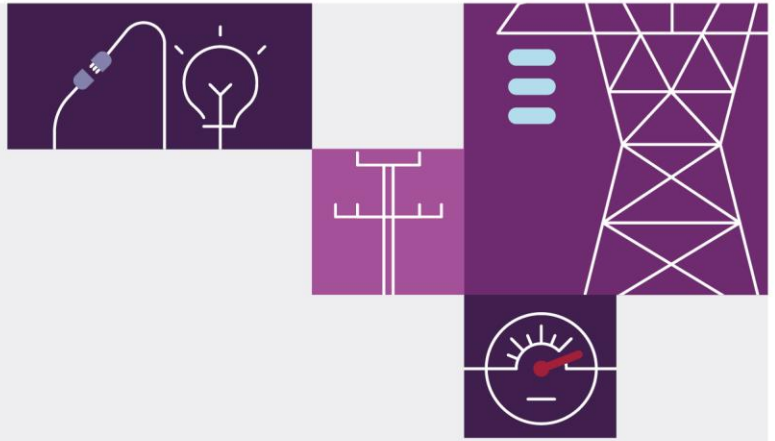


AEMO review of technical requirements for connection

26 July 2023

Draft Recommendations Update
Report (Part 1) – Schedules 5.2 &
5.3a of the National Electricity Rules





Important notice

Purpose

This document is published as part of AEMO's periodic review of the technical requirements for connection in the National Electricity Market, under clause 5.2.6A of the National Electricity Rules. It is an interim report published for consultation purposes only.

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Executive summary

AEMO review of technical requirements for connection

AEMO is conducting a review of the technical requirements in Schedules 5.2, 5.3 and 5.3a of the National Electricity Rules (NER) for connection to the National Electricity Market (NEM) power system (Review). This is the first Review AEMO has undertaken under NER 5.2.6A. The Review commenced in October 2022.

Draft report

AEMO released its draft report under the Review on 3 March 2023 and invited submissions on its recommendations by 20 April 2023. AEMO received 18 written submissions on the draft report, which have been taken into account in delivering revised and extended draft recommendations.

Report purpose and structure

This Draft Recommendations Update Report (Report) presents AEMO's consideration of stakeholder views and revised recommendations for amendments to the NER Schedule 5.2 and Schedule 5.3a technical requirements for connection in the NEM. This Report also makes further recommendations for structural changes and consequential amendments to the NER to improve the clarity of the technical requirements and their application to relevant plant and participants, and provides indicative draft NER amendments for stakeholder consideration. AEMO considers these will be necessary to effectively implement the primary recommendations arising from the Review.

This Report is supported by two key appendices which provide detail for stakeholders:

- **Appendix A1. Stakeholder consultation analysis and revised recommendations** – summarises stakeholder feedback received for each draft report recommendation, analyses feedback received, and sets out reasons for AEMO's decision to either revise or retain draft report recommendations.
- **Appendix A2. Draft NER amendments** – initial proposed drafting of NER changes that could give effect to the revised recommendations, provided in mark-up form.

This Report does not include substantive recommendations or amendments for the technical requirements in NER Schedule 5.3. AEMO intends publishing its revised Schedule 5.3 recommendations in a separate update report.

Invitation to submit feedback

AEMO invites written submissions on the revised draft recommendations and draft NER amendments in this Report. Submissions must be received by close of business on 23 August 2023 at:

contact.connections@aemo.com.au.

Submissions received will help inform AEMO's finalisation of the recommendations and any subsequent rule change proposal, including AEMO's decision on whether to ask the Australian Energy Market Commission (AEMC) to consider a 'fast track' rule change process for any of the proposed amendments. AEMO would also

appreciate any feedback on the possibility of any unintended consequences arising from the initial drafting of the NER amendments.

Revised recommendations

Technical requirements

After consideration of submissions on its draft report, AEMO has revised its draft recommendations for changes to a number of technical requirements in NER Schedule 5.2 and 5.3a. The original and revised draft technical recommendations, including changes, are set out in full in sections 0, 3 and 4, and the detailed analysis and proposed changes to draft report recommendations are provided in Appendix A1.

Structural amendments

There has been strong support for the recommendation to apply the technical requirements to relevant plant types irrespective of the registration category of the connection applicant, and also to entities including network service providers (NSPs) who may own, operate or control (for example) synchronous condensers or high voltage direct current (HVDC) links as part of their networks. AEMO highlighted in the draft report that decoupling the participant type from the plant type was likely to require more extensive changes to Chapter 5 and other parts of the NER.

In considering the required NER changes, in addition to defining and using suitable terms for the plant covered by each schedule, AEMO has identified the need to address existing issues to clarify:

- The application of the technical requirement schedules to both registered and relevant non-registered participants, as well as NSPs.
- The process by which performance standards are determined, including AEMO's involvement.

To provide for a comprehensive solution that identifies the connection process and technical requirements for all types of plant and connection applicants, the structural changes recommended in this Report and corresponding draft NER amendments also extend to network users in respect of customer load (NER Schedule 5.3).

Consequential amendments

A number of further changes have been proposed, in addition to those raised in the draft report, or as a consequence of changes made as part of those issues previously raised. This includes significant changes to a number of NER definitions. These proposed amendments are detailed in Section 6 of this Report.



Contents

Executive summary	3
1 Introduction	6
1.1 The Review	7
1.2 Scope of this Report	7
1.3 Consultation approach	8
1.4 Timeframes	9
1.5 Next steps	9
2 Revised recommendations – NER Schedule 5.2	12
3 Revised recommendations – NER Schedule 5.3a	24
4 Revised recommendations – multiple schedules	27
5 Recommendations – NER structural amendments	28
5.1 Issues with the current rules	28
5.2 Proposed principles and approach for application of the technical schedules	30
6 Recommendations – consequential amendments	32
6.1 Definitions changes	32
6.2 Other changes	33
A1. Stakeholder positions and analysis	37
A2. Draft NER amendments	38
A3. List of stakeholders making submissions	39
Glossary	40

1 Introduction

The National Electricity Rules (NER)¹ require AEMO to conduct a review of some or all of the technical requirements of Schedules 5.2 (for Generators), 5.3 (for Customers and, from July 2024, Integrated Resource Systems (IRS)²) and 5.3a (Market Service Providers) at least once every five years to assess the need for amendment to those requirements.

Focusing on Schedules 5.2 and 5.3a, this Draft Recommendations Update Report (Report) sets out for consideration by stakeholders:

- AEMO's revised draft recommendations after considering stakeholder feedback and undertaking further analysis.
- Initial draft NER amendments which could give effect to the revised recommendations.

AEMO has published this Report to give stakeholders an opportunity to review AEMO's revised recommendations to account for stakeholder feedback on the draft report, as well as further issues arising in the process of AEMO's development of potential amendments. AEMO is also providing an initial draft of potential NER amendments to give effect to the revised recommendations, for further feedback prior to AEMO publishing its final report under the Review.

This Report is not a formal step in the Review as contemplated under NER 5.2.6A. However, AEMO is seeking further feedback through this Report given the extent and complexity of some of the issues being considered, and offering the opportunity to engage on possible NER drafting for specific requirements. AEMO would appreciate the identification of any unintended effects or uncertainty that may arise from these proposed changes, recognising that the drafting represents a preliminary view, and is not intended as a complete or final proposal. Feedback received through this process will also inform AEMO's decision on whether to ask the Australian Energy Market Commission (AEMC) to consult on any of the proposed amendments under a 'fast track' rule change process.

The next and final stage of this Review requires AEMO to publish its final recommendations for amendments to the technical requirements set out in NER Schedules 5.2, 5.3 and 5.3a. In the final report, AEMO will also include recommended NER amendments where possible. The final report will have regard to submissions made in response to its draft report and this Report.

¹ NER 5.2.6A.

² See AEMC final rule change determination "Integrating energy storage systems into the NEM" (ref. ERC0280).

1.1 The Review

As stated above, under NER 5.2.6A, AEMO must conduct a review of some or all of the technical requirements of Schedules 5.2, 5.3 and 5.3a at least once every five years to assess the need for amendment.

The current Review is AEMO's first under NER 5.2.6A since the requirement was introduced in 2018³.

Prior to this Report, AEMO has published the following key documents in the Review:

- An approach paper that described the matters that AEMO proposed to review⁴.
- A draft report setting out its draft recommendations for amendments to technical requirements of NER Schedules 5.2 and 5.3a, and the reasons for its recommendations⁵.
- An addendum to the draft report setting out its draft recommendations for amendments to technical requirements of NER Schedule 5.3, and the reasons for its recommendations⁶.

This Report sets out AEMO's revised recommendations for the substantive changes proposed to Schedules 5.2 and 5.3a, which have been informed by AEMO's consideration of the 18 submissions received on these aspects of the draft report⁷.

1.2 Scope of this Report

For each of the issues raised in the draft report, this Report summarises the draft recommendations previously made and sets out revised recommendations, taking into account the views received in submissions and with the benefit of further analysis. This Report also includes an explanation of the structural and consequential changes AEMO considers will be necessary to effectively implement the primary technical recommendations under the NER.

This Report is intended to be read in conjunction with two key appendices which provide supporting detail for stakeholders:

- **Stakeholder consultation analysis and revised recommendations** (Appendix A1) – this analysis:
 - summarises stakeholder feedback received for each draft report recommendation;
 - analyses feedback received, and
 - makes recommendations to revise or retain draft report recommendations based on AEMO's consideration of feedback and further analysis.

³ See AEMC final rule change determination on "Generator technical performance standard" (ref. ERC0222).

⁴ AEMO Review of technical requirements for connection - Approach Paper, 12 October 2022, refer to: https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/aemo-review-of-technical-requirements-for-connection-ner-clause-526a/aemo-review-of-ner-technical-requirements-for-connection.pdf?la=en

⁵ AEMO Review of technical requirements for connection - draft report, 3 March 2023, refer to: https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/aemo-review-of-technical-requirements-for-connection-ner-clause-526a/2023-03-03_technical-requirements-review_draft-report_final.pdf?la=en

⁶ AEMO Review of technical requirements for connection – Addendum to draft report, 4 April 2023, refer to: https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/aemo-review-of-technical-requirements-for-connection-ner-clause-526a/2023-04-04_technical-requirements-review_draft-report_s53-addendum_final.pdf?la=en

⁷ Refer to Appendix A3 for a list of stakeholders which made submissions to AEMO regarding recommendations set out in its draft report.

Draft NER amendments (Appendix A2) – initial proposed drafting of NER amendments that could give effect to the revised recommendations. This is provided in mark-up form against version 198 of the NER, with the addition of relevant changes in the Integrating Energy Storage Systems (IESS) rule that will come into effect on 3 June 2024. This rule will make extensive changes to Part B of NER Chapter 5 and Schedule 5.2 to accommodate IRS. For that reason, the IESS provisions have been incorporated into the base draft, against which AEMO has marked its proposed amendments. Appendix A.2 comprises the network connections and access sections of NER Chapter 5 (including its schedules), with individual clauses from NER Chapters 4 and 6A and glossary definitions that are relevant to the access standards and their application.

1.3 Consultation approach

Throughout the Review, AEMO has been committed to open engagement with stakeholders and the development of solutions that balance priorities across affected parties as far as practical given the review criteria⁸. The approach paper and draft report were developed with input and feedback from:

- AEMO's connections and operations teams and its consultants engaged for the Review, DigSILENT Pacific.
- Connections Reform Initiative workshop participants.
- Members of technical focus groups established to inform this Review, comprising representatives with direct experience with technical requirements from network service providers (NSPs), market participants, developers and original equipment manufacturers (OEMs).
- Industry associations, including briefings to the Clean Energy Council, Energy Users Association, Australian Energy Council and Energy Networks Association on the proposed scope of the Review.
- Interested parties, via:
 - the formal consultation process in which 18 respondents accepted AEMO's invitation to make submissions in response to the draft report, and
 - the draft report webinar in which over 100 participants attended for the opportunity to hear more about the report and ask questions.
- The Reliability Panel, which AEMO updates approximately every two months on the progress of the Review.
- The AEMC, which has participated in most workshops run by AEMO with its technical working groups.

Further details of engagement with these stakeholders were provided in the draft report.

⁸ Refer to NER 5.6.2A(a).

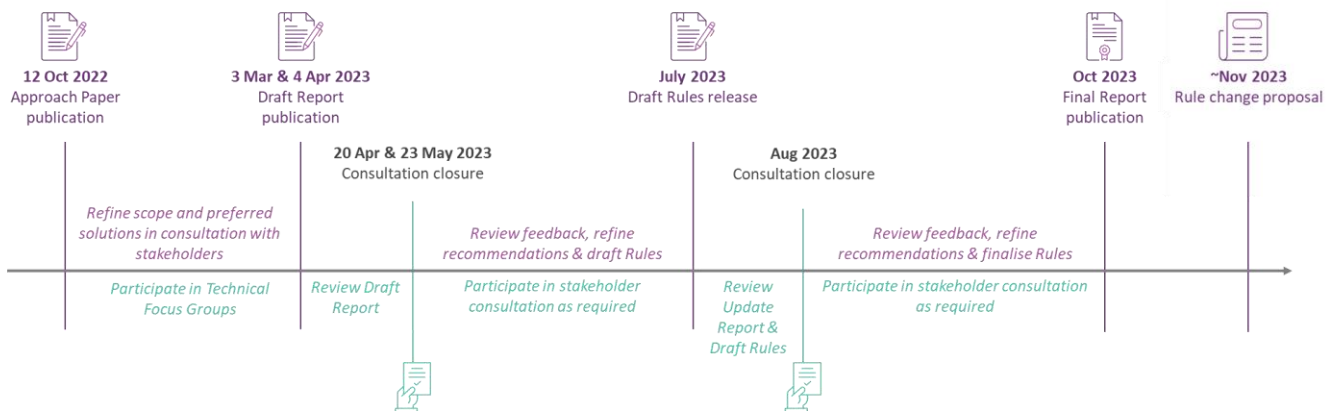
1.4 Timeframes

The timeframes for the key activities to conduct this Review are set out in the table and figure below.

Table 1 Timeline of Review

Milestone	Timing
<i>Approach Paper published</i>	12 October 2022 (complete)
<i>Draft Report (Part 1) published</i>	3 March 2023 (complete)
<i>Draft Report (Part 2) addendum published</i>	4 April 2023 (complete)
<i>Information forum</i>	12 April 2023 (complete)
<i>Draft Report (Part 1) consultation closed</i>	20 April 2023 (complete)
<i>Draft Report (Part 2) addendum consultation closed</i>	23 May 2023 (complete)
<i>Draft Recommendations Update Report (Part 1) and draft NER amendments published</i>	26 July 2023 (complete)
<i>Draft Recommendations Update Report (Part 2) published</i>	Mid-late August 2023 (indicative)
<i>Draft Recommendations Update Report (Part 1) consultation close</i>	23 August 2023
<i>Draft Recommendations Update Report (Part 2) consultation close</i>	Mid-late September 2023 (indicative)
<i>Final Report published</i>	October 2023
<i>Formal outcomes notified to AEMC</i>	Q4 2023

Figure 1 High level timeline of Review



1.5 Next steps

1.5.1 Invitation for written submissions

AEMO invites stakeholders to make written submissions on the revised draft recommendations and draft NER amendments recommended in this Report. Submissions must be received by close of business on 23 August 2023 at: contact.connections@aemo.com.au.

Any inquiries and/or meeting requests should be directed to the same email address.

AEMO intends to publish all submissions on its website. Respondents must identify any part of a submission that is confidential and not to be published. Respondents should note that if material identified as confidential cannot be shared and validated with other interested persons, then it may be accorded less weight in AEMO’s

decision-making process than published material. AEMO prefers that submissions be forwarded in electronic format to be published on the AEMO website.

Prior to the submission deadline, AEMO will hold a public forum on this Report on 9 August 2023, with the time and further details of the forum to be notified on the AEMO website.

1.5.2 Update report (Part 2) for NER Schedule 5.3 recommendations

AEMO continues to consider feedback received on its draft report addendum relating to Schedule 5.3 recommendations, and intends to publish an update report (Part 2) setting out revised draft recommendations for amendments to Schedule 5.3 in the month following this Report. AEMO does not anticipate it will publish draft NER amendments for Schedule 5.3 as part of the Review process itself, because significant novel and complex issues remain and will be further informed by consultation on the update report.

1.5.3 Final report

AEMO will consider feedback submitted on this Report, and submissions received on recommendations relating to NER Schedule 5.3, to finalise its recommendations for NER changes to improve Schedules 5.2, 5.3 and 5.3a and related provisions.

AEMO is aiming to publish its final report in October 2023. This date may be adjusted based on the outcomes of consultation on this Report, for example where complex or contentious issues are identified, requiring additional consultation or consideration by AEMO. If there are any material changes to the timetable, AEMO will advise stakeholders through its normal communication channels.

1.5.4 Rule change proposals

After publishing a final report, under NER 5.2.6A, AEMO is also required to notify the AEMC of whether AEMO will request rule changes as a result of this Review. Consultation undertaken through the Review process, in particular any feedback received in response to this Report and the draft NER amendments, will also inform a decision on whether AEMO will ask the AEMC to consider the 'fast track' rule change process⁹.

The 'fast track' process for rule changes allows the AEMC discretion to move directly to the draft determination stage, if satisfied that another market body (such as AEMO) has undertaken adequate prior public consultation on the nature and content of the proposed rule. The AEMC is not obliged to follow the 'fast track' process, even if adequate consultation has occurred, and will make its own decision on any request to do so.

By way of background, the approach paper published by AEMO in October 2022 confirmed that the aim of the Review was to support the National Electricity Market (NEM) energy transition to a reliable power system based on renewable energy sources, while ensuring that the future power system can be operated securely and is sufficiently resilient to extreme conditions. Relevantly, the approach paper also set out key considerations in support of this aim.

Based on this, AEMO is currently of the view that the 'fast track' process should be pursued, to:

- expedite as much as possible to align NER Schedule 5.2 and 5.3a access standards with desirable power system performance;
- reduce the potential for delay and conflict by clarifying uncertainties; and

⁹ Pursuant to s.96A of the *National Electricity Law*.

- remove unnecessary technology-specific provisions as well as any ambiguous or outdated wording.

Criteria that AEMO intends to apply in considering whether it will pursue the 'fast track' process globally¹⁰ or for specific access standard changes include:

- Complexity of any proposed changes and/or the identified issues being addressed¹¹.
- Contentiousness of any proposed changes to one or more parties.
- Consensus of stakeholders towards a proposed solution.
- Urgency of a proposed change to address identified issues¹².

AEMO anticipates that the decision to allow the 'fast track' process will require significant consideration by the AEMC. For this reason, AEMO encourages affected parties to consider providing specific feedback and supporting rationale regarding whether the 'fast track' process is supported, generally or in respect of specific access standards changes (and associated NER amendments).

¹⁰ In particular, for NER Schedule 5.2

¹¹ Noting that, some proposed changes to the access standards will be dependent on other amendments across other NER provisions to achieve their intended effect.

¹² With particular focus on current impediments affecting the expansion within the NEM of grid forming (GFM) technology.

2 Revised recommendations – NER Schedule 5.2

AEMO has revised its draft recommendations on amendments to the technical requirements of Schedule 5.2 on the basis of feedback provided through written submissions to the draft report.

This section summarises AEMO’s draft recommendations and revised recommendations for amendments to NER Schedule 5.2 as informed by consultation on the draft report. A summary of stakeholder positions on the draft recommendations, AEMO’s consideration of these views, and its proposed revisions to draft recommendations based on careful consideration of issues raised is set out in Appendix A1. This section should be read in conjunction with the details provided in Appendix A1.

Table 2 Schedule 5.2 Conditions for Connection of Generators recommendations

NER Schedule 5.2 issue	Draft recommendations	Revised recommendations
NER S5.2.1 – Outline of requirements		
Application of Schedule 5.2 based on plant type instead of registration category and extension to synchronous condensers	<p>Replace all the references to Generators or Integrated Service Providers in NER Schedule 5.2 with another defined term (e.g. connected participant or Registered Participant), to apply the schedule more generally, with appropriate interpretation clauses to confirm the meaning of the term in the context of the schedule¹³. Corresponding changes may be required elsewhere in the NER, to the extent the access standard schedules and associated performance standards are referenced elsewhere in Chapter 5 or in other defined terms</p> <p>Amend NER S5.2.1 to provide that references to generating systems, synchronous generating systems and synchronous generating units are taken to include synchronous condensers, with a list of exceptions also specified in NER S5.2.1.</p>	<p>Replace all the references to Generators or Integrated Service Providers in NER Schedule 5.2 with another defined term (e.g. ‘Schedule 2 Participant’), to apply the schedule more generally, with appropriate interpretation clauses to confirm the meaning of the term in the context of the schedule¹⁴. Corresponding changes will be required elsewhere in the NER, to the extent the access standard schedules and associated performance standards are referenced elsewhere in Chapter 5 or in other defined terms.</p> <p>Amend NER S5.2.1 to extend the application of the schedule to synchronous condensers, with exceptions and modifications to be specified in the technical requirements as necessary.</p>

¹³ Including the application of the schedule to exempt participants where clause 5.3.4A (proposal and negotiation of access standards) extends to those parties under the NER Chapter 5 connection framework.

NER Schedule 5.2 issue	Draft recommendations	Revised recommendations
NER S5.2.5.1 – Reactive power capability		
Voltage range for full reactive power requirement	<p>Modify the AAS to include a voltage-dependent requirement for reactive power:</p> <ul style="list-style-type: none"> Limit the requirement for full reactive power capability to a 10% voltage band around a centre point nominated by the NSP. For voltages within the 10% voltage band, require 0.395 x Pmax reactive injection and absorption. For voltages below the 10% voltage band down to 90%, require 0.395 x Pmax reactive injection. For voltage from the lower limit of the 10% voltage band to 90%, the requirement for reactive absorption decreases linearly with decrease in voltage from -0.395 x Pmax to 0 MVAR. For voltages above the 10% voltage band up to 110%, require 0.395 x Pmax reactive absorption. <p>For voltage above the upper limit of the 10% voltage band to 110%, reactive injection reduces linearly from 0.395 x Pmax to 0 MVAR.</p>	<p>Modify the AAS to include a voltage-dependent requirement for reactive power (with percentages based on nominal voltage):</p> <ul style="list-style-type: none"> Limit the requirement for full reactive power capability to a 10% voltage band around a centre point nominated by the NSP, where the centre point can be nominated in the range 95% to 105% For voltages within the 10% voltage band, require at least 0.395 x Pmax reactive injection and absorption. For voltages below the 10% voltage band down to 90%, require at least 0.395 x Pmax reactive injection. For voltage from the lower limit of the 10% voltage band to 90%, the requirement for reactive absorption decreases linearly with decrease in voltage from -0.395 x Pmax to 0 MVAR. For voltages above the 10% voltage band up to 110%, the requirement for reactive injection reduces linearly from 0.395 x Pmax to 0 MVAR. As bidirectional units can have different demand and active power capability, separate reactive power requirements can be established for injection and absorption of active power. Use active power capability definition instead of rated active power, as, because of the convention for nameplate rating of IBR, rated active power would represent MVA rating for IBR plant.
Treatment of reactive power capability considering temperature derating	<p>Clarify that for the purpose of NER S5.2.51, the rated active power or rated maximum demand must take account of the temperature dependency of the rating, and that the required Qmax and Qmin are functions of Pmax as derated. That is, $Q_{max}(T) = 0.395 P_{max}(T)$, and $Q_{min}(T) = -0.395 P_{max}(T)$ for operating temperature T at the connection point, for reactive power absorption.</p> <p>Require the performance standards to document:</p> <ul style="list-style-type: none"> Active power derating of production units as a function of temperature, if any. Reactive power derating as a function of temperature of production units and any other reactive power facility, if any. Maximum operating temperature and minimum operating temperature of the generating system or IRS. Maximum operating temperature for which the plant is not derated. 	<p>Clarify that for the purpose of NER S5.2.51, the rated active power or rated maximum demand may take account of the temperature dependency of the rating, and that the required Qmax and Qmin are functions of Pmax as derated. That is, $Q_{max}(T) = 0.395 P_{max}(T)$, and $Q_{min}(T) = -0.395 P_{max}(T)$ for operating temperature T at the connection point, for reactive power absorption, where at least these levels of reactive power injection and absorption apply.</p> <p>Where there is derating, require the performance standards to document:</p> <ul style="list-style-type: none"> Active power derating of production units as a function of temperature, if any. Reactive power derating as a function of temperature of production units and any other reactive power facility, if any. Maximum operating temperature and minimum operating temperature of the generating system or IRS. Maximum operating temperature for which the plant is not derated. Reactive power performance requirement as a function of active power at the connection point at the maximum temperature for which the plant is not derated.

NER Schedule 5.2 issue	Draft recommendations	Revised recommendations
	<ul style="list-style-type: none"> Reactive power performance requirement as a function of active power at the connection point at the maximum temperature for which the plant is not derated. Reactive power performance requirement as a function of active power at the connection point at the maximum operating temperature, where different. Reactive power performance requirement at the connection point as a function of temperature. 	<ul style="list-style-type: none"> Reactive power performance requirement as a function of active power at the connection point at the maximum operating temperature, where different. Reactive power performance requirement at the connection point as a function of temperature Any maximum operating temperature limit. <p>Note that there are three main variants for treatment of temperature derating. These are:</p> <ol style="list-style-type: none"> To require the same reactive power regardless of temperature derating To require the same active power regardless of temperature derating To require the reactive power proportional to active power accounting for any temperature derating. <p>For the common situation of temperature derating associated with a current limit, there is a trade-off between provision of active and reactive power. Option 1 prioritises provision of reactive power over active power, which is an advantage for power system voltage management. Option 2 prioritises provision of active power over reactive power, which is an advantage for maximising supply under high temperature conditions where a supply scarcity is more likely. The recommended Option 3 is a middle-ground where reactive power and active power both reduce proportionally when a temperature derating applies.</p> <p>The NEO requires consideration of efficient investment in the NEM. There may be a high requirement for reactive power in some parts of the NEM during high temperature events, as demand is likely to be high, and some lines may be heavily loaded. Optimal location of reactive power may be at the generators' locations or at other locations distant from generators. Provision of reactive power for high demand periods would entail a cost to NSPs, which flows through to consumers. Provision of additional reactive power from generators involves additional capital expenditure and generator costs will also flow through to consumers. Active power supply requirements are also likely to be high during high temperature events, because of high demand. Reliability of supply must be considered under the NEO, and supply deficits lead to reliability impacts on consumers. The proposed Option 3 seeks to balance these considerations. AEMO welcomes further feedback on whether the proposed solution represents the most optimal solution considering the NEO.</p>
<p>Compensation of reactive power when units are out of service</p>	<p>Amend as follows:</p> <ul style="list-style-type: none"> Remove requirement to restrict the reactive range where the voltage impact of the generating system or IRS with units not in service is less than a voltage threshold (to be defined). Where the Generator or Integrated Resource Provider (IRP) and the NSP agree to limit the range of reactive power at the connection point by means of a subset of production units operating in voltage, reactive power 	<p>Amend as follows:</p> <ul style="list-style-type: none"> Add a requirement to limit the impact on voltage to [0.5%] when the plant is not in service, compared with fully disconnecting the plant. Record in the performance standard how this requirement is to be met Where the voltage impact at the connection point is limited by means of a subset of production units operating to compensate reactive power through the connection point, reduced compliance requirements apply, provided the operating mode is a

NER Schedule 5.2 issue	Draft recommendations	Revised recommendations
	<p>or power factor control, compliance is assessed as if the control is a secondary mode of operation under S5.2.5.13.</p> <ul style="list-style-type: none"> Maximum active power consumption of a generating system or integrated resource system in respect of auxiliary load and the range of permitted reactive power at the connection point to be specified as steady state values. 	<p>primary or secondary mode under S5.2.5.13. Compliance with S5.2.5.2 applies. Compliance with other clauses is not required.</p> <ul style="list-style-type: none"> Clarify that maximum active power consumption of a generating system or integrated resource system in respect of auxiliary load and the range of permitted reactive power at the connection point to be specified as steady state values. <p>Note: AEMO has shown the 0.5% in square brackets and requests specific feedback on this number. The threshold provides a balance between provision of reactive compensation centrally by an NSP and provision by multiple connecting parties individually. Either way there will be costs borne by the consumer that are reflected in the price of electricity. The challenge is to set a threshold that achieves the overall minimum cost to consumers consistent with the NEO.</p>
S5.2.5.7, S5.2.5.8, S5.2.5.13		
Simplifying small connections	<p>Amend as follows:</p> <ul style="list-style-type: none"> S5.2.5.1 AAS: Set the reactive power required for injection and absorption to be the lower of $0.395 \times P_{max}$ and the reactive power that would give rise to a [5%] voltage change, for generation connected to a distribution network. S5.2.5.5 AAS, MAS: Exempt synchronous and asynchronous generating systems and IRS less than [30] MW connected at MV or LV level, from assessments related to reactive current injection. S5.2.5.7 AAS, MAS: Exempt generating systems and IRS less than 30 MW from this clause in both automatic and minimum access standards. S5.2.5.8 MAS: See the related proposal for this rule. S5.2.5.10 See the related proposal for this rule. In the definition of AEMO Advisory Matters, exclude connections less than 30 MW. 	<p>Amend as follows:</p> <ul style="list-style-type: none"> S5.2.5.7 AAS, MAS: Exempt production systems less than a threshold of 30 MW on the mainland and (effectively) 7 MW in Tasmania from this clause in both automatic and minimum access standards. S5.2.5.8 MAS: Apply consistent technology-neutral thresholds for the emergency overfrequency response requirements under this clause: 30 MW on the mainland, and (effectively) 7 MW in Tasmania S5.2.5.13 Apply consistent reduced requirements for some elements of the MAS across all technologies, with a 30 MW threshold on the mainland and (effectively) 7 MW in Tasmania The lower thresholds proposed for Tasmania are achieved by definition of a 'relevant system', where the threshold is set to the lesser of 30 MW (or MVA as relevant) and 5% of the largest credible contingency event defined in the Frequency Operating Standards. For Tasmania the largest credible contingency event has been defined as 144 MW. <p>AEMO advisory matter threshold to all technical requirements</p> <ul style="list-style-type: none"> In the definition of AEMO advisory matters, exclude connections less than 30 MW.
NER S5.2.5.2 – Quality of electricity generated		
Reference to plant standard	Remove reference to AS1359.101(1997) in respect of a synchronous generating unit as a plant standard for harmonic voltage distortion.	Remove reference to AS1359.101(1997) in respect of a synchronous generating unit as a plant standard for harmonic voltage distortion.

NER S5.2.5.4 – Generating system response to voltage disturbances

NER Schedule 5.2 issue	Draft recommendations	Revised recommendations
Overvoltage requirements for medium voltage and lower connections	<ul style="list-style-type: none"> Amend the AAS to make the point of application of overvoltages the nearest HV transmission location, for MV connections not through a transformer with onload tap changer, and Amend S5.2.5.4(c) (limit on negotiation) to a threshold consistent with the largest generator contingency in the region. 	<p>Amend as follows:</p> <ul style="list-style-type: none"> Amend the AAS to make the point of application of overvoltages the nearest HV transmission location, for connections below 66 kV and not through a transformer with an automatic onload tap changer. Remove the limit on negotiation based on size of plant.
Requirements for overvoltages above 130%	<p>AEMO recommends that risk to generators of this clause be bounded. Given the complexities of the issue, AEMO is seeking input from its stakeholders into the most appropriate method of addressing this issue, which may be one of the identified options or an alternative.</p>	<p>Amend as follows:</p> <ul style="list-style-type: none"> Require CUO for peak voltages greater than 184% (with reference to IEC 60071.1 waveforms) Apply an obligation on NSPs under S5.1.4(a1) to design its network and insulation coordination so that switching of network elements does not expose a Network User's plant to switching surges for voltages above those described in the system standards. Amend NER 5.7.2 so that a Registered Participant whose plant is affected by switching surges can request the NSP to undertake an assessment of the cause. Permit the plant to block for transient overvoltages that exceed 184% peak voltage at the connection point for less than 10 ms. Clarify that for the voltages described in S5.2.5.4 (a) (2) to (8) and (b)(1) to (5) are power frequency root mean square voltages and the voltage described in S5.2.5.4(a)(1) refers to voltage waveforms described in IEC 60071.1.
Clarification of continuous uninterrupted operation (CUO) in the range 90% to 110% of normal voltage	<p>Specify that for the purposes of NER S5.2.5.4(a)(6) subject to energy source availability, reactive capability must be maintained, and active power not materially reduced, for voltages in the range 90 to 110% of normal voltage for voltage variations up to 10% within 5s, within the reactive power range and voltage range specified in S5.2.5.1.</p>	<ul style="list-style-type: none"> Specify that for the purposes of NER S5.2.5.4(a)(6) reactive capability must be maintained, and active power not reduced other than for transient response, losses, energy source availability and any other factors the NSP and AEMO consider are reasonable in the circumstances, for voltages in the range 90 to 110% of normal voltage, for voltage variations up to 10%. Clarify that for voltage variations greater than 10% within the range 90% to 110% of nominal voltage, temporary active power output reduction and temporary reduction in reactive power capability, corrected by tap-changing transformer action are permitted.
NER S5.2.5.5 – Generating system response to disturbances following contingency events		
Definition of end of a disturbance for multiple fault ride through	<p>Specify that the end of a power system disturbance, for the purpose of multiple fault ride through (MFRT) assessment, is the time when, following fault clearance, the voltage recovers to and remains within the range 90 to 110% of normal voltage at the connection point for at least [20ms].</p>	<p>Specify that the end of a power system disturbance, for the purpose of multiple fault ride through (MFRT) assessment, is the time when, following fault clearance, the voltage recovers to and remains within the range 90 to 110% of normal voltage at the connection point for at least 20ms.</p>

NER Schedule 5.2 issue	Draft recommendations	Revised recommendations
<p>Form of multiple fault ride through clause</p>	<p>Amend as follows:</p> <ul style="list-style-type: none"> • A suite of tests, established by AEMO, incorporating the MFRT requirements under the AAS and MAS. • A requirement on the proponent to apply the tests considering the range of fault levels nominated at the connection point by the NSP, and using the site-specific settings proposed for the plant. • A requirement on the proponent to declare in proposed performance standards any impediment to MFRT, and provide evidence to support the declaration. • A requirement that compliance with the performance standard is to be demonstrated by performance against the test suite and, throughout the life of the plant, not tripping for any undeclared impediment, checked by verifying the cause of any applicable trips during multiple disturbance events. 	<p>Amend as follows:</p> <ul style="list-style-type: none"> • Require the NSP, where requested by the Schedule 5.2 Participant, to provide connection-specific advice to the Connection Applicant about combinations of contingency events that might be onerous for CUO of the plant. • Provide the NSP the flexibility to require additional studies only where it has reasonable grounds to believe there is an inadequately disclosed limitation • Require documentation of the specific limitations in the performance standard.
<p>Number of faults with 200 ms between them</p>	<p>Retain for the MAS, up to six faults and 200 ms and combination but allow specific limitations such as technology-related limitations (but not limitations arising from inadequate tuning) to be carved out of these requirements for modelled and non-modelled limitations.</p> <p>This allows flexibility while minimising the carve outs from present requirements. It also promotes efficient connection as it can be programmed into the proposed common test suite.</p>	<p>Retain for the MAS, up to six faults and 200 ms and combination but allow specific limitations such as technology-related limitations to be carved out of these requirements for modelled and non-modelled limitations.</p>
<p>Reduction of fault level below minimum level for which the plant has been tuned</p>	<p>Amend as follows:</p> <ul style="list-style-type: none"> • Carve out from the MFRT conditions for CUO, in both the AAS and MAS, conditions where fault levels fall below the lower bound of the fault level range for which the plant has been tuned. • Require that the range of fault levels for tuning be advised by the NSP and recorded, along with (but not within) the performance standards • Enable the NSP to require retuning of the plant, where changes to fault level on the power system could cause the plant to be unable to remain in CUO for multiple disturbance. 	<p>Amend as follows:</p> <ul style="list-style-type: none"> • Carve out from the MFRT conditions for CUO, in both the AAS and MAS, conditions where fault levels fall below the lower bound of the fault level range for which the plant has been tuned. • Require that the range of fault levels for tuning be advised by the NSP and recorded, in the RUG. <p>Clarification on draft report – retuning of plant is already covered by S5.2.2. The changes in S5.2.5.5 make the conditions that might require retuning more transparent.</p>
<p>Active power recovery after a fault</p>	<p>Change the AAS, substantially consistent with the MAS changes, subject to minor amendments proposed by AEMO in response to the AEMC draft Rule Change determination (ref. ERC0272).</p> <p>In the final report for this Review, consideration will need to be given to how AEMC’s final determination deals with frequency response, inertial response and active power response to phase angle changes.</p>	<p>Amend as follows:</p> <ul style="list-style-type: none"> • Amend the MAS to include reference to clause 4.4.2(c1) for primary frequency response (PFR) where S5.2.5.11 has been referenced in regard to a frequency disturbance, and include frequency response in the AAS. • Apply consistent conditions for synchronous machines. • Use the same definition of end of a disturbance as for MFRT.

NER Schedule 5.2 issue	Draft recommendations	Revised recommendations
<p>Rise time and settling time for reactive current injection</p>	<p>Amend as follows:</p> <ul style="list-style-type: none"> • Omit settling time for the AAS. • Replace adequately damped with adequately controlled. • Qualify that rise time is to be measured for “step-like” voltage profile at the production unit terminals. • Add a commencement time requirement, less than 10 ms, with response in a direction that opposes the change in voltage at the production unit terminals. 	<ul style="list-style-type: none"> • Amend MAS to refer to inertial response and phase angle response as well. <p>Amend as follows:</p> <ul style="list-style-type: none"> • Omit the settling time requirement in the AAS • Retain risetime, as per the existing AAS • Use “adequately controlled” instead of “adequately damped”. • Define “adequately controlled”. • Qualify that risetime is to be assessed for steplike voltages (this will affect MAS and AAS) • Add commencement time of no greater than 10 ms in the AAS, and clarify, in both AAS and MAS that this is for response opposing the voltage deviation.
<p>Commencement of reactive current injection</p>	<p>Specify that reactive current response to an undervoltage event commence above 85% of normal voltage at the connection point, and for an over-voltage event commence below 115% of normal voltage at the connection point.</p>	<p>Specify that reactive current response to an undervoltage event commence above 85% of normal voltage at the connection point, and for an over-voltage event commence below 115% of normal voltage at the connection point.</p>
<p>Clarity on reactive current injection volume and location and consideration of unbalanced voltages</p>	<p>Amend as follows:</p> <ul style="list-style-type: none"> • Clarify that the GPS should record the capability provided by the facilities and the settings for reactive current injection that are implemented. • Clarify that the settings should be set to minimise the voltage deviation on each phase from its pre-disturbance value, subject to maintaining stable operation over the expected range of system impedance levels. • Require that the reactive current injection capability be assessed for positive sequence values. • Require documentation of the negative phase sequence injection. 	<p>Amend as follows for asynchronous plant:</p> <ul style="list-style-type: none"> • Retain in the AAS 4% and 6% levels for injection and absorption but with clarification that these levels apply for balanced voltage disturbances. • Require the control strategy to minimise voltage deviation on each phase from pre-disturbance levels, for unbalanced faults. • Require for unbalanced faults and overvoltages positive and negative sequence current to meet the control objective. • For unbalanced faults record in the GPS: <ul style="list-style-type: none"> – The positive sequence reactive current response as a function of positive sequence voltage deviation and <ul style="list-style-type: none"> ▪ The negative sequence reactive current response as a function of negative sequence voltage, which may be different for different fault types ▪ The reactive current response on each phase, to phase unbalance, in % current per % voltage deviation, which may be different for different fault types; or ▪ other way of describing the negative phase sequence response agreed with AEMO and the NSP. – Priority (active current vs reactive, and/or positive vs negative sequence).

NER Schedule 5.2 issue	Draft recommendations	Revised recommendations
Metallic conducting path	Remove NER S5.2.5.5(a) on the basis that existing wording does not appear to add anything useful to the clause.	Remove NER S5.2.5.5(a) on the basis that existing wording does not appear to add anything useful to the clause.
Reclassified contingency events	Expand the credible contingency reference by reference to specify credible contingency events selected by the NSP for the purpose of NER S5.1.2.1 (credible contingency events).	Expand the credible contingency reference, for both the AAS and MAS, by reference to credible contingency events selected by the NSP for the purpose of NER S5.1.2.1 (credible contingency events) with additional commonly reclassified contingencies likely to affect the connection point, noting that the power system is managed on the assumption that production units will remain in operation for any credible contingency as classified at any time unless AEMO.
NER S5.2.5.7 – Partial load rejection		
Application of minimum generation to energy storage systems	Amend the clause to refer to generating units for the carve out about operating above minimum generation.	Amend the clause to refer to generating units for the carve out about operating above minimum generation.
Clarification of meaning of CUO for NER S5.2.5.7	Replace the term “be capable of” with “remain in”.	Replace the term “be capable of” with “remain in”.
NER S5.2.5.8 – Protection of generating systems from power system disturbances		
Emergency over-frequency response	<p>Amend as follows:</p> <ul style="list-style-type: none"> • Make paragraph (2) apply only if the plant does not provide PFR consistent with relevant PFR Requirements (published under NER 4.4.2A), considering deadband and droop. • Change the reference from “upper limit of the extreme frequency excursion tolerance limits” to “0.5 Hz less than the upper limit of the extreme frequency excursion tolerance limits”. • Remove the reference from “not less than the upper limit of the operational frequency tolerance band”. • Add a carve out for the 3 seconds requirement in (a)(2)(i)(B) and (a)(2)(ii), so that where AEMO agrees that the physical attributes of the plant do not allow it to meet the time constraints of these rules, a longer time can be specified consistent with the fastest active power ramp down rate for safe operation. • Apply the same size threshold irrespective of nature of plant – 30 MW. 	<p>Amend as follows:</p> <ul style="list-style-type: none"> • Convert the MAS to a AAS and MAS, with the AAS reflecting a proportional response, the MAS tripping and the NAS specifically including rapid reduction by 50% by means other than tripping. Express the remainder of the rule as a general requirement. • Change the reference from “upper limit of the extreme frequency excursion tolerance limits” to “0.5 Hz less than the upper limit of the extreme frequency excursion tolerance limits”. • Remove the reference from “not less than the upper limit of the operational frequency tolerance band”. • Allow for lags in a proportional response or fast ramp down which are longer than 3 seconds, as part of a negotiated access standard, considering the capability of the plant. • Apply the same size threshold irrespective of nature of plant, being a threshold of 7 MW in Tasmania, and 30 MW on the mainland. • Remove the reference to transmission-connected, for the AAS and MAS.

NER Schedule 5.2 issue	Draft recommendations	Revised recommendations
<p>Requirements for stability protection on asynchronous generating systems</p>	<p>In the AAS, specify that a generating system or IRS, for its asynchronous units:</p> <ul style="list-style-type: none"> • Must have a protection system that can detect an instability and disconnect the production unit based on its nominated settings such as disconnection time and oscillation magnitude. • May take corrective actions such as ramping down or changing control mode (where the thresholds and corrective actions, are to be coordinated by the NSP). • The generating system or IRS must have a detection device to identify whether the production unit or system is contributing to the instability or (subject to the agreement of the NSP and AEMO) a PMU connected to the unit or system capable of providing information to a central system to identify if the unit or system is contributing to an instability. Where a central system is used, the generating system or IRS must have the capability to accept information on contribution from the central system. • The generating system or IRS must have a PMU, regardless of whether a centralised system for determining contribution to an oscillation is used. The PMU would need to monitor and analyse the active power, reactive power and voltage at the plant, and provide the results to AEMO and the NSP. <p>The MAS, for a generating system or IRS [20 MW] or more, would require:</p> <ul style="list-style-type: none"> • For generating systems or IRS greater than 20 MW, its asynchronous units, a protection system to disconnect for instability or sustained oscillatory response in active power, reactive power or voltage. • For its synchronous units, to have a protection system to disconnect a synchronous generating unit for pole slipping. • Have capability to accept a trip command from AEMO or the NSP <p>In the MAS,</p> <ul style="list-style-type: none"> • Require a monitoring system for active power, reactive power and voltage, capable of providing timestamped data to the NSP and AEMO. • Not require a detection device to identify whether the production unit or system is contributing to the instability. • Remove reference to AS/NZS 61000.3.7:2001 from the MAS. <p>In addition, remove to AS/NZS 61000.3.7:2001 from the MAS.</p>	<p>In the AAS, specify that a generating system or IRS, for its asynchronous units:</p> <ul style="list-style-type: none"> • Must have system that can detect an instability in voltage, reactive power and active power • Must have a protection system capable of disconnecting for oscillatory behaviour • On detection of oscillations, execute a hierarchy of actions based on configurable trigger conditions, thresholds and timeframes, agreed with the NSP and AEMO, where <ul style="list-style-type: none"> – Any action to disconnect is based on contribution to the oscillations – Actions are automatically and promptly actioned • For synchronous and asynchronous production systems 100 MW or greater, must have a PMU and capability to receive information about contribution to oscillations from an AEMO central system (in a form nominated by AEMO) <p>The MAS requires:</p> <ul style="list-style-type: none"> • Where the plant, considering its reactive power range under S5.2.5.1, can change the voltage at the connection point, for system normal or planned outage conditions, by more than 1%, <ul style="list-style-type: none"> – The plant must have capability to detect an oscillation of voltage, reactive power and, where relevant, active power – For asynchronous production systems a process agreed with the NSP and AEMO to manage oscillations promptly – For synchronous production units and synchronous condensers a protection system to disconnect the plant for sustained pole slipping, if required by the NSP • If required by AEMO or the NSP, for production systems with active power capability 100 MW or greater and synchronous condensers 100 MVA a PMU, and capability to receive data on contribution to an oscillation in a form nominated by AEMO;

NER Schedule 5.2 issue	Draft recommendations	Revised recommendations
NER S5.2.5.13 – Voltage and reactive power control		
<p>Voltage control at unit level and slow setpoint change</p>	<p>Amend as follows:</p> <ul style="list-style-type: none"> To clarify that voltage, reactive and power factor control may be implemented at production unit level, for both synchronous and asynchronous plant. Specifically allow rate-limited setpoint change of the generating system. Bypass rate limiting during testing to assess stability of the controls. <p>The changes would apply to both synchronous and asynchronous plant.</p> <p>The slow setpoint change amendment would apply to voltage, power factor and reactive power modes.</p>	<p>Amend as follows:</p> <ul style="list-style-type: none"> Specifically allow rate-limited setpoint change of the generating system. Permit bypass of setpoint rate limiting during testing to assess stability of the controls. Apply to voltage, reactive power and power factor modes. <p>The changes would apply to both synchronous and asynchronous plant.</p> <p>The slow setpoint change amendment would apply to voltage, power factor and reactive power modes.</p>
<p>Realignment of performance requirements to optimise power system performance over expected fault level (system impedance) range – Voltage control</p>	<p>Require that the range of system impedances for which the plant is tuned be recorded in the releasable user guide.</p> <p>In the AAS:</p> <ul style="list-style-type: none"> Require a 2 second rise time of reactive power for a 5% setpoint change for the highest system impedance level nominated by the NSP. Retain a 5 second settling time (5% step not into a limit) and 7.5 s settling time (5% step into a limit). <p>In the general requirements:</p> <ul style="list-style-type: none"> Where 5 second settling time cannot be met at both minimum and maximum system impedance, control tuning should be set to achieve AAS level settling time for maximum system impedance and target as close to AAS level settling time as possible for highest system impedance, and settling time for low, typical and high system impedances to be recorded in the GPS. The typical system impedance level should be reflective of typical dispatch levels. Similar clarifications as those proposed for the general conditions for voltage control, should be applied for reactive and power factor modes where settling time cannot be met at minimum and maximum system impedance conditions with the same control tuning settings. <p>In the MAS:</p> <ul style="list-style-type: none"> Retain settling times as per existing MAS for highest system impedance level. Allow a higher settling time for lowest system impedance level, provided the response is critically- or over-damped. 	<p>In the AAS:</p> <ul style="list-style-type: none"> Require a 2 second rise time of reactive power system voltage change up to 5% for the highest system impedance and typical system impedance level nominated by the NSP. Retain a 5 second settling time (5% step not into a limit) and 7.5 s settling time (5% step into a limit). <p>In the negotiated access requirements:</p> <ul style="list-style-type: none"> Require that controls must be tuned to achieve the lowest reasonably achievable settling time for the highest apparent system impedance level, prioritising the primary operating mode. If a settling time of 5 seconds cannot be met for the full range of apparent system impedances, then target achieving it for the range highest to typical apparent system impedance. <p>In the MAS:</p> <ul style="list-style-type: none"> Allow a higher settling time longer than 7.5s to be agreed with the NSP for a voltage disturbance up to 5% (for both synchronous and asynchronous plant) <p>General requirements</p> <ul style="list-style-type: none"> In the general requirements, explain the concept of apparent system impedance (see note below) and require that the minimum, maximum and typical values be recorded in the RUG. The typical system impedance level should be reflective of typical unit commitment. <p>Note:</p> <p>The concept of apparent system impedance relates to the impedance at operating voltages as opposed to the equivalent impedance level that would be calculated considering short circuit condition, which is more commonly understood. The apparent</p>

NER Schedule 5.2 issue	Draft recommendations	Revised recommendations
	<ul style="list-style-type: none"> Where the MAS settling time cannot be met at both highest and lowest system impedance, settling times for highest, typical and lowest impedances are to be recorded in the GPS. <p>In addition, apply the same approach to the synchronous machine requirements for settling times only (as there is no rise time requirement for synchronous generating systems).</p>	<p>system impedance would give the same dV/dQ and dV/dP at the connection point, as would be measured with dispatch pattern including inverter-based plant online and in their normal operating configuration. The difference between traditional system impedance and this approach will be greatest with very high IBR penetration electrically close to the connection point. As noted by some consultation respondents, electrically close generation affects the measured reactive power response to a voltage disturbance, and the reactive power response to a voltage setpoint change. AEMO invites specific feedback from stakeholders on this concept and its application to this performance standard.</p>
<p>Materiality threshold on settling time error band and voltage settling time for reactive power and power factor setpoints</p>	<p>Amend as follows:</p> <ul style="list-style-type: none"> Remove the calculation of voltage settling time for reactive power and power factor modes. Assessment of active power settling time is not applicable for voltage, voltage setpoint, reactive or power factor steps when the maximum change in active power is less than 5 MW. 	<p>Considering stakeholder feedback, AEMO proposes to retain the draft report recommendation with the following revisions to:</p> <ul style="list-style-type: none"> Apply a materiality threshold of 3MW, below which the calculation of settling time for active power excursions is not required, and Apply a settling time error band that is the larger of ± 0.5 MW and the value calculated under the settling time definition, for voltage steps in any mode or setpoint change in voltage control.
<p>Clarification of when multiple modes of operation are required</p>	<p>Require two modes in the AAS:</p> <ul style="list-style-type: none"> With the ability to switch between them Where primary mode is voltage control Where secondary mode either power factor or reactive power With reduced assessment requirements for secondary mode: <ul style="list-style-type: none"> remove the requirement for settling time compliance assessment for power factor and reactive power setpoint changes retain the requirement for settling time assessment for voltage disturbances. 	<p>Require two modes in the AAS:</p> <ul style="list-style-type: none"> With the ability to switch between them Where primary mode is voltage control Where secondary mode either power factor or reactive power With reduced assessment requirements for secondary mode: <ul style="list-style-type: none"> remove the requirement for settling time compliance assessment for power factor and reactive power setpoint changes retain the requirement for settling time assessment for voltage disturbances.
<p>Impact of a generating system on power system oscillation modes</p>	<p>Amend as follows:</p> <ul style="list-style-type: none"> Modify the AAS to require facilities capable of providing positive damping for system strength-sensitive critical modes of oscillation identified by the NSP. Modify the MAS to require it not to exacerbate any mode of oscillation beyond the point at which it would be adequately damped or to exacerbate any oscillation that is not adequately damped. Carve out the damping requirements of MAS (d)(1) pertaining to system-strength sensitive oscillations (only) where the Generator or IRS has opted to pay for system strength services to be provided by a SSSP. 	<p>Amend as follows:</p> <ul style="list-style-type: none"> Modify the MAS to require the plant not to reduce the damping of any oscillation that is not adequately damped. Where a Schedule 5.2 Participant has elected to pay the system strength charge (under NER 5.4.3B(b1)), require that assessments take into account the performance required to be provided by the SSSP at the relevant system strength node.

NER Schedule 5.2 issue	Draft recommendations	Revised recommendations
Definition – continuous uninterrupted operation		
Recognition of frequency response mode, inertial response and active power response to an angle jump	Modify the CUO definition or relevant clauses to: <ul style="list-style-type: none"> • Permit responses opposing voltage phase angle jumps and frequency changes, including inertial response during disturbances, in clause (b). • Permit inertial response and response opposing voltage phase angle jumps and inertial response, after clearance of any fault, in clause ©. • Take into account inertial response and response to voltage phase angle jumps for subsequent response, in clause (d). 	Modify the CUO definition or relevant clauses to: <ul style="list-style-type: none"> • Carve out inherent or programmed responses opposing rate of change of frequency (inertial response) and opposing phase angle jumps, and operation in accordance with PFR requirements.



3 Revised recommendations – NER Schedule 5.3a

AEMO has revised its draft recommendations on amendments to the technical requirements of Schedule 5.3a on the basis of feedback provided through written submissions to the draft report. AEMO has retained its recommendations in the draft report with the following clarifications:

- High voltage direct current (HVDC) systems will be excluded from the requirements of NER S5.1, noting that transitional arrangements will be needed for current and committed HVDC systems.
- Fault ride through requirements for HVDC systems are to include the capability to inject or absorb reactive current during the fault (consistent with s5.2.5.5 requirements for generating systems).

This section summarises AEMO’s draft recommendations and revised recommendations for amendments to NER Schedule 5.3a as informed by consultation on the draft report. As for the preceding section, this section should be read in conjunction with the details provided in Appendix 1.

Table 3 Schedule 5.3a Conditions for connection of MNS revised recommendations

Issue	Draft recommendations	Revised recommendations
NER S5.3a.1a Introduction to the schedule		
Alignment of schedule with plant-type rather than registration category	Apply the requirements of Schedule 5.3a to all to HVDC systems irrespective of registration classification.	Amend as follows: <ul style="list-style-type: none"> • Define HVDC systems (as ‘schedule 5.3a plant’) and apply the requirements of Schedule 5.3a to all to HVDC systems irrespective of registration classification. • Exclude HVDC systems from the requirements of NER S5.1 where they have performance standards documented under Schedule 5.3a. • Allow flexibility for application of the performance requirements to an offshore wind facility. • Current and committed HVDC projects will not be affected by the recommended changes to the HVDC access standards.

Issue	Draft recommendations	Revised recommendations
NER S5.3a.8 – Reactive power capability		
Reactive power	Align the reactive power capability requirements for HVDC systems with those for generators in NER S5.2.5.1, noting the proposed changes to NER S5.2.5.1 for generating systems.	Align the reactive power capability requirements for HVDC systems with those for generators in NER S5.2.5.1, noting the proposed changes to NER S5.2.5.1 for generating systems.
NER S5.3a.13 –Response to disturbances in the power system		
Voltage disturbances	Align the voltage disturbance power capability requirements for HVDC systems with those for generators in NER S5.2.5.4, considering the proposed changes to NER S5.2.5.4 for generating systems discussed in this report.	Align the voltage disturbance power capability requirements for HVDC systems with those for generators in NER S5.2.5.4, considering the proposed changes to NER S5.2.5.4 for generating systems discussed in this report.
Frequency disturbances	Align frequency disturbance power capability requirements for HVDC systems with those for generators in NER S5.2.5.3, including the RoCoF requirements, noting the proposed changes to NER S5.2.5.3 for generators discussed in section 4.5 of this report. Exempt NSPs from the requirement of NER S5.1.3 to align with the recommended requirements for all HVDC systems.	Align frequency disturbance power capability requirements for HVDC systems with those for generators in NER S5.2.5.3, including the RoCoF.
Fault ride through requirements	Align fault ride through and MFRT capability for HVDC systems with those for generators in NER S5.2.5.5, noting the proposed changes to NER S5.2.5.5 for generating systems discussed in this report.	Amend as follows: <ul style="list-style-type: none"> Align fault ride through and MFRT capability for HVDC systems with those for generators in NER S5.2.5.5, noting the proposed changes to NER S5.2.5.5 for generating systems discussed in this report require HVDC systems to inject or absorb reactive current during the fault.
NER S5.3a.4 – Monitoring and control requirements		
Remote monitoring and protection against instability	Align remote monitoring and protection against inverter instability requirements for HVDC systems to the equivalent requirements for generating systems in NER S5.2.5.10.	Align remote monitoring and protection against inverter instability requirements for HVDC systems to the equivalent requirements for generating systems in NER S5.2.5.10. Therefore, amend as follows: AAS: <ul style="list-style-type: none"> A requirement to install a PMU for each connection point The capability to detect instabilities and execute hierarchy of automated actions agreed with the NSP and AEMO to suppress instabilities; The agreed hierarchy of automatic actions may include the protection system disconnecting the HVDC system if required by AEMO or NSP but it should only be triggered when all other measures have been taken and the HVDC system is contributing to the instability; If required, the HVDC system must have the capability to send information from the detection system to AEMO and NSP.

Issue	Draft recommendations	Revised recommendations
		<ul style="list-style-type: none"> • If required, the HVDC system must have the capability to receive a remote tripping signal from NSP. • If required, the HVDC system must have the capability to receive information from AEMO about plant's contribution to instability. <p>MAS:</p> <ul style="list-style-type: none"> • A requirement to install a PMU, subject to request from NSP. • The capability to detect instabilities and execute hierarchy of actions to suppress instability, and which is agreed with the NSP and AEMO. • If required, the capability to send information from the detection system to AEMO and the NSP. • If required, the capability to receive remote tripping signal. • A requirement for detecting the contribution to instability is not required.
New standards		
Voltage control	Align AC voltage control capability for HVDC systems with those for generators in NER S5.2.5.13, noting the proposed changes to NER S5.2.5.13 for generating systems discussed in this report.	Align AC voltage control capability for HVDC systems with those for generators in NER S5.2.5.13, noting the proposed changes to NER S5.2.5.13 for generating systems discussed in this report.
Active power dispatch	Align active power control requirements for HVDC systems with those for generators in NER S5.2.5.14, including for dispatch and ramping.	Align active power control requirements for HVDC systems with those for generators in NER S5.2.5.14, including for dispatch and ramping.



4 Revised recommendations – multiple schedules

AEMO proposes to retain its draft recommendation to amend the references in *NER SS5.1.5, S5.1.6 S5.1a.5 and S5.1a.6* to the latest versions without dates.

Table 4 Multiple schedules revised recommendations

Issue	Draft recommendations	Revised recommendations
NER Multiple clauses		
References to superseded standards	Amend the references to AS/NZS 61000.3.6 and AS/NZS 61000.3.7 (with or without dates) in S5.1.5, S5.1.6 S5.1a.5 and S5.1a.6 to the latest versions TR IEC 61000.3.6 and TR IEC 61000.3.7, without dates.	Amend the references to AS/NZS 61000.3.6 and AS/NZS 61000.3.7 (with or without dates) in S5.1.5, S5.1.6 S5.1a.5 and S5.1a.6 to the latest versions TR IEC 61000.3.6 and TR IEC 61000.3.7, without dates.

5 Recommendations – NER structural amendments

AEMO received strong support in participant workshops and in submissions to the draft report for its recommendation to reframe the technical schedules to apply to particular types of plant or facilities, irrespective of the registration category of the person who owns, operates or controls the plant¹⁵. This reframing will recognise that, for example:

- Technical requirements for facilities like synchronous condensers can operate and impact the power system in a similar way to generating systems in many respects, yet may be owned and operated by an NSP, a market customer, or an exempt or non-registered user.
- Most HVDC links in the NEM are not (or are no longer) operated as market network service facilities, and it is unclear whether any future links will operate on a market basis. This means the requirements in NER Schedule 5.3a may not apply to future HVDC links purely because of their economic regulation status, rather than the way in which those links interact with the rest of the power system.

AEMO highlighted in the draft report that decoupling the participant type from the plant type was likely to require more extensive changes to Chapter 5 and other parts of the NER than simply replacing references to ‘Generators’, ‘Integrated Service Providers’ or ‘Market Network Service Providers’ with another defined term.

In considering the NER amendments needed to break the link between registration category or status and the type of plant covered by each schedule, it has become clear that this requires fairly significant structural changes. It is also necessary to clarify the regulated processes by which the access standards are applied to registered participants and other network users. This entails substantial amendment of the primary rules for establishing and modifying connections in NER Chapter 5 and related definitions, to provide a clear and consistent NER basis for the current and ongoing application of Schedules 5.2, 5.3 and 5.3a to all appropriate plant.

The proposed draft rule amendments seek to make clear when and how these schedules apply, and reconcile AEMO’s explicit role in many of those access standards with the potential for NSPs to apply them without AEMO involvement where appropriate.

5.1 Issues with the current rules

5.1.1 Ambiguity on application of connection frameworks, including technical requirements

Over many years, the NER frameworks for connection and access have been incrementally expanded and separated by connection or network type, and the technical schedules are difficult to reconcile with the various connection processes. There are also several apparent inconsistencies and gaps in Chapter 5, making it unclear how certain types of connection or connection applicants fit into the framework and causing ambiguity that ideally requires clarification.

The following examples describe some of the clauses that give rise to this ambiguity:

- The application provisions within the schedules themselves extend them beyond registered participants:

¹⁵ Recommended in relation to NER S5.2.1 and S5.3a.1a

- NER S5.2.1(a) states that the requirements apply to (registered) ‘Generators’, and that is how each technical requirement is expressed. However, S5.2.1(b) indicates that exempt generating or integrated resource systems are only *excluded* from Schedule 5.2 if the NSP considers the use of the system is unlikely to cause a material degradation in quality of supply to other network users. Schedule 5.3 is expressed to apply to any network user in respect of loads, including non-registered customers.
- NER S5.3.1a(d) obliges an NSP to include each obligation and performance standard in Schedule 5.3 in a connection agreement with a non-registered customer. Other clauses, however, link the purpose of the schedule to the connection process under rule 5.3, which does not apply to retail customers (including very large loads and synchronous condensers).
- These application provisions within the schedules are not easy to reconcile with Parts A and B of NER Chapter 5, which themselves include inconsistent provisions. Applications for connection can occur under one of three frameworks. Only two are within Chapter 5 (rules 5.3 and 5.3A for transmission connections and distribution connected unit respectively, both involving the establishment of performance standards under the schedules). The third, covering most retail customer connections, is in Chapter 5A.
- The table in NER 5.1.2(d), although expressed as illustrative, nonetheless seems intended as a comprehensive overview of the connection process applicable to each type of connection. The table has been amended multiple times to capture successive changes to Part B, but highlights a number of consistency issues including:
 - Applicants connecting to a transmission network who are exempt from registration as a generator or IRP, or for load connections where registration is not required:
 - Are not captured in the NER 5.1.2(d) table other than for the declared shared transmission network (Victoria).
 - For load connections, are permitted (but not required) under NER 5.1(c) to elect to comply with the Chapter 5 connection process.
 - Are expressed in NER 5.2A.3 to be subject to the connection and access process in NER 5.3, but are not mentioned in NER 5.3.1, which covers only registered participants.
 - Under NER S5.2.1(b) or S5.3.1a(d), are subject to the performance standards and obligations
 - The NER 5.1.2(d) table excludes connection of load incorporating a large inverter based resource to a distribution network from the NER Chapter 5A process, but does say what process should be followed for those connections. Large inverter-based loads connecting to transmission are not mentioned at all.
- After the IESS rule effective date, IRS will generally be covered by NER Schedule 5.2, but several requirements will be expressed to apply only to the extent that the IRS is comprised of production units – that is, any non-auxiliary and non-bidirectional load within the IRS will be excluded from the requirement. This could result in IRPs not being subject to any technical requirements for a potentially very large load component of an IRS.

5.1.2 AEMO’s role in the connection process

Given the inconsistencies in the NER relating to the connection process to be followed by different types of applicant for different types of plant, there is existing uncertainty, in particular for non-registered applicants, as to whether and by what process the technical requirements (in particular Schedules 5.2 and 5.3) are applied to their

facilities. Examples include large inverter-based loads, exempt generating systems, and large non-registered customers.

AEMO has a regulated role in advising on access standards and specifying or agreeing to elements of those standards. This is specified in NER 5.3.4A and in individual access standards within the schedules. However, it is not clear whether or how AEMO is to provide the specified input or agreement on matters set out in the Schedule in cases where the 5.3.4A process itself is not applicable to a particular applicant. This will most commonly occur where the applicant is not a registered participant (and does not intend to be), but the relevant access standards are nevertheless applied by the NSP due to the plant's impact. Nor is it necessarily efficient for AEMO to be required to assess or advise on the determination of performance standards for small facilities that may wish to be registered for market participation reasons.

5.2 Proposed principles and approach for application of the technical schedules

5.2.1 Drafting principles

AEMO considers that the following principles should underpin the redrafting of Part B of NER Chapter 5 and the technical requirement schedules, to achieve the twin objectives of decoupling technical requirements from the registration (or otherwise) of the connection applicant, and ensuring consistent application of the technical requirements to plant that should appropriately be subject to those requirements:

- The application of the technical requirement schedules should be determined by the nature of the connecting plant and its impact on the power system, not by ownership or market participation.
- The process applicable to network connections for production, synchronous condensers, loads (including inverter-based loads) and other networks (including HVDC links and embedded networks) should be comprehensively and consistently set out in the introductory sections of Part B of Chapter 5.
- Schedules 5.2 and 5.3 should continue to apply to exempt or non-registered participants (which they are currently expressed to do), but conditional on the NSP forming the view that the operation of the plant would adversely impact security or quality of supply to other network users.
- It should be clear when and how the requirements in the schedules can apply to network users that may not be required to follow one of the Chapter 5 processes to establish a connection.
- The criteria for AEMO's mandatory involvement in advising on performance standards should be based on appropriate thresholds, with regard to the potential impact of a given type and size of plant on power system security.

5.2.2 Proposed approach

- Define the plant subject to each of the schedules:
 - Schedule 5.2 plant: Production systems (defined as generating systems, and IRS production units together with auxiliary and reactive plant), synchronous condensers both as standalone systems and part of a production system).
 - Schedule 5.3 plant: Loads, including loads within an IRS.

- Schedule 5.3a plant: HVDC networks proposing to connect to another NSP’s distribution or transmission system, or connecting between AC parts of the NSP’s own network.

Importantly, for Schedules 5.2 and 5.3, plant is only captured if it is either above the AEMO advisory threshold (see below), the connection applicant is or will be a registered participant, or the NSP considers the plant will have a material impact on other network users.

- Define a ‘Schedule 5.2/5.3/5.3a Participant’ as the person who will own, operate or control the corresponding plant. This will tie the technical obligations to the person who will enter into the connection agreement (not necessarily a registered participant), or an NSP who operates the plant within its own network. Modify the process for determination and documentation of performance standards for an NSP’s own equipment.
- Define AEMO’s advisory role in relation to the negotiation of access standards and consideration of plant alterations as 30 megawatts (MW)/30 megavolt amperes (MVA) nameplate rating for Schedules 5.2 and 5.3. For plant that does not meet the relevant threshold, the schedules may still apply if the NSP considers there to be an impact on other network users, but AEMO will not be involved and the NER 5.3.4A process (where applicable) will proceed as if all AEMO functions were removed.
- Where connection applicants using the NER Chapter 5A connection framework are nevertheless ‘Schedule 5.2/5.3 Participants’, those schedules will still apply. AEMO recommends explicitly allowing NSPs not to apply all of the standards in an applicable schedule – only those that are reasonably necessary to minimise the impact of the plant on other network users.
- AEMO will only register performance standards (for compliance purposes) for registered participants (including NSPs), but AEMO will still receive a copy of all performance standards for which it does have an advisory role. Performance standards for non-registered participants are enforceable by the NSP through the connection agreement.
- Use clear and consistent terminology to describe the access standards set out in the schedules and the process by which they become performance standards and are recorded in a connection agreement (or other document for relevant equipment of the NSP itself).

The draft NER amendments published with this Report propose several changes throughout Chapter 5 and the schedules to address these issues based on the principles and approach set out in this section. AEMO is keen to receive feedback in particular on any further consequential changes that require consideration, or any potential unintended consequences. There are a number of notes in the draft intended to assist stakeholders’ review.

6 Recommendations – consequential amendments

This section summarises other material NER changes that have been proposed, in addition to those raised in the draft report, or as a consequence of changes made as part of those issues previously raised.

6.1 Definitions changes

The table below sets out significant proposed changes to NER definitions. There are consequential changes to other definitions because of these changes, as well as clarifications or corrections, which do not significantly alter the meaning and are not specifically included below. The proposed draft NER amendments published with this Report shows all suggested definitional amendments and notes others that are likely to require further consideration in developing a rule change proposal.

New or changed NER definition/s	Rationale
production system	Added for convenience to avoid specifying in multiple instances in Schedule 5.2 a generating system and an integrated resource system to the extent of its production units. This definition excludes loads that are part of an integrated resource system.
Schedule 5.2 plant, Schedule 5.3 plant and Schedule 5.3a plant	Terms added for convenience to specify the types of plant covered by Schedule 5.2, Schedule 5.3 and Schedule 5.3a respectively.
Schedule 5.2 Participant, Schedule 5.3 Participant and Schedule 5.3a Participant	Terms added for convenience to specify the connecting parties under the relevant schedules to whom the access standards apply.
synchronous condenser	Enhanced definition of synchronous condenser to differentiate it from a synchronous generating unit.
synchronous condenser system	A new term added to provide for one or more standalone synchronous condensers to be referenced in Schedule 5.2.
active power capability	Definition adapted for use instead of rated active power for all Schedule 5.2 access standards, and used also in relation to the use of short circuit ratio in NER 5.3.4C and 6A.23.5(j).
continuous uninterrupted operation	Changes made to make the definition more appropriate for clauses referencing it (rather than being very specific to S5.2.5.5) and to provide for phase angle jump response, inertial response and PFR.
nameplate rating	Changes made to provide for synchronous condenser ratings (in MVA).
negotiated access standard	Change to the definition removing reference to a connection agreement because performance standards, not access standards, are included in a connection agreement.
normal voltage – definition removed	The defined term 'normal voltage' has been removed along with all uses of it in Chapter 5 to simplify the rules because the concept has not proven useful and it causes confusion.
performance standard	Amended as part of structural changes to Chapter 5 described in section 5 of this report.
plant	Change to include synchronous condensers and better reflect the range of plant that may be covered by the technical schedules.
rated active power - deleted	This term was problematic as it referred to production units operating at nameplate rating. As nameplate rating for inverter-based units is the same as their MVA rating, inverter based units in the NEM are not operated at nameplate rating. Similar issues can arise for synchronous machines where a generator can be rated higher than maximum permitted output at the connection point would allow.
rated maximum demand - deleted	Same issue as for rated active power above. The existing term <i>maximum demand</i> is used in relevant rules instead.

New or changed NER definition/s	Rationale
reactive power capability	Change to the definition to broaden it from just production unit to other types of plant such as synchronous condensers and HVDC.
rise time	Change to the definition to make it more standard, and work more effectively for grid forming inverters (especially in S5.2.5.5).
settling time	Change made to make the error bands for settling time consistent as the ratio of sustained change to maximum induced change increases.
short circuit ratio	Change made to address an issue with the definition of the term 'rated active power'.
voltage – definition deleted	The term 'voltage' is used in various different ways in Chapter 5 and elsewhere in the rules, and is best understood from an engineering perspective in the context where it is used. As a result, the term 'voltage', when not used in conjunction with a composite defined term, should be un-italicised throughout the NER.

6.2 Other changes

This section summarises other material consequential changes, other than those described in the earlier sections of this Report, and some additional changes made to address specific issues raised either as part of the consultation process, or considered by AEMO in preparing this Report.

6.2.1 Technical changes

Incorporating synchronous condensers

Other than the structural changes described in Section 5 of this Report, there have been multiple changes necessary to NER Schedule 5.2 to incorporate synchronous condenser systems. In NER S5.2.1, which prescribes who the schedule applies to, AEMO has proposed a general clause that states that some requirements of NER S5.2.5 and S5.2.6 that apply to synchronous plant have been modified or excluded, as noted in the first paragraph of the relevant subclauses. The parts modified or excluded are generally those associated with active power performance requirements.

Additions to information provision

Additions to NER S5.2.4(b) and (e1) are proposed to incorporate additional information required from an NSP under NER S5.2.5.5 and S5.2.5.13.

Relevant system – in relation to small plants exempt from some requirements

The draft report considered parts of NER Schedule 5.2 for which relaxation of requirements might be possible for small plants. While most respondents agreed with the concept and where AEMO proposed to apply it, TasNetworks and Hydro Tasmania argued that, because of the small size of their system, the exemption should be reduced from 30 MW to 5 MW within their NEM region. The NER do not generally differentiate between different regions or jurisdictions for the purposes of technical requirements. An exception to this is the references to the Frequency Operating Standards (FOS) which apply different standards in Tasmania compared to the mainland. To give effect to the different threshold in Tasmania, AEMO proposes to use the maximum contingency size that is defined in the FOS, which is a reflection of the size of generation in Tasmania. Accordingly, the relevant system has then been described as the lower of 30 MW or 30 MVA as applicable and the amount (in MW or MVA) that is 5% of any maximum credible contingency event size specified in the FOS for the relevant region. This gives a threshold of 7 MW for Tasmania based on its 144 MW maximum contingency size.

S5.2.5.8 Over-frequency emergency generation reduction requirements

The draft report identified inflexibility of over-frequency generation reduction requirements in the Minimum Access Standard (MAS) under NER S5.2.5.8 as an issue to be addressed. In the draft report, AEMO proposed several changes that increased flexibility. On further consideration, AEMO has refined the proposed changes. In particular, the proposal to exempt plant from these requirements if they met primary frequency response (PFR) requirements identified in AEMO's PFR Requirements was not progressed¹⁶. In addition, to maximise the prospects of successful power system recovery, AEMO has a strong preference for proportional response, with fast runback as the second preference and tripping least preferred. As a result, it is proposed that NER 5.2.5.8 be reoriented to reflect these preferences by establishing the response proportional to frequency deviation as an Automatic Access Standard (AAS), tripping as a MAS, and Negotiated Access Standard (NAS) specifically allowing for fast runback as an alternative, and also allowing for relaxation of the 3 second requirement for response as a NAS. Other parts of the clause previously part of the MAS are proposed to be described as general requirements. AEMO believes that these changes will provide improved outcomes, by prioritising the type of response that provides a smooth proportional response for the NEM while also allowing flexibility in the way that plant can meet these requirements without need for tripping.

S5.2.5.8 Protection settings and relationship to ride through clauses

The present rule S5.2.5.8(a)(1) has been moved to the general requirements section of S5.2.5.8 under the proposed drafting, with some subtle but important changes to which AEMO would like to draw stakeholders' attention. The proposed changes include:

- The present requirement of S5.2.5.8(a)(1) has been moved, but the requirement for not disconnecting for conditions which the plant must withstand has been omitted, because withstand typically means “not be damaged for” which is not the same as remaining in operation. The wording has instead been amended to “remains in operation” rather than “remains in *continuous uninterrupted operation*” to cover S5.2.5.6 in addition to S5.2.5.3, S5.2.5.4, S5.2.5.5 and S5.2.5.7.
- A further change proposed for this clause is a requirement to set protection so that operation for abnormal power system conditions (such as frequency and voltage excursions) is maximised, while maintaining stable operation of the plant within safe operating margins consistent with good electricity industry practice. This change is consistent with what was proposed for loads in the draft report Addendum and would assist longer-term resilience of the power system to abnormal power system conditions. It is not expected that this change will present additional cost or risk to connecting parties, as existing plant capability would be utilised.
- A third change incorporates the requirement in S5.2.5.16 related to vector shift protection into this clause, rather than as a separate clause.

In regard to the last point, AEMO notes that the current clause S5.2.5.16 is written only for asynchronous plant. The proposed drafting omits this scope limitation, but AEMO requests stakeholder feedback as to whether this technology specific reference is necessary.

¹⁶ Because the PFR Requirements have minimum requirements that are much less than what is required under NER S5.2.5.8, they are not suitable for NER S5.2.5.8 purposes.

S5.2.5.8 Conditions for which the plant may trip and recording of conditions

Clause S5.2.5.8(e) lists conditions for which NER Schedule 5.2 plant is permitted to trip. This list has been amended to include in accordance with an ancillary services agreement with an NSP (in addition to AEMO) and adds requirements of a special protection scheme or a runback scheme. These changes have just been made for completeness.

The description of what needs to be recorded in the performance standards in relation to trip information has also been updated to clarify it.

S5.2.5.8 Network Service Provider liability

AEMO proposes to move clause NER S5.2.5.8(f), which describes that an NSP is not liable for losses or damage incurred by a Generator or IRP, to NER Schedule 5.6, as it does not fit well in NER Schedule 5.2.

S5.2.5.11 Minimum operating level

At present, NER S5.2.5.11 describes minimum operating level requirements in terms of generating systems or IRS, but minimum operating level is specifically a unit-related issue. A system level minimum operating level for frequency droop performance is only correct if all the units are operating at the same initial level above their minimum operating level. The proposed changes rectify this issue.

S5.2.5.11 Response direction for bidirectional units taking power from the system

NER S5.2.5.3(b)(1) and (c)(1) describe requirements for the plant response to a frequency rise and fall for the AAS and MAS, respectively. However, they only capture power transfer to the system and do not otherwise consider when the plant is taking power from the system (for example, batteries charging). AEMO has addressed this omission from NER S5.2.5.11 in the proposed drafting.

6.2.2 Drafting changes

In reviewing the NER to implement the recommended changes described in this Report, AEMO has identified corrections, clarifications and potential drafting improvements relating directly or indirectly to the determination, application and amendment of performance standards. These have been marked in the accompanying draft NER amendments, or flagged for review or further consideration. They are not intended to be comprehensive at this stage.

At a high level, these changes seek to address matters including:

- Consequential changes, clarification and streamlining of registered participant obligations in NER 5.2.
- Clarification of the application of access standards set by an NSP for protection systems and fault clearance times in NER S5.1.1(f).
- A request for feedback on a proposal to separate NER S5.2.5.5 into two separate clauses, dealing respectively with (multiple) fault ride through and response.
- Removing generally applicable principles and considerations relevant to the assessment of performance standards from the schedules, and instead providing for consideration of those matters on a consistently worded basis in NER S5.3.4A(b).

- Consistent with the principle in NER 5.3 that AEMO advises the NSP on AEMO advisory matters, amending references in the schedules that may imply AEMO is also negotiating standards between the NSP and applicants.
- Adding provision for assessments (e.g. simulation studies) as well as physical testing in NER 5.7.2, which currently allows NSPs and connected participants to require testing of each other's facilities for compliance with the NER or a connection agreement.
- Amendments for consistency with revised terminology relating to plant, participants, applicants and technical requirements.
- Removing or consolidating unnecessary references to registered participants, or specific categories of registered participants or plant types throughout Chapter 5.
- Proposed streamlining of substantially identical clauses relating to generating systems and IRS, and correction of minor omissions or inconsistencies relating to the IESS rule amendments.
- Proposed deletion of redundant, duplicated or unnecessary wording.



A1. Stakeholder positions and analysis

Refer to separate attachment to this report, *Stakeholder consultation analysis and revised recommendations*, which summarises stakeholder feedback received for each draft report recommendation, analyses feedback received, and sets out reasons for AEMO's decision to either revise or retain draft report recommendations.



A2. Draft NER amendments

Refer to separate attachment to this report, *Draft NER amendments*, which provides initial proposed drafting of NER changes that could give effect to the revised recommendations, provided in mark-up form.

A3. List of stakeholders making submissions

AEMO received submissions on its draft report from the following:

1. AGL
2. Amp Power
3. APD
4. AusNet
5. Bo Yin
6. CEC
7. CPSA
8. Energy Queensland
9. EUAA
10. Goldwind Australia
11. Hitachi Energy
12. Hydro Tasmania
13. Marinus Link
14. Rod Hughs Consulting
15. TasNetworks
16. Tesla
17. Total Eren
18. Transgrid

Glossary

This document uses many terms that have meanings defined in the NER. The NER meanings are adopted unless otherwise specified.

Term	Definition
AAS	Automatic access standard
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
BESS	Battery energy storage system
CRI	Connections Reform Initiative
CUO	Continuous uninterrupted operation
DC	Direct current
FCAS	Frequency control ancillary service
GFL	Grid following
GFM	Grid forming
HVDC	High voltage direct current
IBR	Inverter-based resource/s
IESS Rule	National Electricity Amendment (Integrating energy storage systems into the NEM) Rule 2021
IRP	Integrated Resource Provider
IRS	Integrated resource system
MAS	Minimum access standard
MFRT	Multiple fault ride through
MNSP	Market Network Service Provider
NAS	Negotiated access standard
NEM	National Electricity Market
NEO	National Electricity Objectives
NER	National Electricity Rules
NSP	Network Service Provider
OEM	Original equipment manufacturer
PFR	Primary frequency response
PMU	phasor measurement units
POD	Power oscillation dampers
PPC	power plant controller
pu	Per unit
Review	AEMO review of technical requirements for connection (pursuant to NER 5.2.6A)
REZ	Renewable Energy Zone
RoCoF	Rate of change of frequency
VSC	Voltage source convertor