchronisation in the face of disturbances. Without standards the worst-case scenario is over-frequency tripping of plant followed by subsequent tripping of other loads and generation.

A size threshold for a given standard should also be considered having regard to the design of the access standard in question. Many access standards are flexible and allow for performance standards that are tailored to the specific nature



and location of the connecting plant. This flexibility is accommodated by allowing performance standards to be negotiated (with the NSP) between a minimum access standard (that must be met) and an automatic access standard (that must be accepted by AEMO and the NSP if proposed by a connection applicant). Other access standards only prescribe a minimum requirement – such as the existing requirement for a short circuit ratio (SCR) of 3.0.

### Should the AEMC seek to define large loads?

Given the above complexities, AEMO submits that defining large loads merits detailed consideration of the access standard in question. The timeframes of this rule change process may not allow for the depth of engagement that would likely be necessary to determine appropriate size thresholds. AEMO's review of the access standards for large loads is a more appropriate forum for more iterative engagement towards fit for purpose application thresholds for load access standards.

## 1.4 Large loads and system strength

### AEMC questions

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*Do stakeholders consider it an issue that the short circuit ratio requirements under clause S5.3.11 apply to all IBR plant without any size threshold?*

*a. Should it only apply to large inverter-based resources as defined in AEMO's SSIAG?*

*b. Is the definition of a large inverter-based resource in the SSIAG sufficient for the purposes of this proposal?*

*Do stakeholders agree there should be flexibility to agree to higher short circuit ratio than 3.0? Could there be unintended consequences?*

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#### 1.4.1 Size threshold for the application of the system strength requirements

Under the NER, the requirement to provide or procure system strength is linked to the access standards requiring inverter-based resources (IBR) to remain stable and connected at an SCR of 3.0. Whether connecting loads meet this standard is assessed in accordance with the system strength impact assessment guideline (SSIAG). The NER also requires that the SSIAG define 'large inverter based resources'.

NER S5.3.11 itself is currently expressed to apply to all inverter based load connections. AEMO's rule change request would limit the application of NER S5.3.11 to large inverter based loads. This would ensure that loads with small IBR components, for which the cost of the SCR requirement could far outweigh any system benefits, would not be captured. AEMO considers that this is consistent with the intent of the NER.<sup>16</sup>

Currently the SSIAG defines a large inverter based resource as having a minimum capacity of 5 MW or 5 MVA.<sup>17</sup> AEMO is sympathetic to concerns that this threshold is too low and that there are impediments to large loads demonstrating compliance with the SCR requirement. AEMO understands that the requirement to model the susceptibility of large inverter

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<sup>16</sup> NER 5.1.2(b) provides that chapter 5A (and not Rule 5.3A) should apply to loads not connecting a large inverter based resource.

<sup>17</sup> AEMO, [System Strength Impact Assessment Guidelines](#), July 2024, p.8.

based loads to instability presents difficulties. Given these concerns, AEMO is currently considering ways for the SSIAG to more appropriately apply to loads.

#### 1.4.2 Flexibility in the application of the SCR standard

AEMO maintains its support for this aspect of its rule change proposal. Relaxing the access standard for NER S5.3.11 to allow the NSP to agree a minimum SCR above 3.0, facilitates flexible application of the system strength rules in circumstances where the cost of meeting the current SCR requirement would far outweigh any system benefits. This will allow appropriate consideration of the connection in the context of local system requirements.

### 1.5 Detection and response to instability

AEMO maintains that load access standards should allow for the application of stability monitoring and instability response requirements to large inverter-based loads that correspond to those for generators and IRP where appropriate. AEMO notes that its proposed rule limits the application of this standard in the following ways:

- It may only apply to loads where the NSP or AEMO considers the inverter-based load component could reasonably contribute to instability at its connection point, and
- It is not required if the inverter-based load component cannot change the voltage at its connection point by more than 1 per cent.

On the specific wording of the requirements in S5.3.12 for schedule plant meeting the application criteria, these mirrored the requirements proposed for NER S5.2.5.10 in AEMO's package 1 access standards rule change request. Given the differences between the final package 1 rule and its rule change request, AEMO agrees that consistency is appropriate and that corresponding drafting adjustments should be made to S5.3.12.

### 1.6 Under frequency ramp down of large loads

AEMO maintains support for this proposed rule change, which again provides flexibility given the potential efficiency benefits of utilising fast ramp down capability (where it exists) for both the power system and individual customers.

### 1.7 Further large load considerations

#### AEMC questions

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*Do stakeholders have any reflections or data and information they wish to share with the AEMC regarding the prospective growth of large loads connecting to the NEM, including from international experience?*

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There are many other active considerations regarding the integration of large loads into electricity grids. Most are beyond the scope of AEMO's proposed rule change. AEMO refers the AEMC to the NERC's large load task force.<sup>18</sup> Reports recently

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<sup>18</sup> [Large Loads Task Force \(LLTF\)](#)

published by the Energy Systems Integration Group and Western Electricity Coordinating Council are quite relevant.<sup>19</sup> Large loads will increase the demand on energy markets. Managing the operation of these large loads in energy systems that are integrating higher proportions of intermittent and asynchronous generation can pose challenges. Given this AEMO is aware of interventions that have been taken to manage large load growth.<sup>20</sup> There is uncertainty regarding the forecast growth of large loads in the NEM. AEMO is currently considering and consulting on the growth in large loads, including data centres, in the preparation of its Integrated System Plan (ISP) Inputs Assumptions and Scenarios Report (IASR).<sup>21</sup> The question of resource adequacy is the focus of National Electricity Market wholesale market settings review.<sup>22</sup>

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<sup>19</sup> ESIG, [Grid Planning and Operation of Large Loads ESIG](#), November 2024 and Elevate Energy Consulting, [An Assessment of Large Load Interconnection Risks in the Western Interconnection](#), February 2025.

<sup>20</sup> Examples include: **EirGrid** in Ireland has established requirements for data centres to manage their demand with generation/storage when connecting to constrained areas of the network: EirGrid, [Data Centre Connection Offer Process and Policy Version 2.0](#), July 2020. **Singapore** imposing a temporary moratorium on data centre connections to allow generation capacity to keep up with demand: Robert Clark, [Singapore ends data centre pause as it seeks sustainable growth](#), July 2023. **PJM** (a regional transmission organization that coordinates the movement of wholesale electricity in all or parts of 13 US states and the District of Columbia) fast-tracking generation developments to meet data centre demand: Paul Ciampoli, [FERC Accepts PJM Proposal Tied to Interconnection Queue](#), February 2025.

<sup>21</sup> Please direct any queries regarding these demand forecasts to the Forecasting Reference Group [energy.forecasting@aemo.com.au](mailto:energy.forecasting@aemo.com.au)

<sup>22</sup> <https://www.dccew.gov.au/energy/markets/nem-wms-review>

## 2 Other rule changes

### 2.1 Allowing HVDC links to procure system strength

#### AEMC question

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*Do stakeholders agree that the NER should be amended to allow HVDC link owners to procure system strength services from third parties? Is the current inability to do so a material problem, or will it become a material problem?*

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AEMO maintains that HVDC link owners should be allowed to procure system strength services from third parties in the same manner that generators and integrated resource providers can. AEMO considers that this is likely to promote efficient investment and streamline the connection process. AEMO notes that its requested amendment to S5.3a.7 would also allow a HVDC links to meet the requirements of 5.3a.7(c)(1) by undertaking investment in its plant to achieve plant capability sufficient to operate stably and remain connected at a short circuit ratio of 3.0 (as generators may do). Taken together these more flexible requirements may reduce the costs of HVDC link connections (given the system strength charge and the costs of third party procurement or capital investment).

AEMO welcomes feedback from stakeholders on the involvement of AEMO in agreements on how HVDC links can procure system strength. AEMO's involvement is required under the rules as the SCR access standard in NER S5.3a.7 is an AEMO advisory matter given the link to power system security. That said, AEMO's involvement may be beneficial where there is a need to balance competing objectives of other parties involved in the process, including the connection applicant, system strength service providers and third party providers of system strength.

### 2.2 Generator protection systems

AEMO would welcome amendments to NER S5.2.5.9 that clarify its intention without changing the substantive requirement of the standard. AEMO considers that it is important to ensure that access standards are clear and well understood.

### 2.3 Credible contingency events

As noted in AEMO's rule change proposal, AEMO considers there is inherent uncertainty associated with the requirement for schedule 5.2 plant to be capable of remaining in continuous uninterrupted operation for disturbances caused by any credible contingency event. This is because the technical parameters of the most significant credible contingency affecting the plant can change over time, or at any time through reclassification.

It is critical for the resilience of the power system for plant to withstand the effects of disturbances within reasonable limits, and for that purpose it is also important that plant capabilities are measurable and attainable for design and operational purposes. AEMO considers that the proposed change represents an improvement on the current position in this respect.

## **2.4 Testing and commissioning of unregistered participants**

AEMO did not propose extending the formal AER/AEMO compliance regime (rules 4.14 and 4.15) to non-registered participants because it considered the compliance burden may not be justified for the majority of non-registered participants that may become ‘Schedule 5 Participants’. With the benefit of expanded testing/assessment rights and a limited extension of the commissioning regime, enforcement could be retained within the existing connection agreement framework and allowable operational action where necessary.

Otherwise, AEMO maintains its support for the requested changes to the testing and commissioning Rules.

## **2.5 Extension of time for complex issues in future access standards reviews**

AEMO maintains its position on the benefit for the extension of time to consider complex issues in future access standards reviews – but are open to considering different options regarding how this might best be facilitated as may be raised in stakeholder submissions.