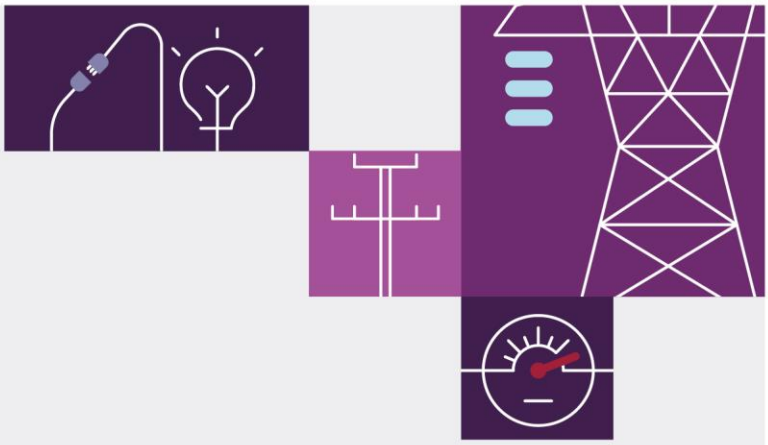
AEMO review of technical requirements for connection final report: Appendix 2

22 December 2023

Stakeholder consultation analysis and revised recommendations – NER Schedules 5.2 & 5.3a



Important notice

Purpose

This is Appendix 2 to the Final Report 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.

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2 General feedback

General feedback

General issue	Summary of feedback provided – general	AEMO response
Negotiation framework and need to meet AAS	**CEC** AEMO considers this to be out-of-scope for this review, however the framework is resulting in the industry being exposed to higher CapEx and development costs without any system need for additional capability. We strongly urge AEMO to consider this as part of their review. We recommend 5.3.4A(b)(1A) be removed as it presents a barrier to upgrading existing plant and/or new capabilities from being implemented to existing assets where there is an overall benefit to the power system. • The need to meet the AAS is resulting in additional CapEx and development costs to projects without there being a substantiated system need. • The requirement to meet the AAS is at odds with the NEO which requires '…efficient investment in, and efficient operation and use of, electricity services…'. • We recommend this clause be removed or where the NSP or AEMO rejects a negotiated access, then the level of performance that will be accepted should be proposed along with a justification which clearly ties the rejection with an associated network need for additional performance. • Furthermore, we recommend there be a carveout of this clause for legacy assets that are not affected by an alteration. • This clause has been especially problematic for existing assets looking to retrofit a BESS behind the existing connection point. Grandfathering of these legacy assets will not discourage plant upgrades and /or modification that can have an overall positive impact on the power system. • The CEC appreciates that AEMO is running a separate workstream reviewing the 5.3.9 process, however this issue is best managed as part of this workstream. **Goldwind Australia** We consider it just as important to address some limitations placed by the provisions under clause 5.3.4A as the changes AEMO proposed for all the S5.2.5 clauses. Clause 5.3.4A(b)(1A) specifies that the performance standard must be no less onerous than the existing performance standard under a 5.3.9 process. However, our experience has shown that some modifications (e.g. retrofitting grid forming capabilities) may lead to small reduction in performance for some aspects of the GPS (e.g. active power recovery time, reactive power and voltage rise/settling times) but with a net positive effect on the network around them. This clause would preclude and likely discourage such changes due to the risks associated with a drawn out 5.3.9 process. Furthermore under clause 5.3.4A(b1) there is a requirement to aim for the AAS even when modifying existing generators. This presents a sizeable risk for projects considering expansion or addition of BESS since there is a risk AEMO and/or NSP can request for higher performance standard even for	Under NER 5.2.6A, AEMO's review must consider whether the technical requirements for connection to the NEM should be amended. AEMO has undertaken extensive consultation with a view to recommending changes to automatic and minimum access standards, as well as suitable general requirements for negotiated access standards, that can be expected to maintain the integrity of the power system and be reasonably and efficiently achievable by a broad range of technologies expected to connect to the grid. These recommendations have been developed to work better than the existing requirements within the existing parameters under NER 5.3.4A, including the addition of some flexibility or discretion for some aspects of the MAS. This may help to accommodate cases where a non-material reduction in performance is acceptable (or potentially even beneficial) at a given network location. While we appreciate that interpreting the 'no less onerous' requirement relative to the existing performance standards can present issues for some alteration projects, AEMO remains firmly of the view that the changes to the NER 5.3.4A/5.3.9 negotiating framework raised in submissions by the CEC and some of its members are outside the scope of this review. The implications of these proposed options, together with potential alternative improvements either in drafting or in application/understanding of the current framework, need to be carefully and comprehensively worked through before recommending rule changes. This should continue to progress through separate workstreams.

General issue	Summary of feedback provided – general	AEMO response
	existing plant. Not only can this end up in requiring lots of engineering effort to investigate the headroom to meet AAS which constitutes a time and cost risk to the project but also be forced to install costly hardware to meet the demands of the AAS. This prevents projects to augment BESS which can be a net positive contributor the network. We propose both clauses are removed from the rules. **Neoen** There should be a clear requirement for the NSP and AEMO to justify the need to meet AAS under any clause. NSPs and AEMO should have to provide evidence to support their decision (e.g. by presenting results of the studies) when rejecting negotiated standards. The proponents are required to do so under 5.3.4A(b2) however AEMO and NSPs don't have the same obligation making the negotiation process uneven from the start. At the moment typically AEMO and NSPs reject negotiated standards as a starting point in all negotiations and only agree to them towards the end of the process if the proponent can show via extensive studies that they can't in any way or shouldn't (e.g. due to a detrimental impact on the network) meet the automatic standard. We don't think this was the intent of the framework established under 5.3.4A. **Tesla** Although it has not been specifically considered within the NER clauses proposed to be changed by AEMO, we would suggest that as this progresses to a Rule Change, AEMO should also update the language used in rule 5.3.4A(1A), specifically deleting the phrase "no less onerous". This wording is currently creating challenges in respect of BESS assets transitioning from grid following inverters to grid forming inverters. • Currently there is no special provision or acknowledgment in the NER of the unique operating characteristics of grid forming assets. They are treated the same, and subject to the same connection requirements as all asynchronous plant. However, they have different technical performance characteristics. • Industry would benefit from an update to rule 5.3.4A(1A) clarifying the intent is not to prevent the transition from grid following inverters to grid forming.	
Fast-track rule change process	**ElectraNet** ElectraNet shares AEMO's view on the timeliness for AEMO to review technical requirements for connection to ensure they are fit for purpose as we see the rapid and ongoing changes to the NEM power system. However, ElectraNet has reservations about progressing a number of the proposed rule drafting changes via the fast-tracked process noted in 1.5.4 p10 of the published recommendations report. The measure of what could be fast tracked and what may need to go through the normal Rule change consultation processes is currently unclear, unjustified and it is noted that some aspects of the proposed changes materially affect the application of the Rules beyond the negotiation of access standards. **ENA – caution on use of fast-track approach** ENA is supportive of improving the access standards, so they are fit for purpose for a future power system at the earliest opportunity. ENA is also supportive of AEMO's efforts to involve stakeholders throughout this process. However, we have reservations about progressing the rules drafting as a	AEMO acknowledges that some proposed changes are more contentious than others. However, the level of consultation undertaken for this review has been extensive, particularly in relation to schedules 5.2 and 5.3a. There have been multiple opportunities provided for input and AEMO has updated its recommendations based on consideration of feedback on each occasion. AEMO therefore considers that there is scope to propose a fast-track process for most recommended rule changes. As noted in several submissions, aspects of the current standards are causing confusion or unnecessary barriers to connection and it is particularly important to implement improvements as soon as is feasible to facilitate the energy transition. Ultimately the AEMC will determine whether a fast-track process proceeds and the extent of any rule made under that process.

General issue	Summary of feedback provided – general	AEMO response
	fast-tracked process given the extensive nature of the review. The measure of what could be fast tracked and what may need to go through normal consultation processes is currently unclear. **Powerlink** Powerlink recommends AEMO not recommend the Rule change is fast-tracked, given two rounds of consultation would be prudent to ensure all relevant impacts are captured in amendments to the Rules. **Tesla** While we acknowledge the work done by AEMO in running multiple forms of consultation already, we would caution against an expedited rule change process. The proposed changes to the NER are comprehensive and wide-reaching. AEMO's consultation process has been incredibly engaged, however this does not mean that industry has not missed potential issues; nor that unforeseen impacts of some of the proposed changes may not come up. An additional benefit of the AEMC running a standard rule change process is that the AEMC approach to considering the impacts of a Rule Change will also differ from the approach taken by AEMO, which may highlight different perspectives.	
Overly prescriptive approach to specification of technical requirements	**ENA – cautions on overly specific approach** ENA recommends that AEMO avoids an overly prescriptive approach to ensure technical requirements for connection remain appropriate throughout the energy system's transition. Some of AEMO's proposed changes include guidance for engineering judgements and may be inappropriate in the NER. An adaptive approach where market participants, NSPs and AEMO are able to apply engineering knowledge and make judgements to reflect a connecting plant's specific circumstances and attributes better supports a balance of process efficiency and customer outcomes. **Powerlink** Powerlink recommends AEMO: • adopt a less prescriptive approach to the specification of technical requirements in the NER to accommodate the evolution of generation technologies and knowledge of power system engineering over time. Some of the proposed changes which we consider inappropriate in the Rules include guidance for engineering judgements. We consider that improvements to overall performance of the power system in the interests of consumers is best supported by an adaptive approach where market participants, NSPs and AEMO apply engineering knowledge and make judgements that can reflect a connecting plant's specific circumstances and attributes. • reassess the desirability of increasing the complexity of automatic access standard requirements for generating systems. We consider this approach may not achieve the intended outcomes and instead favour an approach that encourages proponents to discuss their particular requirements with NSPs under the negotiated access standards. **TasNetworks** A detailed response to the revised draft recommendations and draft NER amendments recommended in the Update Report are provided in the attached template. These responses are given based on the specific circumstances found in the Tasmanian network. Where there are no specific concerns or comments raised does not mean we do not support concerns raised by other	AEMO agrees that an overly prescriptive approach is generally undesirable, and has sought to include flexibility in the technical requirements. On the items in Powerlink's detailed response that it specifically considers to be overly prescriptive: • Powerlink is not supportive of including synchronous condensers in S5.2, because they may be installed for a specific purpose. AEMO notes that the same argument could be applied to any plant. Common purposes of synchronous condensers are to provide fault level for system strength, inertia to support frequency response, or reactive power to support voltage. Each of these requirements is important for power system security it is therefore important for synchronous condensers to meet appropriate performance standards. • Powerlink was concerned about AEMO's drafting describing the rise time for reactive current injection to be in response to a "steplike" voltage change. AEMO notes that the concept of rise time cannot be properly assessed, unless the input to the test is steplike. AEMO acknowledges that in some cases it has proposed provisions to guide the determination of some negotiated standards. In general, there is a tension between clear unambiguous requirements and flexibility that permits engineering judgement to be exercised. Clarity and precise language simplifies decisions, but can also lead to the rejection of solutions that otherwise would have been acceptable, because not all circumstances can be considered in the ruled drafting. Flexibility allows for engineering judgement to be exercised, but can be at the expense of negotiation time. Guidance has in a few cases been provided to

General issue	Summary of feedback provided – general	AEMO response
	network service providers based on their circumstances. We have contributed to and support Energy Networks Australia's (ENA's) submission. Noting these differences, TasNetworks requests AEMO provide the ability for technical requirements to vary between networks and parts of networks to allow a fit for purpose set of standards on connections to be imposed.	reconcile these potentially conflicting drivers. For example, a control objective has been proposed for establishing correct tuning in S5.2.5.5, which is intended to guide the negotiation around the design and settings for reactive current injection during faults. In some cases definitions have been provided at the request of stakeholders (including some NSPs). AEMO has, for example provided a definition for "adequately controlled" at the request of stakeholders. In response to TasNetworks, AEMO notes that it has accommodated different thresholds for Tasmania and the mainland, where relaxations to standards have been allowed based on size of plant, at TasNetworks' request, and support from Hydro Tasmania.
Proposal to remove the defined term frequency	**Marinus Link** Given AEMO's proposal and reasoning to remove the defined term voltage from Chapter 10 and noting also that the term "current" is not defined in chapter 10, MLPL proposes that the definition of "frequency" also be deleted. The definition of frequency is: > For alternating current electricity, the number of cycles occurring in each second. The term Hertz (Hz) corresponds to cycles per second. MLPL considers that the term frequency is also best understood from an engineering perspective in the context in which it is used. Furthermore, if the above definition was to be relied upon it could prove problematic: the definition implies that one second must elapse in order that the number of cycles occurring is known. In many instances, however, the quantity of interest is the frequency when measured over a much shorter timescale, potentially as small as one cycle or one half-cycle. The above definition is therefore unsuitable for such circumstances. MLPL acknowledges that, given the stage of the consultation in this technical standards review, it may be too late to incorporate such a Rules amendment. However, we put the proposal forward for consideration.	AEMO acknowledges Marinus Link's comments, but does not intend to recommend removing the term "frequency" from the glossary at this time, as its removal has not been consulted on.
Definition of disconnection	**CPSA** This term is used throughout and refers to (as defined in the NER) interrupting the flow of electricity at the connection point. This term should not be italicised in most clauses to provide flexibility to disconnect units / reactive plant not at the connection point.	There are 127 instances of the term disconnect in the NER, some of which are intended to mean complete disconnection of everything behind the connection point, and some of which include partial disconnection – for instance disconnecting a production unit, but not the balance of plant. Of these, the existing italicisation does not always correspond with the former meaning. The word disconnect (without italicising) and the impact should also be clear to an engineer, in the context of the plant that is referenced. AEMO would therefore agree that "disconnect" without italics referring to a production unit or part of a generating system or IRS could be less ambiguous than the italicised version, in some usages. AEMO does not intend to examine all uses of the word disconnect, as that is beyond the scope of the review. However, we agree that in the

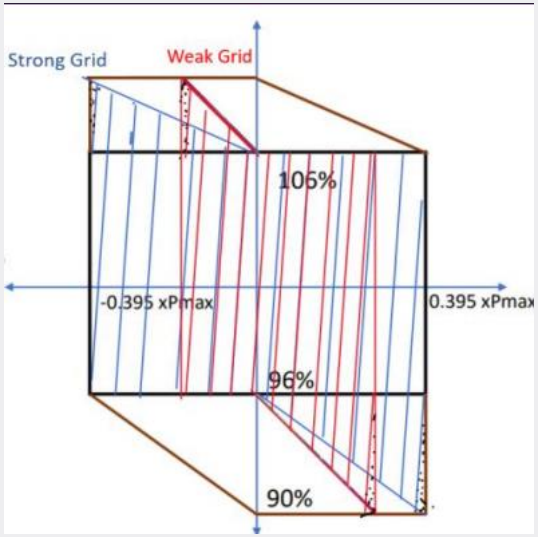
General issue	Summary of feedback provided – general	AEMO response
		context of Schedules 5.2, 5.3 and 5.3a there could be usages where no italics would be less ambiguous.
Use of guidelines	**Neoen** We would like AEMO to consider the use of guidelines in the negotiation process in this review of the Rules. AEMO and various NSPs issue guidelines which have no legal standing in the NER, and insist these guidelines be met to the letter as soon as they are published and in some cases even before that with guideline provided in a draft format. This is effectively bypassing the negotiated standard pathway. Only the guidelines referenced by the NER (e.g. Power System Modelling Guideline) should have any impact on the connection process. The process for establishing the guidelines that the Rules currently reference must be reviewed – very little (if any) consultation appears to take place with the wider industry before the guidelines are issued/revised and there is no time allowed for projects to react to the new requirements. Rules are silent on notice that must be given before guidelines are amended, the consultation period and the transitional arrangements when updated guidelines are published. The NER should describe the consultation and application process in detail. Additionally, many matters for which AEMO has applied guidelines are matters for which the Generator has direct and sole responsibility – and bears all risks – under the NER. While we appreciate that AEMO is expressing "care" that other Participants operate according to AEMO's (perceived) ideal, this is not part of AEMO's role under the NER or the NEL. We are concerned that these matters hinder the ability of Participants to deliver efficient outcomes according to the NER and the NEO.	AEMO acknowledges Neoen's comments, noting that the purpose, use and application of informal guidelines are not within scope of this review, but are part of process discussions being conducted in other forums. As a general observation, from AEMO's perspective, the primary objective of guidelines that are not prescribed by the rules should be to promote common understanding and, as a result, improve efficiency via transparency. They should assist stakeholders to understand how relevant NER requirements are likely to be interpreted and applied in making assessments and decisions under the NER that involve a degree of discretion or judgment, including the balancing of individual interests and circumstances with broader responsibilities and requirements for security, quality and reliability of supply in the interests of all network users.

3 Schedule 5.2 feedback

Schedule 5.2 Conditions for Connection of Generators

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
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	**AusNet – Supports** AusNet supports AEMO's revised recommendation. **Caterpillar – Clarification on classification of generators as Small or Large Generators** It is proposed to classify synchronous generators (as Small- and Large Generators) based on their individual unit capacity (MW) instead of the aggregated plant capacity. Synchronous generators are autonomous units (an indivisible set) which can generate electrical energy such that the frequency of the generated voltage, the generator speed and the frequency of network voltage are in a constant ratio and thus in synchronism. These units can be started and stopped independently; therefore, should be considered individually in determining the classification as Small- or Large Generators. **ElectraNet – Opposes the requirement for technical performance obligations for NSP owned synchronous condensers** While ElectraNet agrees that there are benefits to defining technical performance obligations for synchronous condensers, the effects of including network equipment in schedule 5.2 significantly changes the obligations of NSPs with material financial and resourcing implications that require further justification and consultation. It is not clear why the existing planning, modelling and commissioning obligations of NSPs with regard to network augmentations are not sufficient for network owned and operated synchronous condensers. **Powerlink – Partial support; Alternative proposed** • Powerlink appreciates the intentions and agrees some performance standards should apply to dynamic plant connecting to the network. However, the whole of Schedule S5.2 should not apply to synchronous condensers, SVC and STATCOMs, particularly for plant that has been installed to address a specific purpose. We consider NSPs and AEMO should retain discretion to apply relevant subclauses for these classes of plant. • Powerlink does not support the default inclusion of synchronous condensers into the S5.2 standards. **Solar Turbines** It is recommended a classification that as much as possible permits to define requirements associated to components of the unit rather than a complete system. This would help manufacturer in provide and design a suitable product, it would help integrators in complete the	Many respondents did not comment on this issue, indicating that the general support for the principle articulated in responses to the draft report still holds. Of those that raised concerns, most were from TNSPs (ElectraNet, Powerlink and TasNetworks) seeking flexibility to apply some but not all requirements of schedule 5.2 to synchronous condensers, or exclude synchronous condensers that are network assets. The point that NSPs may install synchronous condensers for different purposes could equally be applied to synchronous condensers installed by other parties. AEMO considers it is important for secure and predictable system operation for similar types of plant to have comparable performance, whether they are operated as part of a network or connected to it. AEMO's recommendation acknowledges the NSP's broader responsibilities for its network and provides flexibility to establish standards within the ranges allowed under schedule 5.2. In relation to Powerlink's submission, AEMO has not proposed that all schedule 5.2 requirements would apply to synchronous condensers (rather a subset, with modifications as applicable), and at this stage has not proposed that any schedule 5.2 standards would apply to standalone SVCs or STATCOMs. Transgrid considered it is unclear how the requirements would apply to a synchronous generator that is also able to operate as a synchronous condenser. AEMO's view is that many of the access standards requirements would be common to both operating modes, but if different there would be scope to describe that difference in the performance standard, within the range of the negotiated access standards. Transgrid also queried how NER 5.3 would apply to negotiation of standards for plant owned by NSPs. In terms of setting appropriate standards within the Schedule 5.2 range AEMO does not see that this should raise particular difficulties, as the NSP would be in a good position to understand both the capability of the plant and the needs of the network to propose performance standards within the range of the access standards. In terms of the 'negotiating' process, AEMO's

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	plant assessment, it would permit to speed up a process which seems to be frequently pretty long and complex and it would limit cost associated to compliance verification. We also consider, as a general comment, that requirement shall not necessarily be technical agnostic, but vice versa shall be tailored to best use the specificities of each technology. This should be valid also for mixed plants (plants with multiple technologies) • It is difficult to evaluate if the proposed changes would go in such direction. **TasNetworks – Supports in principle; alternative proposed** • TasNetworks is supportive of the broad principle of applying Schedule 5.2 based on plant type rather that registration category. We remain concerned that there may be situations where basing standards solely on the type of technology could be unnecessarily restrictive. The same technology could operate in different ways depending on whether it is a load/generation or a network and therefore the performance expectations may be different and should be reflected in the ability to apply Schedule 5.2. **Transgrid – Supports** • Transgrid supports applying NER S5.2 to synchronous condensers connected by a participant other than a Generator or Integrated Resource Provider (i.e. an NSP). • Considers that the negotiation of performance standards is unclear for synchronous condensers owned by an NSP. While NER S5.2.5.1(b1) sets out how the process differs, NER 5.3 will still apply to a synchronous condenser owned by a NSP (as stated in the modified table under 5.1.2). NER 5.3 is ambiguous when applied to NSP owned synchronous condensers where the connection applicant is the NSP. • It is unclear how the requirements of NER S5.2 would apply to a synchronous generator that is also capable of operating as a synchronous condenser. Would: – The negotiated access standard be defined by the lowest performance: or – Separate access standards apply for generator and synchronous condenser modes of operation. **Siemens Gamesa** • SGRE support these changes.	indicative drafting recognises that an NSP cannot 'agree' access standards with itself and the process is one of establishing and documenting standards. AEMO acknowledges the clauses relating to the negotiating process (particularly 5.3.4A and 5.3.9) may require additional drafting to eliminate any ambiguity about their application to NSPs as Schedule 5.2 Participants but not Connection Applicants. AEMO will clarify this in its rule change proposal. Solar Turbines suggested refocusing the technical standards to unit level. This approach has been taken in many overseas standards where the focus is on proving equipment is suitable for use rather than establishing performance at the connection point. While AEMO acknowledges these benefits, this change could result in a negative level of injection at the connection point, which is not desirable and would represent a major shift from the performance standards approach adopted in Australia in the early 2000s. AEMO is not in a position to recommend such a significant change at this stage of the Review. Caterpillar suggested that synchronous condensers should be considered individually from the perspective of classification as small or large. However, any MW/MVA 'thresholds relate to the impact of the generating system as a whole, not the impact of individual units. AEMO does not see benefit in differentiating between synchronous and asynchronous plant for these thresholds. The capability to be stopped and started independently is not the most relevant characteristic. **Final recommendation** Considering all feedback, AEMO will retain its Update Report recommendation.
NER S5.2.5.1 – Reactive power capability		
Voltage range for full reactive power requirement	**Ausnet Supports – with addition** AusNet supports AEMO's revised recommendation in principle. However, for S5.2.5.1 NAS c(3), it is suggested to change to the following wording including the voltage-dependent reactive power requirement: "may include negotiate a limit that describes how the reactive power capability varies as a function of active power level or voltage level due to a design characteristic of the plant"	A majority of stakeholders who responded to the draft report supported the proposed amendments. Some stakeholders indicated a concern that the mid-point selection might lead to a reactive power requirement specified for higher than 110% of nominal voltage. AEMO made clarifications to address this issue in the update report and indicative rule drafting. Bo Yin, AusNet and Caterpillar suggested more restricted reactive power ranges for weak grids, or to require less oversizing of plant. However, AEMO notes this access standard has broad scope for

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	AusNet believes that the efficient voltage-dependent reactive power curve should be as follows, which can form a basis for the NAS. It can be provided in the assessment guideline or approach paper setting up as a recommenced negotiation principle. • For a key voltage bus node where the voltage is meant to be tightly controlled, the UQ profile similar to the GB grid code (as mentioned in Bo Yin's response to the Draft Report) utilises plants' capability more effectively which takes the high dV/dQ sensitivity into account.  • For the bus nodes that are not remote from system strength nodes on the transmission level and are regularly experiencing bidirectional load flow may require more network voltage control support. Under such circumstances, the wider-band UQ profile (e.g., strong grid in the image above) provides more resilience assuming the Q margin (i.e., away from knee point of QV curve) and stability margin (i.e., away from stability limits) are well maintained. **Bo Yin – Alternative proposal** Bo Yin's submission comments that the amount of reactive power required at low SCR to achieve voltages in the range 90 -110% is much less than 0.395 pu because of high dV/dQ sensitivity. BoYin suggests that AEMO should investigate the amount of reactive power actually being utilised by power plants. Bo Yin suggests that the requirement for reactive power injection at low voltage should be balanced against the cost of providing it. He suggests the following:	negotiation of lower requirements where appropriate. AEMO acknowledges the proposed AAS is more onerous than many international standards, but it should be noted that those are mostly mandatory standards. On the other hand, Transgrid preferred the AAS to remain as is, and Powerlink argues that a reduction in the AAS is not needed as negotiation is available. Given that the NER negotiation framework specifies the AAS as the maximum performance that can be required, and the target level for negotiation, AEMO does not consider it appropriate for the AAS to require performance that is essentially unusable (full injection at very high voltage and full absorption at very low voltage). This translates into unnecessary additional cost for generators and does not promote efficient investment in electricity services, as required by the NEO. Some submissions expressed concerns about the selection of a mid-point voltage by NSPs. Midpoint voltage is not the same as setpoint or target voltage, but simply defines, for drafting convenience, the midpoint of a range. However, AEMO agrees that the value specified for target voltage should be coordinated with the range of values set for this standard. AEMO considers that the proposed standard has a sufficiently wide range (full absorption and injection plus full injection at low voltages and full absorption at high voltages) to accommodate the range of operating voltages that could be reasonably expected over the life of the plant. For example, distribution networks are typically operated within a few percent of nominal voltage, so a mid-point close to nominal voltage would be appropriate in most instances, whereas transmission voltages might be operated a little higher so a mid-point between nominal voltage and 104% might be suitable. In any case, basic insulation levels of network equipment would not make it practical to have a mid-point voltage above 104%, lest the upper band (midpoint voltage+5%) impinge on the basic insulation level of the network equipment. Hydro Tasmania raised a concern about inconsistencies between ranges set for different parties at the same location. The common party is the NSP who is in a position to provide the same range to all relevant connecting parties. Hydro Tasmania and Solar Turbines noted the shape of the characteristic does not align with the capability characteristic of synchronous machines. AEMO notes that the AAS is an "at least" requirement, not a requirement to match the shape of the performance. The current AAS also does not match the capability curve of a synchronous machine, and it is not necessary for it to do so.

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	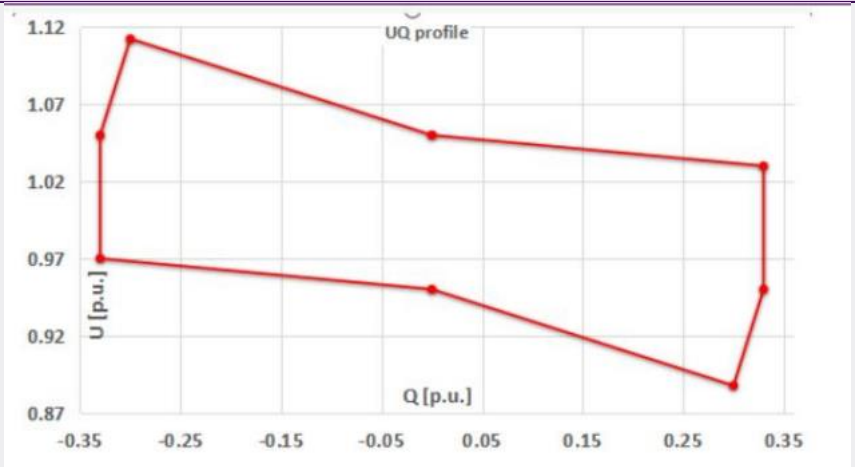 **Caterpillar – Alternative proposed** • Synchronous generators (alternators) offer a large over-excited operating range, up to +0.75 Q/Pmax at rated active power (Pmax) but are constrained in their under-excited operating range owing to voltage stability and stator heating. On the other hand, inverter capabilities at rated active power (Pmax) in the over-excitation range are constrained owing to over-current capabilities of the inverter switches. It is proposed to limit the Q-requirements from ±0.395 to ±0.33 Q/Pmax (±0.95 power factor) to avoid over-sizing of alternators and inverters. The NAS can be used to agree on larger Q-ranges. It proposed to add a figure, with the voltage axis as a percentage of the nominal grid voltage and the required reactive power as a percentage of the unit's nominal active power, showing the required voltage-reactive power "U-Q/Pmax" range. This figure would represent that reactive power capability of units is reduced with increase in voltage deviation. **Energy Queensland – partial support; alternative proposed** Ergon Energy and Energex agree that a graph would be useful for interpretation. However, we note the "centre point" concept could introduce challenges in future due to the dynamic nature of networks. In our view, it would be simpler to specify that for voltages in the range 0.95pu to 1.10pu, reactive absorption requirement of -0.395 x Pmax, and for voltages 0.90-1.05pu, specify a reactive injection requirement of 0.395 x Pmax. **Huawei Australia – clarification requested** What is the rule for NSP to nominate a centre point?	AEMO agrees with Transgrid that voltage dependent limits matching the AAS requirement of S5.2.5.1 are neither necessary nor desirable, and the drafting in S5.2.5.1 does not require such limits. Energy Queensland suggested simplifying the requirement to be for voltages in the range 0.95pu to 1.10pu, reactive absorption requirement of -0.395 x Pmax, and for voltages 0.90-1.05pu, a reactive injection requirement of 0.395 x Pmax. AEMO acknowledges this is a simpler approach, but considers it would not necessarily result in better outcomes and could have shortcomings compared with the current proposed approach. It would effectively have a mid-point at nominal voltage, which might not suit some transmission locations, and would not require injection above 105% or reactive absorption below 95%. If implemented in this way, there would be a discontinuity of the requirement at 105% and 95%, which could cause undesirable hunting of the control system if a plant was set up to provide just this performance level. Transgrid identified that the active power capability definition does not consider the number of units in service, in contrast with the current NER definition of 'rated active power'. The purpose of moving away from the use of rated active power is to recognise that nameplate rating of equipment is not always a useful reference point when seeking to establish the maximum amount of active power transfer that can be permitted or required at a connection point. The proposed changes to the existing definition of active power capability recognise that the term can apply to both a unit and a system, and both would be recorded in the performance standards. The draft definition neither prescribed nor limited the relationship between the capability of a system and the number of its in-service units at any point in time. However, AEMO agrees that the access standards themselves (rather than the active power definition) should clearly establish when it is relevant for performance to be linked to the combined active power capability of those units currently in operation, instead of the maximum value for a system with all its units operating. In the context of S5.2.5.1, AEMO will modify the drafting to require that maximum active power and maximum demand consider only those production units that are in-service (operating), recognising not all units will necessarily be identical. **Final recommendation** Considering all update report feedback, in conjunction with the draft report consultation feedback, AEMO will retain its update report recommendation, subject to clarification that the maximum active power

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	Hydro Tasmania – partial support; alternative proposed Hydro Tasmania (HT) acknowledges that NSP is best placed to identify the expected voltage profile of a network, however, without basic nomination principles or guidelines, leaving the 10% centre line nomination to a single party alone, could lead to potential issue when inconsistency is encountered between different participants, e.g. generator A had a centre line nominated at 1 p.u., subsequently generator B is required to have a different centre line at similar location due to the network shift caused by generator A. At most, +/-5% consistent with S5.2.5.13 (2B) (iii), should be allowed if the TNSP is able to nominate the centre line to also avoid conflicts may arise with this clause. Ungoverned TNSP nomination also releases the possibility of the TNSP biasing the centre line prohibitive of achieving 0.395*Pmax, and thus negating the intent of this change. To avoid that, HT suggests that certain principles need to be established. For example, the nomination should be pre-specified and published, ideally in a regional rather than individual unit. This also will help generators to manage the specification of the machine reactive capability in long term. Additional, in the revised recommendation, an identical reactive capability is required for both absorption and injection. As previously submitted, the main power transformer reactive power consumption facilitates the GS leading reactive capability, but being a burden for lagging reactive capability, hence being challenging to be satisfied. The symmetrical reactive power requirement in the proposed rule change doesn't well reflect this fact. HT notices that the revised recommendation used word 'linearly', while it may be ok for the IBRs, it could be challenging for synchronous machines due to its non-linear characteristic between voltage and reactive capability. **Neoen – Supports with clarification** There needs to be alignment on the different voltage levels referred to in the NER. To maintain consistency with the practical operation of the NEM and avoid introducing another extraneous term, the "target voltage" which should be recorded in the connection agreement should be utilised here. It is not efficient or effective to introduce another definition such as "voltage centre point". If the new quantity is introduced it should be considered what mechanisms are in place for setting and potentially revising it. Refer to the provisions in 5.3.13 – similar would be required here. Proposed change to limit the requirement for full reactive power capability to a 10% voltage band around a centre point nominated by the NSP (in the range 95% to 105%) could mean that the capability of the plant needs to be maintained down to the 85% of the nominal voltage, if the nominated centre point is the lower boundary of the range, i.e. 95%. This could require further plant oversizing that must be supported by additional funding and considered in design. Clarification on this expectation is required from AEMO in a guideline or report prior to the Rule being amended. The nomination of voltage centre point must have a sound basis and be received from the NSP sufficiently early to enable connection studies to be accurate and commence in a timely manner. Neoen therefore recommends the voltage centre point, if	level and maximum demand are only to consider the in-service (operating) units for the purpose of assessing compliance with reactive power requirements.

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	introduced to the NER, to be determined from the connection point's voltage profile, which the NSP should be required to share at Connection Enquiry stage. **Powerlink – Opposes** • The negotiation framework already permits the provision of capabilities less than the automatic levels of full supply (capacitive) of reactive power at high voltages, and capabilities less than automatic levels of full absorption (inductive) of reactive power at low voltages. The proposed changes do not add material benefits to the performance required, assuming that appropriate engineering judgement is made by all parties when negotiating an access standard. • Powerlink does not support the determination of a mid-point voltage, given this could change over time. • The proposed changes could lead to more complex access standards for S5.2.5.1, which would result in an incrementally more complex task in the assessment of the access standard itself and more complexity in the network and its operation. **Siemens Gamesa - Supports** • SGRE support these changes. **Solar Turbines** • It is considered that the provided wording is not self-exhaustive without a figure (as the one in the presentation) which shall be part of the documentation. • It is not so clear the aim of having a mid point in addition to the nominal/rated voltage which is floating within the +/-5%. It is expected that requirements will be based on nominal/rated voltage. • For synchronous generators (4-pole generators) a symmetrical reactive power limit is unusual and typical reactive power in underexcitation condition is PF 0.95, corresponding to Q/Pref 0.328 while in overexcitation condition this can range between 0.9 and 0.8 (corresponding to Q/Pref 0.484 respectively 0.75). • Such values could be used as a better reference, in particular for requirements on the underexcitation side since higher Q/P values will lead for bigger generators (longer generator shaft). **TasNetworks – Supports** • TasNetworks supports this proposed change. **Tesla – Supports** • Tesla is supportive of the final position proposed by AEMO. **Transgrid – Opposes** • Prefers the existing AAS as some plant can provide full reactive power capability of the full voltage range without additional equipment. • It is unclear whether the mid-point voltage in S5.2.5.1 is the target voltage mentioned in S5.2.5.13.	

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	• The proposed amendment to S5.2.5.13(2B)(iv)(A) requires limiting devices to achieve S5.2.5.1, which could be interpreted as voltage dependant reactive power limits in the PPC. This could unnecessarily limit the reactive control in the NEM, meaning that the NSP may require more FACTS devices than would otherwise be required. • Considers that the term active power capability does not full consider the impact of reduced numbers of in-service generating units. The proposed draft NER amendments replace the term rated active power in the current Rules with the term active power capability; in Transgrid's view this term does not fully consider the impact of reduced number of "in-service generating units". The definition of the rated active power in the current rules refers to "in-service generating units", which is not referenced in the new definition of active power capability. Therefore, it is unclear what the reactive power requirement for a generating system or an integrated resource system is when there are reduced number of generating units are in-service. This would lead to a lack of clarity as to the expected performance of non-scheduled and semi-scheduled plants when generating units are switched out of service. Transgrid has also included additional feedback on this item under the "Definition changes" section below.	
Treatment of reactive power capability considering temperature derating	**Akaysha Energy - Opposes** Akaysha Energy is not in favour of temperature derated reactive power limits stating it is difficult to implement. Supports GPS modelling capturing temperature derating. Scaling of 0.395 x P(T) artificially reduces reactive capability unnecessarily. **Amp Energy – alternative approach** The revised changes are generally welcomed. Regarding the three main variants for treatment of temperature derating, our view is that all three options have its own merits and hence the rule should be flexible to allow the most appropriate choice to be made at each location. **AusNet – alternative approach** For weaker systems, Voltage sensitivity to Q and sometimes P (i.e., cross coupling effects) are prone to be high. Therefore, extension of Q (i.e., prioritization of derating P) would not enhance the network's voltage stability. Hence, it is not a preferable option. For a distribution network where SCR is typically low, which tends to have the characteristics of weak grid connection, therefore, the reactive power proportional to active power accounting for any temperature derating is more preferred. On the other hand, in grid conditions where voltage sensitivity to Q (i.e., dV/dQ) is less pronounced and grid bus angle is not sensitive to P (i.e., $d\delta/dP$ is low), prioritizing derating of P (i.e., option 3) becomes more favourable. There is not one fits all 'balanced right' approach. AusNet proposes to leave selection of option 1 or 3 up to the relevant NSP's discretion considering network regulation needs and plant limitations. The expectation can be communicated at the connection enquiry stage or as early as practical. **Energy Queensland – Alternative proposed** Ergon Energy and Energex support option 1 to require the same reactive power regardless of temperature derating. **Goldwind Australia**	A broad spectrum of views on the proposed change was expressed in the stakeholder responses. Goldwind, Huawei, Siemens Gamesa, TasNetworks and Transgrid generally supported the proposal to reduce active and reactive power proportionally if a temperature derating applies. Amp Energy generally supported the proposal, but suggested more flexibility to allow for other derating options. Neoen and Powerlink noted that not all plants derate active and reactive power in the same way. Akaysha Energy also opposes including temperature derated reactive power limits in the AAS, as they may be difficult to implement and artificially reduces reactive capability unnecessarily, and would be difficult to implement for some technology. AusNet suggested leaving it to the NSP's discretion as to whether reactive power is prioritised or active and reactive power reduced equally when temperature derating applies. Amp Energy suggests that flexibility should be allowed for the most appropriate choice but does not indicate which party should have the choice of derating mode. Solar Turbines, by contrast, preferred clarity upfront on the requirement (which it would be if in the access standard), rather than different derating options being applied. Powerlink and Energy Queensland preferred the AAS to require reactive power to be maintained regardless of any temperature derating. AEMO notes that if the plant is derated with temperature, meeting an AAS that derates active power in preference to reactive power would not

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	We support the proposed option 3 seems like a reasonable balance. **Huawei Australia - Support** We propose Option 3. Both active power and reactive power should be reduced to keep the power factor unchanged. **Neoen – Opposes** Proposal to consider temperature derating is unnecessarily complicating the standard – temperature impacts on active power capability. Each generating system bids to the market with accordance to their current capability which already takes temperature derating into consideration. It is unnecessary to add this to the Rules and will only prolong the discussions related to this standard. Recording additional irrelevant material under the Rule will mean more testing and modelling needs to be conducted initially and through project life to "prove" the statement extending and complicating the negotiations. **Powerlink – Opposes** • While some inverter-based generating units derate current as a function of temperature, other generating unit types do not. From our experience, some wind turbines reduce active power as a function of temperature, but do not necessarily reduce reactive power as a function of temperature. Additionally, some thermal plants derate active power as a function of temperature, and do not derate or vary reactive power. • The adoption of an automatic standard that reduces the required reactive power as a function of temperature-derated active power could result in that reactive capability that could be provided by some technologies at no additional cost is no longer provided. • Powerlink suggests that the automatic standard for reactive power is retained as being invariant to temperature and considers that the S5.2.5.1 negotiated access standard already supports negotiation around temperature derating. • We recommend that if there is any temperature derating of active power at the connection point, and if there is a requirement to document the reactive power derating in the GPS, then active power should also be documented within the GPS. • We consider generating unit-level temperature derating information is not needed within the GPS and that only the information for temperature derating of the generating system at the connection point is needed. **Siemens Gamesa - Supports** • SGRE support these changes. **Solar Turbines** It is not clear in which format the derating factor shall be represented (or maybe any representation is acceptable) or how the requirements is stated. In the draft recommendation update report dated 26th of July 2023 (see page 14 of the pdf) it is indicated that the there are three main variants possible. At present they seems not to be integrated in the draft document.	necessarily create the best outcome for the power system on a hot day, when system demand is very high. Tesla did not support recording temperature derating in the GPS as it is commercially sensitive. AEMO notes that the GPS is a confidential document shared only between the Generator, AEMO, the NSP and the AER. AEMO considers that if the plant is subject to temperature derating this should be documented in the GPS as it has a significant impact on performance capability that can affect power system security when the cumulative impact is considered. Considering all the submissions, the best outcome for the power system would be no derating of active or reactive power with temperature. Including temperature deratings in the GPS keeps the compliance requirements in line with actual plant capability. Knowledge of active and reactive power deratings at temperature extremes assists AEMO to assess power system security and reliability for those conditions. **Final recommendation** Considering all feedback, AEMO will revise its recommendation to have no derating of active or reactive power at the AAS level (below 50°C), and to require any derating of active and reactive power with temperature to be documented in the GPS as part of a NAS. In the NAS, express that, unless otherwise agreed with the NSP and AEMO, the derating is to be based on a proportional derating of active power and reactive power at equipment level, projected to the connection point.

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	For the sake of clarity any specific variant shall be clearly specified by the relevant party to which the plant shall be connected to. The information shall be made publicly available and it is not expected to change when applying for connection. That would permit manufacturer to properly quote a solution that is in line with what is requested. Later change would lead to unnecessary costs. Regarding the requirements, reactive power capability is normally defined for a reference power (for Gas Turbine for example it can be used Prated at ISO condition); reactive power capability corresponds to such a value and it is valid considering voltage range and operational temperature. It has also to be noted that AVR limiters are typically fixed values or characteristic (static); dynamic characteristic can be found as function of voltage (eg underexcitation limiter) in advanced AVR, not as function of temperature. Operational capability may be affected on how limiters can be set for properly protecting the generators. That is to say that limiters can frequently be considered the operational limits at any given condition. **TasNetworks – Supports** TasNetworks has applied temperature derating consistent with Option 3 in the past, where we have maintained the ability to direct generators to reduce their active power output to a level that meets 0.395*Pmax(T). It remains critical that the maximum temperature at which no derating occurs must be set in such a way as to prevent inadvertent reduction in reactive power capability during high temperature events, when cooling load is largest. **Tesla – Does not Support documentation of reactive power derating in GPS** Tesla is not supportive of the second dot point which would require reactive power derating as a function of temperature to be captured in the GPS. This data is commercially sensitive.	
Compensation of reactive power when units are out of service	**Akaysha Energy – Partial support** Akaysha Energy urges AEMO and NSPs consider on-site measurements of harmonics and filter impacts around operating a filter when the IBR is offline. Any reactive plant to meet S5.2.5.2 compliance should not deteriorate the network for other parties in the vicinity and downstream from the POC. The 0.5% threshold should be confirmed with modelling. **Amp Energy – Partial support with clarification** The 0.5% requirement or any value should be properly assessed. By having 1 single value in the General requirements this may become an unnecessary barrier if it is not necessary for a particular connection point. Should this be a value but can be increased if an agreement can be reached with the NSP and AEMO? **AusNet – Support, with clarification** AusNet agrees with AEMO's revised recommendation to introduce reasonable impact threshold. AusNet supports the initially proposed 0.5% threshold to minimize the impacts on network voltage regulation. Nevertheless, proponents could argue for the adoption of a 3% voltage	In the update report AEMO proposed a 0.5% threshold: the plant while not otherwise in service except for reactive power compensation, for typical system impedance nominated by the NSP, should not cause a voltage deviation (compared with fully disconnecting the plant) of more than 0.5%. AEMO specifically requested feedback on the appropriateness of the 0.5% threshold. The proposed requirement was intended to reflect that for multiple small impacts it may be more efficient for the NSP to install a single central solution to compensate the voltage compared with many generators installing compensation devices or operating plant and causing additional losses. A central solution is likely to be more cost efficient if the NSP must otherwise install reactive compensation to account for the voltage impacts related to line loading. "Not otherwise in service" in this context means the units are not generating or, for bi-directional units, consuming energy other than auxiliaries.

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	variation tolerance for transmission and 5% for distribution to maintain consistency with S5.2.5.12 voltage variation assessment criteria. **Caterpillar – Partial support, with clarification** This requirement can influence the design of AC filters. A project-specific study (at the plant-level) is required to confirm the proposed 0.5% voltage variation. It is therefore proposed to move this requirement under the AAS standard and allow for relaxation in the NAS/MAS (Negotiated/Minimum Access Standard). **CEC – Support with clarifications** It is not clear how the requirement to limit impact on voltage to [0.5]% will be assessed. Can AEMO provide an example? • Subject to clarification of the above, the 0.5 % figure seems extremely low and arbitrary. Any requirements should be determined based on the needs of the power system at a particular location. The draft report isn't clear on what is 'not in service'. Depending on the technology used, there are three operating scenarios that result in different reactive power capabilities at the connection point. Namely, o generating, o not generating (but units electrically connected), and o units disconnected. • Seldom are all units fully disconnected. Hence some operational flexibility should be exercised to avoid having to over capitalise on solutions for the rare event that all units are disconnected. E.g., allow the use of operational solutions such as switching out equipment within (say) 30 minutes if required by the NSP (to manage voltages) to bring reactive power at the connection point to a small MVAR band. • Recommend de-italicising the word 'disconnect' (defined term) such that disconnection does not have to be via the connection point circuit breaker. **Energy Queensland – alternative proposed** Ergon Energy and Energex welcome clarity around compliance with clauses. However, we do not consider that a fixed voltage figure (such as the 0.5% proposed) is universally applicable. We suggest it should be within the Network Service Provider's (NSP's) discretion to determine appropriate voltage figures for specific locations in their network. **Goldwind Australia – Partial support; alternative proposal** We think it is important to distinguish two different potential scenarios that AEMO may be trying to capture as one: • All generating units are in service but for intermittent generators, the energy source (e.g. sun or wind) is unavailable. • All/some generating units are offline/unavailable For case 1, it would be reasonable to have all/some generating units to continue provide voltage control. It is noted that not all generators have the ability to continue providing voltage support in the absence of the energy source, therefore it is important to maintain the flexibility around the number of units that can mitigate any voltage impact to a reasonably agreed value – in this case the proposed 0.5% would be reasonable.	Note that this clause is not applicable to a situation where all units are operational, but the dispatch level or energy source availability is zero. It caters for the situation in which the units are switched off (other than those being used to provide reactive compensation). There was a variety of responses on this issue. Akaysha Energy, Amp Energy, Caterpillar, Energy Queensland, Hydro Tasmania, SA Power Networks, Transgrid and TasNetworks all argued that a one-size threshold is not appropriate, and different thresholds might apply at different connection points. Amp Energy and Caterpillar suggested the threshold could be increased, considering modelling of the impact. AusNet supported 0.5% but considered proponents could argue for the adoption of 3% voltage variation tolerance for the transmission network and 5% for the distribution network to maintain consistency with S5.2.5.12 voltage variation assessment criteria. CEC considers the 0.5% to be extremely low and arbitrary. Siemens Gamesa suggests increasing it to 1% and Tesla suggests it should be 5%. Caterpillar suggested it could be an automatic access standard, but Powerlink suggested it should be a minimum access standard. Powerlink considered 0.5% would be too high in situations where there are pre-existing high voltages in the network that need to be managed. AusNet, Goldwind and TasNetworks considered the 0.5% threshold is reasonable (or reasonable in most cases). TasNetworks considered it might be too onerous in a weak network. Some stakeholders considered the standard should take account of how often the situation is likely to occur. Wind farms and batteries are not often in the situation of turning off units (some wind farms might turn off for too low wind conditions), but for solar farms there is no generation every night. Synchronous machines might or might not have balance of plant in service with or without auxiliary plant operating. The cost of providing reactive support is also variable with technology, so providing an exact one-size optimal solution is not feasible. CEC suggested that where units are seldom fully connected operational flexibility should be exercised to avoid overcapitalising on solutions e.g. switching out equipment within a certain timeframe if required by the NSP to manage voltages. Powerlink considered the requirement should be expressed in MVAr. AEMO notes this would not be a consistent measure of impact as the voltage sensitivity of the power system is different in different parts of the network and the significance of a MVAr threshold would depend on the size of the generating system. On the other hand, converting a

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	For case 2, this is where we recommend AEMO consider the practicalities around the physical plant being switched in and out without the presence of any mitigation from generating units. For example, this could be energising the transformers and/or overhead lines for a project after a maintenance regime. In such situations sometimes it may not be practical to limit the voltage impact to 0.5% (e.g. due to line charging currents of long transmission lines). Such scenarios in our view would be quite rare occurrences, therefore on that basis we propose AEMO consider 3% voltage impact limit similarly to the specification of "Infrequent events" under "ENA Engineering Recommendation P28" standard in the UK. **Hydro Tasmania - Partial support; Alternative proposed** HT is of the opinion that this clause fundamentally relates to auxiliary load specification/management, rather than the performance of generating unit, hence putting the requirement to auxiliary loads would be more logical, e.g. auxiliary loads power factor. In order to identify the impact on voltage e.g. [0.5%], obviously, the typical system X/R ratio (as proposed in the calculation) changes as the network evolving, given that, it is recommended: 1) The requirement is applied to new connection application only. 2) Remain the NSP technical judgment in parallel with the threshold, e.g. 0.5%, given the fact that some area in the system could be more robust to voltage variation, whereas some area could be more sensitive. **Powerlink – Opposes; Alternative proposed** • Powerlink notes that if multiple solar farms were connected in to the one bus or to different buses in the same area, then under the proposed standard, the combined effect of those solar farms at night-time could appreciably increase the voltage by several percent. In some networks, there are pre-existing high voltage challenges to manage, and the proposed standard (of 0.5% voltage increase) would not be appropriate. Solar farms spend more than 50% of the time (i.e. at night-time) with generating units not generating or potentially out of service. • Powerlink suggests that the 0.5% threshold of the proposed General Requirements should instead be considered for a Minimum Standard. We recommend the Automatic Standard be expressed as a requirement for 0 MVAr at the connection point, combined with a nominal reactive power tolerance. • Powerlink recommends that, by default, all clauses of a GPS apply whenever a plant is energised. The performance requirement during the day and at night could differ, and some clauses may not be relevant or could be negotiated for different performance during the day and at night as agreed by NSP and AEMO. For example, for a solar farm at night with a subset of inverters in night-time reactive support mode, S5.2.5.3, S5.2.5.4, S5.2.5.9, S5.2.8, should still apply. • Powerlink recommends those clauses that specifically related to active power are carved out (e.g. S5.2.5.11, S5.2.5.14). Components of S5.2.5.5 should still be applicable when a solar farm is operating at night (e.g. the requirement to stay connected). Some flexibility should be provided under a Negotiated Access Standard for provision of reactive current under S5.2.5.5 when a solar farm is operating at night, while other components of S5.2.5.5 (e.g. active power recovery) are not relevant.	voltage threshold into an equivalent MVAr has the advantage that it would not vary over time with changes to the power system. Powerlink commented on the application of performance standards to a small subset of units that will be online for reactive power compensation, that all performance standards should apply, other than those specifically associated with active power. AEMO agrees that S5.2.5.9 should be unaffected by the number of units in service. The fault contribution under S5.2.8 should be much less, and the tolerated fault level should not be affected by the number of units in service, so these clauses need not be assessed for compliance but should nevertheless comply. Likewise, S5.2.6 should be unaffected by the number of units in service. S5.2.5.12 is also unlikely to be affected, while S5.2.5.15 should only be considered with all units in service. AEMO does not agree that it is essential to apply S5.2.5.3, S5.2.5.4 or S5.2.5.5 requirements to a small number of units that are in service solely for the purpose of reactive compensation, as the impact of tripping should be minimal. AEMO does not consider there is a need to apply S5.2.5.6 or S5.2.5.7 to these units for similar reasons. S5.2.5.8 over-frequency response is not relevant since there will be no active power generated. AEMO agrees that S5.2.5.11 and S5.2.5.14 are not relevant. Hydro Tasmania is of the opinion that the clause relates to auxiliary load specification and management, and suggests that it be treated as a power factor requirement. AEMO notes that the provision is presently written in this form, largely considering synchronous machines. A power factor specification works for generating systems that have substantial auxiliary loads, but not for systems for which the load from the balance of plant is largely inductive or capacitive. For those systems with few auxiliary losses, the current requirement effectively translates to zero impact on voltage, which is unnecessarily onerous. Many of the responses to this proposal depend on the primary type of generation considered by the respondent – solar, wind, battery, hydro or thermal, which present different issues with different impacts on the power system. The NSPs also see different impacts on their networks. AEMO considers voltage impact is a more objective assessment criterion than a power factor or reactive power value for determining whether a limit on reactive power is required for the connection point, although voltage sensitivity can vary over time as well as from location to location. AEMO does agree that the voltage impact could be recorded as a MVAr range for the purpose of the GPS, which would also address Hydro Tasmania's concerns about changes over time.

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	SA Power Networks - alternative proposed We recommend that both active power and reactive power requirement to scale down linearly as a proportion of the number of generating units still in service and leave freedom for each NSP to determine whether the voltage impact on the connection point is acceptable as part of the due diligence assessment. Given that each NSP applies different planning criteria to meet the unique requirements of each connection point with different network characteristics, it may not be advisable to develop an automatically accepted voltage impact limit as this could trigger the NSPs to invest significant amount of capital to resolve voltage constraints which goes against the principles of the NEO. In the scenario where a significant portion of the plant's reactive power requirements are met by a pure reactive plant such as SVCs and STATCOMs, the NSP and the generating system should have the freedom to negotiate on an appropriate active power and reactive power requirement / limitations when the reactive plant is out of service, and document it as part of the agreed performance standards for the generating system. **Siemens Gamesa - Supports with clarification; Alternative proposed** SGRE suggest to increase the voltage deviation from 0.5% to 1% for a typical system impedance nominated by the Network Service Provider, the higher the voltage deviation is, the less will be the costs borne by the consumer. SGRE understand that the typical system impedance is as extracted form system normal snapshot considering the nearby voltage control by adjacent plants. **Solar Turbines** There could be multiple reason for which a generating plant is not in operation, but basically this can be summed in market driven reasons or maintenance/repairing/modifying activities. There are also multiple plant type (pure generation, mixed pure generation, Combined Heat & Power, part of industrial plant) that can drive the requirements and the way this shall be fulfilled. In case of market driven reasons and for pure generating plant, the system is most probably completely off or it will be on minimum loads to keep it operational. It is not considered that any requirement shall be applicable in such condition. In case of reactive power becomes a system need it is recommended to create an appropriate ad-hoc market for reactive power and inertia. In case of maintenance/repairing/modifying activities of pure generating plant, where a single unit is present, then no reactive power requirement has to be considered. When multiple units are present, then the expectation is that the overall reactive power requirement decreases as a function of the units connected. Basically the Pref used for calculating the reactive power contribution is function of the number of units connected, it is not economically viable to install a compensating system to keep on with such activities and there is merit to used the resources available instead of having the complete generating plant off. Different consideration can be made for CHP plant and generating plants embedded in industrial power plant when the generation is considered a by-product and the target could be the Heat (steam) production. When generating plant is disconnected from the grid (both for market reason or for maintenance/repairing/modifying activities, it is likely the plant will still be a generation or load to the grid. It is still recommended that reactive power requirements remain proportional to the operational generation when exporting (or when the generation is in operation). In case all generation is off then the applicable requirement shall be of a load.	The requirement could be specified as an automatic and minimum access standard, to reflect that different connection points can tolerate different amounts of voltage change. **Final recommendation** Considering all these factors AEMO proposes to amend its recommendation to include an AAS based on based on 0% voltage variation and an MAS of up to 1% voltage variation or greater value agreed with the NSP, in each case considering the system impedance value nominated by the NSP, considering the equivalent impedance for the minimum three phase fault level determined declared (under NER 5.20C.1(c)) at the electrically closest system strength node range and the impedance between that point and the connection point. The value is to be converted to an equivalent MVAr for recording in the GPS. For performance compliance purposes AEMO proposes that units in service solely for the purpose of reactive compensation should meet protection requirements, requirements under S5.2.5.10, steady state performance requirements (considering the number of units in service), and the relevant requirements of S5.2.5.13, as if for a secondary operating mode. Additionally, require that for conditions where schedule 5.2 plant is not in service, (other than solely for the purpose of reactive compensation): • 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 are to be specified as steady state values.

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	TasNetworks – Support with clarification While TasNetworks generally supports the change, it is our experience that the fixed limit may not be appropriate in all cases. While limiting the voltage impact to 0.5% is reasonable in most cases, this may not be the case in weaker parts of a network. Allowing the Network Service Providers (NSP) to set the limit to a lower value in limited circumstances should be included in the rule drafting to allow better management of these parts of the network. **Tesla – Opposes; Alternative proposed** Tesla does not support the revised recommendation to limit the impact on voltage to 0.5% when the plant is not in service. This should be removed or increased to 5% as a more reasonable expectation. **Transgrid – does not support – Alternative proposed** • Under the proposed voltage impact threshold of 0.5% plants will be able to operate in a wider reactive power range and this impact the network thus requiring more reactive power compensation devices. The cumulative effect of multiple generating systems in an area could be significant. Transgrid prefers allowing the NSP to specify a voltage threshold appropriate for its network. • If a fixed voltage threshold is used then the maximum system impedance should be based to calculate the steady-state voltage impact. Transgrid suggests that AEMO provide clarification and supporting data to demonstrate how the proposed 0.5% voltage impact threshold was determined. • The term "auxiliary load" is used in the draft NER amendment of S5.2.5.1 (g) is italicised but not defined. If this refers to the auxiliary load component it is unclear how harmonic filters, the collector network and other reactive plant are to be managed when the production units are not in-service. • Transgrid's original proposal highlighted two aspects of zero output: the production units are out of service or in service but not producing. Transgrid still suggests some guidance on operation of Q-on-demand modes to streamline the requirements across the NEM, as it is common in solar and wind projects.	
S5.2.5.7, S5.2.5.8, S5.2.5.13		
Simplifying small connections	**AusNet – supports proposals on S5.2.5.7, S6.2.5.8 S5.2.5.13 for small connections; Opposes change to AEMO advisory matters.** AusNet supports AEMO's revised recommendation on S5.2.5.7, S5.2.5.8 and S5.2.5.13 for smaller connections. AusNet disagrees with the recommendation to exclude AEMO's advisory matters on connections less than 30 MW. This is a significant change from current practice and no justification has been provided as to how this recommendation was reached. Additionally, AEMO's position in this matter contradicts discussions between NSPs and other parts of AEMO which have been considering AEMO becoming further involved in setting	Generally, the changes for small connections other than the proposal around AEMO advisory matters are well supported by stakeholders. ElectraNet, SA Power Networks and Energy Queensland, as well as the ENA, expressed various concerns about the proposal to apply a threshold of 30 MW to AEMO advisory matters. Powerlink also cautioned about the possibility of multiple plants close to 30 MW connecting in the same vicinity. Electranet suggested this change would have significant unintended impact on the application of the NER, noting it is unclear how AEMO

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	performance standards for sub 5 MW connections. AusNet requests AEMO share its analysis assessing the merits of excluding AEMO's advisory matters on connections less than 30 MW, compared to the status quo. This should include responding to valid questions and concerns raised by Energy Queensland and AusNet during their first-round response to the review's draft report, which were left unanswered. **Caterpillar – alternative proposals** • General comments: It is proposed to simplify and make the MAS (Minimum Access Standard) requirements exhaustive for Small Generators. This will help OEMs design and test for the base level requirements. Any non-exhaustive requirements or requirements higher than the MAS are proposed to be given under the NAS or AAS. • S5.2.4 - It is proposed to provide relaxation of simulation model requirements (RMS/EMT) for Small Generators. Block diagram representation of Small Generators, using common standards (IEEE, IEC, etc.), can be provided on request. • S5.2.5.4 - Please see the comments below for "S5.2.5.4" (MAS proposal: 70% to 80% for 0.7 seconds after T(uv)). • S5.2.5.5 - It is proposed that the current MAS which states that the fault ride-through capabilities for synchronous generators are agreed with the system operator, be moved under NAS. MAS of 30% Un (residual voltage) for 150 ms is proposed for Small Generators. • S5.2.5.5 - Multiple fault ride-through (MFRT) requirements: It proposed to relax the MFRT for Small Generators considering the MAS proposed above. • S5.2.5.5 – NAS: "…the reactive current contribution of a schedule 5.2 plant to the extent it comprises synchronous production units or synchronous condensers may be limited to 250% of the maximum continuous current maximum continuous current". Reactive current contribution of synchronous generators is a natural response which depends on the grid- and on-site conditions. Restricting the fault current to a lower value for stringent faults requires extensive plant-level studies and solutions. It is proposed to relax (remove) this requirement for Small Generators. • S5.2.5.13 - It is understood that the voltage and reactive power requirements (settling time, PSS, etc.) are for Large Generators and not for Small Generators. If not the case, it is proposed to: – Provide a settling time requirement of greater than 10 s for Small Generators, – Provide relaxation of PSS (power system stabiliser) requirements for Small Generators, Only require reactive power or power factor modes for Small Generators; current NAS: "…Network Service Provider and AEMO will nominate one or more control modes to be implemented…". **CEC – Supports with qualification** Having less parties to negotiate with is generally welcome, however there could be some benefits in having the ability to consult AEMO (by exception) if a proponent and the NSP cannot agree on a set of negotiated performance standards.	would be satisfied that the connection could meet its performance standards under NER 2.2.1(e)(3) without undertaking the advisory role. AEMO's registration functions are considered separate from its advisory role in approving negotiated access standards for matters that are considered to have a power system security impact. AEMO is required to make an assessment under NER 2.2.1(e)(3) for all registered generating and integrated resource systems, irrespective of size, and for all performance standards irrespective of whether AEMO has been involved in their negotiation. This already extends (and will continue to extend) to standards that are not AEMO advisory matters and automatic standards that may not have been negotiated under NER 5.3.4A at all. AEMO will continue to require each registration applicant to provide satisfactory evidence of capability of the actual plant to meet the performance standards agreed at the connection agreement stage. ElectraNet also suggested that NER 4.14(q) should not be deleted as it enables AEMO to reject a change on the grounds of power system security even if it is not an AEMO advisory matter. However, AEMO notes that if it is not an AEMO advisory matter, it should not affect power system security. ElectraNet also noted that NER 5.3.4A(f) (unchanged in the proposed drafting) sets out the reasons for an NSP to reject a proposed performance standard. AEMO notes that regardless of this clause the performance standard must be proposed at a level that does not adversely affect power system security, under NER 5.3.4A(b)(2). NER 5.3.4(f) sets out conditions where the NSP must reject a performance standard, but does not prevent an NSP from rejecting it on other grounds, including if it considers it not to meet NER 5.3.4A(b)(2 However, considering the size threshold proposed, it is unlikely that generating systems in the range 5 to 30 MW would be prevented from connection on grounds of power system security impact, provided that they meet at least the minimum access standards of each requirement in Schedule 5.2. The price sensitivity of generation or otherwise is not a reason for AEMO or an NSP to object to connection of a plant, on power system security grounds, which meets at least the minimum access standards. The price sensitivity for batteries is dealt with through the dispatch process. The concern raised by ElectraNet could be addressed by permitting an NSP to refer a matter to AEMO if they believe there could be an adverse impact on power system security, and if a reference is made the matter would become an AEMO advisory matter. A provision of this nature is also broadly consistent with the CEC's suggestion of allowing consultation with AEMO by exception. Energy Queensland, SA Power Networks and the ENA opposed changes to AEMO advisory matters threshold on the grounds that

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	ElectraNet – Opposes changes to AEMO advisory matters ElectraNet disagrees with the proposed increase to the AEMO advisory threshold for Negotiated Access Standards to 30 MW and considers that this change will have significant and unintended impacts on the application of the National Electricity Rules. It is also noted that 30 MW connections are clearly material to the operation of Distribution Networks and are material for some areas of Transmission Networks. ElectraNet considers that 30 MW connections are material to system security in South Australia. ElectraNet notes that the National Electricity Law requires that all Generators be registered unless an exemption to registration is granted by AEMO. Based on the published AEMO guide, it is understood that standing exemptions are available for Generators with rating of less than 5 MW; Generators larger than this size are required to apply for exemptions and no exemptions are granted for Battery systems larger than 5 MW. NER 2.2.1(e)(3) requires that, when registering a Generator, AEMO be satisfied that the generating system is capable of meeting or exceeding its performance standards. It is unclear how AEMO would gain comfort that, for a generator (production system) with capacity above the threshold for registration but below the proposed 30 MW AEMO advisory threshold, the agreed performance standards could be achieved without undertaking a review of the plant performance and access standards consistent with what is currently performed under AEMO's advisory function. The proposed drafting deletes NER 4.14(q) with the justification that AEMO is not required to agree to performance standards that are not advisory matters. Contrary to this position, ElectraNet considers that this clause enables AEMO to intervene in situations where it considers power system security would be adversely affected (regardless the clauses identified as AEMO advisory matters). Such action is consistent with AEMO responsibility for power system security under NER 4.3. It is unclear what benefits removing this clause brings. NER 5.3.4A(f) sets out the situations where a Network Service Provider must reject proposed negotiated access standards and are unchanged by the proposed drafting. Importantly, these provisions include rejection for reasons of system security only under the advice of AEMO. It is considered that the threshold proposed by AEMO will likely result in the inability to reject negotiated access standards for proposals below 30 MW for security reasons. This presents a material risk to the secure operation of the power system in the expected outcome that relatively large numbers of such production systems connect to distribution systems in relatively close proximity. **ENA – concerns about changes to AEMO advisory matters** • What is included in the definition of an AEMO advisory matter is being altered in the schedules and the list of clauses that are advisory will be updated later. This lacks clarity of what is an AEMO advisory matter and what needs to be considered by the NSPs as part of 2 the connection process. This has the potential to transfer work to networks regarding the Performance Standards and compliance. • AEMO is proposing that the AEMO advisory matters exclude connections below 30MW or 30MVA in relation to Schedule 5.2 (Connections for generation, integrated resources and	AEMO involvement in the negotiation of performance standards helps to provide consistency for performance standards development. While this may be true, it is not the reason for AEMO advisory matters. AEMO and NSPs could also develop other measures to ensure consistency between them such as revised GPS guidelines to assist common interpretation of technical requirements and assessment methodology that need not be in the rules. Some respondents also noted that AEMO has formed a working group to discuss harmonisation of performance requirements for generating systems and batteries in the range 200 kW to 5 MW. AEMO acknowledges that the proliferation/concentration of smaller IBR does collectively impact power system security, but direct involvement of AEMO in individual connections of that size would not be an efficient way to address this issue. AEMO's reason for recommending a size threshold for its involvement in individual connections is to facilitate effective management of engineering resources focusing on larger connections that are much more likely to affect power system security on an individual basis. This is necessary to manage the energy transition efficiently. Caterpillar proposed some additional relaxations of performance requirements for small plant, above those already consulted on. At this late stage of the review process, AEMO is not in a position to consider recommending these proposals as part of this technical standards review, as they would require further detailed consultation with industry. Caterpillar may wish to raise them as part of a subsequent rule change consultation. Hydro Tasmania requested retaining flexibility for plant less than 7 MW not to be scheduled. AEMO does not intend to change any requirements around dispatch as a part of this review. AEMO held an additional meeting with NSPs to discuss this matter. The meeting indicated possible misunderstanding that applying a threshold to an AEMO advisory matter meant not registering the plant. This is not the intention and registration and classification of plant as scheduled or otherwise would not be affected. The generator will still have to satisfy AEMO that the plant will be able to meet or exceed its performance standards under NER 2.2.1(e) as a condition of registration. NSPs raised concerns about whether AEMO would still be responsible for models under the proposed changes. NSPs also raised concerns about the cumulative effect of multiple connections – for example with respect to frequency response. In the meeting TasNetworks also raised that a 30 MW threshold was too high in Tasmania, and a threshold based on the largest contingency

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	synchronous condensers) and Schedule 5.3 Connection of Loads. ENA has a number of concerns with this approach: – There is no justification on why or how AEMO arrived at this decision. What analysis was undertaken that resulted in the decision to take this approach? » AEMO is primarily responsible for the security of the power system and would be losing visibility in the 5MW-30MW category, yet is also seeking increased visibility and standards in the 30kW - 5MW connections progressed under Chapter 5A. These requirements are inconsistent and appear to conflict with each other. – ENA is also concerned that these matters might be considered differently by different networks in the connection process and may create issues down the track. There are already issues being seen on the power system which are created by small connections, these smaller connections in aggregate have the ability to create larger power system issues at both transmission and distribution level, including across the interconnectors creating issues for other states. – This also doesn't seem consistent with past amendments where AEMO has required batteries above 5MW to be registered because of 10MW swings in load. We will see more price responsive load (virtual currency miners, data centers, H2 production, large bi-directional electric vehicle chargers etc) or generation creating power system issues and increased system services cost and we urge AEMO to reconsider their position. – This also impacts connection alterations where the NSP and the Schedule 2 participant need to advise AEMO of connection alterations for agreements that include AEMO advisory matters, rule 5.3.9 (h). The changes both to the threshold and to the list of matters included as AEMO advisory matters make it unclear whether the notification will relate to existing connection agreement/advisory matters or the matters under the new rule. This is also marked a tier 2 penalty clause. **Energy Queensland – opposes changes to AEMO advisory matters; support changes to S5.2.5.7 and S5.2.5.8** Ergon Energy and Energex are strongly opposed to the blanket exclusion of all connections under 30MW from Australian Energy Market Operator (AEMO) Advisory Matters. As referenced in our April 2023 submission1 to AEMO's Draft Report, along with technical due diligence, a key role for AEMO is to ensure consistency and clarity in relation to the technical requirements for connections across the National Energy Market (NEM), as well as support for ensuring the negotiating framework is applied where relevant. These 'small connections' can still be incredibility complex and difficult, as such, losing AEMO's oversight will be significant. Having DNSPs and connecting applicants to resolve technical requirements, may result in discrepancies in interpretations and potential commercial pressures in the determination of matters related to system security. This will not have an immediate impact, but will gradually occur over several years, meaning that any impacts will be difficult to identify early. This is very similar to the compliance considerations of small-scale embedded generation. Given the forecasted impacts of aggregated storage systems in the NEM over the next few years, it seems short-sighted to exclude these from AEMO oversight. It was stated in AEMO's Update Report Forum held on 9 August 2023 that "most connections of this size apply for exemption".	size should apply there. TasNetworks suggests a threshold at the lower of 5% of maximum contingency size and 30 MW. That translates to a 7.5 MW threshold in Tasmania, and 30 MW elsewhere. Energy Queensland commented that "If the assessment, monitoring and ongoing compliance sits with the DNSP to manage and maintain, then there appears to be no value to the proponent or market for any proponent being registered in the range of 5-30 MW, for any technology, including energy storage". AEMO notes that if the Schedule 5.2 plant is registered (irrespective of size), then AEMO and the AER have a role in compliance - but in no case should the NSP regard itself as not having any monitoring and enforcement role, since the performance standards are part of the connection agreement with the NSP. **Final recommendation** Based on analysis of the feedback, AEMO will retain its update report recommendation to change S5.2.5.7, S5.2.5.8 and S5.2.5.13 and amend the update report recommendation to apply a threshold based on the smaller of 5% of the largest generator contingency size or 30 MW. However, considering the strong level of concern expressed by some NSPs regarding the proposed threshold on AEMO advisory matters, AEMO has decided not to progress this as a rule change proposal immediately, but instead undertake further consultation on efficient involvement for AEMO in smaller connections.

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	We suggest this does not cover battery systems, as these are not eligible for exemption. In our view, having an exemptions framework would have little strain on AEMO's resources. Further, we have seen varied compliance of very small embedded generators, that trying to resolve compliance or technical matters post construction is complex, difficult and often very expensive. We do not see any benefit in omitting connections of less from than 30MWs from AEMO advisory matters, especially based on evidence and AEMOs learnings on a market segment that is only expected to grow in the distribution network. Notwithstanding, should these amendments proceed, Ergon Energy and Energex question why these systems/proponents should need to register with AEMO at all. If the assessment, monitoring and ongoing compliance sits with the DNSP to manage and maintain, then there appears to be no value to the proponent or market for any proponent being registered in the range of 5-30MW, for any technology, including energy storage. Ergon Energy and Energex have no objection to the proposed changes to S5.2.5.7 or S5.2.5.8. **Hydro Tasmania – partial support; alternative proposed** The facilities for the TNSP to co-ordinate with AEMO as to whether a connection should be except from a scheduled connection should also be preserved, and in that some flexibility to the discretion of the TNSP in applying 7MW as a firm limit. **Powerlink – Comment** Careful consideration needs to be made if there are multiple connecting plant with nameplate capacities close to the 30 MW threshold proposed in the same geographical area. **SA Power Networks – Oppose change to AEMO advisory matters** We strongly advise for AEMO to be involved and provide an advisory role if the technical requirements in Schedule 5.2 are applied for a 'Schedule 5.2 plant' under 30MW/MVA the NSP considers to have material impact on the wider network. We strongly oppose AEMO's recommendation to exclude connections less than 30MW for AEMO Advisory Matters. – a. This will have a material impact on the consistency of connection assessments across the NEM and places the onus solely on the NSPs to ensure appropriate minimum performance standards are met by 5-30MW Generators to maintain system security without regulatory oversight from AEMO. Considering the influx of more IBR generators in the network and distribution network connected BESS proposals with grid-forming capabilities, to Stakeholder feedback | SA Power Networks | AEMO review of technical requirements for connection under Schedules 5.2, 5.3 and 5.3a of the NER NER Schedule 5.2 issue Schedule 5.2 (Generators) – feedback on revised recommendations and relevant draft NER amendments ensure consistency across the NEM, we strongly believe that it is most appropriate for AEMO to provide the regulatory oversight to ensure all Registered Generators have appropriate, consistent level of performance standards. – b. Aggregated smaller connections on the network can cause a wider power system impact at both transmission and distribution levels and a working group initiated by AEMO was formed to increase visibility and a uniformed assessment approach for Chapter 5A connections. AEMO's proposed recommendation is inconsistent with that initiative and may	

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	hinder their function in maintaining wider power system security. Concerning S5.2.5.7 and S5.2.5.13, we advise that a re-evaluation of this threshold is necessary, particularly considering the impending decommissioning of a significant portion of synchronous generators and increase uptake in Inverter Based Resources (IBR). As a result, the size of the largest credible contingency event in SA is diminishing. Moreover, the collective impact of numerous generators below 30MW, lacking thorough investigation into their voltage and reactive power control, could pose system stability issues. – c. Majority of Generators under 30MW (above 5MW) in SA are registered Market Participants (therefore subject to the technical requirements in Schedule 5.2) and have not applied for exemptions from registration due to financial incentives in participating in AEMO markets. We have received an increase of applications for BESS with a nameplate rating of 5MW which must be registered as Generators. Assuming AEMO's function in managing GPS non-compliances for Registered Generators remain unchanged due to this recommendation, it may be more resource intensive to deal with potentially increase of non-compliances from generators due to influx of <30 MW generating systems (e.g. BESS with grid-forming capabilities). **Siemens Gamesa - Supports** SGRE support these changes. **TasNetworks – Supports** TasNetworks is supportive of setting the threshold to the minimum of 30MW or 5% of any maximum credible contingency event size specified in the frequency operating standards for the relevant region. **Tesla – no concerns raised** Tesla has no additional comments on this revised recommendation. **Transgrid – partially supports** • Does not consider there is an issue with current NER S5.2.5.7, even for small connections. • Does not have any concerns with the proposed amendments for small connections for NER S5.2.5.8. • Does not have any concerns with the proposed amendments for small connections for NER S5.2.5.13. • AEMO advisory matter input helps provide a level of consistency across jurisdictions and adds value to the connection process and need not necessitate significant due diligence by AEMO.	
NER S5.2.5.2 – Quality of electricity generated		
Reference to plant standard	**AusNet** AusNet supports AEMO's revised recommendation. **Energy Queensland** Ergon Energy and Energex have no objection to the removal of the reference to AS1359.101.	There has been general support for the proposal to remove reference to AS1359.101. Hydro Tasmania indicated another plant standard should be substituted, but did not propose an alternative. AEMO notes that the NER already allows a registered participant or other interested person to propose a plant standard to the Reliability Panel under NER 5.3.3(b2).

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	Hydro Tasmania – Supports; alternative proposed The proposed change, while maintaining reference to a plant standard, is acceptable. **TasNetworks – Supports** TasNetworks supports this proposed change. **Tesla - Supports** Tesla remains supportive of this change. **Transgrid - Supports** Supports the draft recommendation to remove reference to the superseded standard.	**Final recommendation** Considering all feedback, AEMO will retain its update report recommendation.
NER S5.2.5.4 – Generating system response to voltage disturbances		
Overvoltage requirements for medium voltage and lower connections	**AusNet - Supports** AusNet supports AEMO's revised recommendation. **Caterpillar -alternative proposal (on a different aspect of the clause)** Currently both the AAS and MAS require "continuous uninterrupted operation where a power system disturbance causes the voltage to vary within 70% to 80% of normal voltage nominal voltage at the connection point for a period of at least 2 seconds after T(uv)." It is proposed to relax the MAS requirement as "continuous uninterrupted operation where a power system disturbance causes the voltage to vary within 70% to 80% of normal voltage nominal voltage at the connection point for a period of less than or equal to 0.7 seconds after T(uv). " **ElectraNet – Opposes the use of point of application for distribution-connected plant** The proposed drafting for S5.2.5.4 includes a definition for point of application. In the case of connection points at or below 66 kV, the proposed definition defines the location of voltage disturbances at the nearest electrical location with a nominal voltage above 66 kV. For some DNSP connection points this location will be on the transmission system and may be significantly remote from the actual PoC. This can have the effect of introducing significant impedance between the generating system and the location of the defined voltage disturbance and therefore reduce the effective ride through obligation of these connections. It is suggested that while such consideration may be appropriate for the Negotiated Access Standard, the Automatic Access Standard should be maintained with the disturbance assessed at the PoC. **Energy Queensland – Opposes use of point of application for distribution-connected plant** Ergon Energy and Energex consider that there are few cases where this would be appropriate, and the reason for changing the automatic access standard is unclear, instead of allowing this nomination under the Negotiated Access Standard. Removal to the nearest bus over 66kV may represent two or three transformations, and significant network – masking the potential impact where the voltage excursion occurs in the distribution network. Given that this clause relates to power system resilience, it appears to be making a change to accommodate a minority of cases where this would be appropriate, rather than the whole system. We instead recommend that	There was a range of views on this proposed change. It was supported by AusNet, Siemens Gamesa, TasNetworks, Tesla and Transgrid. Powerlink considered that it might be more practically dealt with by modifying the negotiated access standard or negotiating process for S5.2.5.4. ElectraNet, Energy Queensland and SA Power Networks opposed the change. As noted by ElectraNet, AEMO agrees the change could have the effect of introducing impedance between the location of the overvoltage and the connection point. The current rule effectively makes the requirements at the voltage ride through requirements at unit level much more onerous for distribution-connected plant, particularly those without tap-changing transformers, than for transmission-connected plant. The purpose of the changes made to this standard in 2018 was to increase power system resilience to high transmission level overvoltages, with the intent of improving the performance of transmission connected generation. ElectraNet and Energy Queensland suggested that an alternative way to deal with the issue would be to allow negotiation on the assessment point. Powerlink also suggested the issue might be better dealt with by modifying the negotiation of this standard. AEMO agrees with the suggestion, instead of applying the point of application to the AAS and MAS, of modifying the negotiation provisions to allow agreement by the NSP and AEMO to a point of application for overvoltage application at a location with nominal voltage higher than the connection point, where the plant is connected at nominal voltage less than 66 kV with no automatic tap-changing transformer between its production units and the connection point. AEMO considers this would address the technical issues while providing more flexibility than the original proposal in appropriate locations.

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	AEMO consider, with the NSP's and AEMO's approval, the ability to negotiate on the assessment point. **Powerlink – Partial support; alternative proposed** • Powerlink considers it more practical to deal with plant connecting to a voltage level below 66 kV by modifying the negotiated access standard or negotiating process for S5.2.5.4. • Powerlink supports the removal of the limit on negotiation based on the size of the plant. • Minor drafting note: The Rules mark-ups refer to the electrically closest location exceeding 66 kV. The revised recommendation in the Update Report refers to the nearest high-voltage transmission location, even though some DNSPs have lines operate at 132 kV. Powerlink assumes the Rules mark-up is the intended change, even though it does not exactly align with the description in AEMO's Update Report. **SA Power Network - Opposes** • The revised approach would imply that the point of application of overvoltage for S5.2.5.4 would be at the nearest 132kV or 275kV transmission connection point which could be very electrically distant, potentially up to 100 kms away from the connection point for a Chapter 5 connected Generator connected to a DNSP's distribution system. Has AEMO completed any studies or publish evidence to confirm overvoltage conditions are non-credible in the sub-transmission and distribution networks and HVRT capabilities from DNSP connected generation are not required for overvoltage conditions in the sub-transmission and distribution networks? This would also imply that S5.2.5.4 for distribution connected generation would need to be assessed on a SMIB model up to the nearest 132kV/275kV connection points through sub-transmission mesh networks, adding unnecessary complexities to the SMIB modelling. In our experience, S5.2.5.4 compliance has not been an issue for distribution or sub-transmission connected Chapter 5 Generators and therefore we suggest re-considering the proposal. **Siemens Gamesa – Supports** SGRE support these changes. **Solar Turbines – No objection; clarification** Additional note to stated requirements: (2), (3) are unlikely to be field testable for generating units for generating units that shall be field tested. Therefore that would be based on manufacturer declaration from manufacturer. It is recommended to have this clearly stated. **TasNetworks - Supports** TasNetworks supports this proposed change. **Tesla – Supports** Tesla remains supportive of this change. **Transgrid Supports**	SA Power Networks raised a concern that this requirement could mean that the overvoltage requirements could be applied a long distance from the connection point. However, AEMO considers that if the connection point was a long way from the transmission, a transformer with tapchanging would be needed to keep the voltages within an appropriate operating range, but agrees that this might be between the connection point and 66 kV level, not the 132 kV. The proposed amendment below should address this scenario. SA PowerNetworks also raised that requiring them to consider overvoltages at transmission level would be more complex for them, as they typically do not model the power system to the transmission network. The proposed amendment below should limit the need for this additional modelling to only circumstances where it provides value as a negotiation position. **Final recommendation** Considering stakeholder feedback, AEMO proposes to modify the update report recommendation to: • allow agreement by the NSP and AEMO to a point of application for overvoltage application at a location with nominal voltage higher than the connection point, where the plant is connected at nominal voltage less than 66 kV with no automatic tap-changing transformer between its production units and the connection point.

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	Supports making the point of application of over voltages at the nearest HV transmission location for connections below 66kV. This is consistent with approach proposed for the NSW REZ access standards.	
Requirements for overvoltages above 130%	**AusNet Support with clarification** In AEMO's revised recommendation, it is aimed to clarify the power frequency root mean square voltages outlined in S5.2.5.4(a)(2) to (8) and (b)(1) to (5). However, this crucial clarification has not been addressed in the draft NER amendments. **Caterpillar – clarification sought** The current set of requirements are understood as the peak voltages seen from network surges and is given for the purpose of insulation coordination. It is requested to clarify if there are specific unit level requirements. **CEC – Opposes Alternative proposed** Reference to peak voltage of 184 % is likely to cause confusion with RMS voltage. It is unclear as to why reference to peak voltage and non-power frequency voltage is required. • Subject to agreement by the OEM, blocking may be considered an appropriate response which is less disruptive than a protection trip. • It is unclear why non-power frequency voltages have been introduced into this clause. Reference to insulation coordination in this clause is not appropriate and is a design matter. • We are concerned that referring to IEC 60071-1 and insulation coordination will require proponents to undertaken insulation coordination studies in order to demonstrate compliance with this clause. • The root cause of the issues of this clause is that the upper limit is unbounded. Hence the correct approach to updating this clause should be to specify an upper limit for high power frequency voltages. These are typically what result in equipment tripping (based on a protection setting). **CPSA – Opposes, Alternative proposed** The problematic aspect of this clause in relation to over voltages has been the unbounded >130 % requirement. Introduction of reference to peak voltage and non- -power frequency voltages and IEC 60071-1 will only complicate things. The focus should be on providing an upper limit to over voltages. **ElectraNet – Partial support, but concern about Rules drafting** The proposed inclusion of new clause S5.1.4(a1) relates to transient voltages and is not considered to be consistent with the existing intent of NER S5.1.4 that relates to power frequency voltages. It is considered that this proposed clause is not appropriate in its current location in the draft Rules. Additionally, while the proposed Rule is understood to be intended to require the design of the network to manage transient voltages resulting from switching of network elements, the current drafting is not sufficiently clear. The specified standard is focused on determining the maximum withstand voltages of plant and the selection of standard insulation levels, yet it is	The specific proposed change was not consulted on in the draft report, but the report sought feedback on how this issue should be addressed. The proposed drafting and the discussion in the update report represents the outcome of AEMO's consideration of that feedback and further analysis of this issue. There was a range of stakeholder feedback on this issue. Several respondents questioned the reference to peak voltages and non-power frequency waveforms. The main reason for these references is that phenomena causing voltages exceeding 130% are likely caused by switching surges or lightning. AusNet, Energy Queensland and Hydro Tasmania requested clarification of which voltages are RMS. AEMO expects that the voltages above 130% are not power frequency voltages, but are more correctly characterised as slow front overvoltages or fast front overvoltages as described in IEC 60071-1. This standard, which applies for equipment designed for operating voltages above 1 kV (not low voltage up to 1kV as suggested by Solar Turbines) describes: • Slow front overvoltages: transient overvoltages usually unidirectional with time to peak 20 µs <Tp ≤ 5000 µs and tail duration less than T2 ≤ 20 ms. • Fast front overvoltages: transient over voltage, usually unidirectional, with time to peak 0.1 µs < T1 ≤ 20 µs and tail duration T2 <300 µs. The standard describes standard shapes for these voltages profiles for testing. For slow front overvoltages which are representative of switching surges, Tp – 250 µs and T2 – 2500 µs. For fast front overvoltages, which are representative of lightning impulses, T1 = 1.2 µs and T2 = 50 µs. The value specified in the access standard was intended to provide the value of the peak voltage (not RMS) for use in specify in ride through. Neoen suggested that the existing limit is derived from the system standard of S5.1a.4, which relates to a power frequency voltage across a 20 ms cycle. AEMO notes that the current wording of "over 130% of normal voltage for a period of at least 0.02 seconds after T(ov)" provides an unbounded requirement whereas the proposed drafting

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	understood that the intent of this clause is to ensure the effective management of peak over-voltages due to plant switching. The current drafting does not achieve this intent. **ENA – switching surges (NER S5.1.4 and NER 5.7.2) – needs further consultation** Appendix A2, S5.1.4 (a1) includes new obligations on NSPs regarding network design to ensure switching of network elements does not cause connected plant to experience slow front transient overvoltage above a certain level. Clauses S5.1.4 and S5.1a.4 are applicable to power frequency voltages and hence it is not appropriate to include transient overvoltage requirements under S5.1.4. It is also worth noting that the proposed requirement to manage switching surges that cause overvoltages outside of the system standard at the connected plant, relies on the switching surge and the resulting transient overvoltage at the connected plant being directly related, which is not the case. The transient overvoltage at the connected plant is highly dependent on the design of the connected plant, and in particular, surge arrester specification and placement at the connected plant. It is also worth noting that this issue is already handled by the existing rules and relevant international standards to which both network elements and connected plant must be designed to. **Energy Queensland – clarification** The amended rule wording should provide clarification as to whether these voltages are root mean squared voltages. Ergon Energy and Energex note that under IEC60071.1, switching impulses are not considered for voltages under 275kV, only lightning impulse withstand and short-duration power-frequency withstand voltages. We would appreciate AEMO's views on whether our assessment aligns with AEMO's intended changes. **Hydro Tasmania – Support, with clarification** The clarifications in terms of clearly identifying which voltages are RMS and which relate to switching surges are acceptable. The explicit capping of the TOV in the 20 ms period is a sound extension of the rule. The related changes to clauses outside of NER S5.2 are also acceptable. The issue of >V/Hz should also be considered here. **Neoen – Partial support with clarifications** This standard needs to introduce a RMS voltage limit for remaining connected to the network. The way the existing standard and recent proposal from AEMO are worded implies there is no RMS voltage limit for remaining connected to the network (voltage "greater than 130%"). Further changes proposed to this standard should avoid specifying values "above" or "greater than" without introducing the limit – it leads to ambiguity and implies there is no limit of voltage for which the plant must be connected. Note that the existing limit is derived from the system standard of S5.1a.4 which relates to power frequency voltage - I.e. voltage across a 20 ms cycle. Introducing limits for voltage of less than 20ms duration relates to transients or impulse voltages. It is essential to ensure that any changes with respect to this requirement are consistent with the agreements made between a Generator and an NSP under S5.2.3(a) and according to the design of S5.2.3(b). These include matters regarding insulation coordination and voltage impulse levels. The requirement for CUO during impulse events needs to be justified and defined. What is being sought with respect to this	specifies "at least" would be satisfied provided the plant can remain in CUO for a small amount above 184% peak for at least 20ms. Transgrid was concerned about relating a peak voltage of 130% rms power frequency to 184% used for a peak voltage for a different type of waveform. The conversion was simply to ensure that the value was higher than the peak of the voltage specified in S5.2.5.4(a)(2). CEC and CPSA suggested instead imposing an upper bound on the voltage. Tesla would prefer to remove the requirement above 130% altogether (as would Siemens Gamesa), but Tesla would also support an upper bound of 140%. AEMO notes that it initially proposed an upper bound of 140% in the 2018 rule change, but this was not accepted based on stakeholder opposition. Neoen questioned whether the plant should be required to remain in CUO for these types of voltages. Neoen suggested recording the peak voltage for which the generator will disconnect to protect its plant. AEMO notes that feedback from OEM discussions suggests that there may be multiple different levels at which disconnection could occur (above 184% peak), so this may not be practical. Transgrid suggested the use of IEC 60071-1 to define ride through requirements for generators. However, IEC 60071-1 is related to the voltage withstand of insulation and does not translate naturally to this application. Insulation is required to withstand conditions that generators should not be expected to ride though. Powerlink did not comment on the proposed inclusion of the reference to switching surges in S5.2.5.4, but suggested that any insulation coordination obligations be placed on all technically relevant parties. AEMO notes that there are existing obligations on the generator within S5.2.3(a) and S5.2.3(b) to agree on relevant technical matters including insulation coordination and protection, and that the insulation levels of the plant are coordinated with the insulation levels of the network to which the generator is connected, and that the plant is capable of withstanding without damage the voltage impulse levels specified in the connection agreement. The proposed drafting places an obligation on NSPs not to cause switching surges that would adversely affect other network users. It would be possible to include a corresponding obligation for generators. TasNetworks was concerned it would be costly to ensure that its equipment would be able to meet an obligation not to cause connected plant to experience slow front over-voltages of the type contemplated in IEC 60071-1. AEMO agrees that only repeated over-voltages of this type should be targeted with any requirement, considering that lightning strikes (fast-

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	provision. Certainly, remaining connected for the duration of a transient event is essential, however, it needs to be recognised that plant must protect itself from externally induced events and continuing to operate under such conditions must be managed within the reasonable capability of plant. The correct coordination of insulation including operation of surge arrestor devices during such transient events will impact what might be considered "CUO". Need to ensure that in this context merely not disconnecting is sufficient. The peak voltage of 184% must be well defined within the Rules and the OEMs should be well consulted on selection of this level – high voltages will damage IBR's equipment and different technologies will require a different level of protection. Defining unreasonably high voltage withstand level is not beneficial to operation of the network as damaged generation will not be able to return to service after fault clearance. Suggestion to record the peak voltage for which the generator will disconnect to protect its equipment instead of imposing an arbitrary level. "Blocking" should also be defined within the Rules – many inverters must disconnect within milliseconds (e.g. 3 ms) to protect equipment from physical and irreversible damage and the use of external devices diverting or "blocking" the voltage or current in any way will not provide sufficient level of protection. General comments: • Proposal refers to matters that are related to primary plant design (e.g. protection and insulation coordination) and are already agreed between the connecting plant and the NSP and recorded in the Connection Agreement. Addition of these in the standard will again further complicate and prolong GPS negotiations without a tangible benefit to network operator/owner. • When NER refers to an AS or IEC document it places an obligation on a potential participant to purchase that standard – these are not open documents accessible to everyone the same way as the NER. With numerous references, it can become expensive to maintain a library. **Powerlink** – Alternative proposed • The proposed change puts an explicit obligation on the NSP to design its network and insulation coordination in a particular manner. In the electrical vicinity of a given connection point, there can be NSP equipment (for which an insulation coordination obligation would be made) as well as equipment that is part of other generating systems. Therefore, we recommend that any insulation coordination obligations are placed on all technically relevant parties. This would include an obligation on each generating system to ensure their equipment has been designed so that switching of their elements does not expose other parties to switching surge voltages. • Powerlink recommends there should be a requirement for no protection elements with trip timer settings <= 20 ms **Siemens Gamesa – Alternative proposed** SGRE suggest to remove the requirement for a voltage at the connection point above 1.30pu as Network users are incentivised to ensure their plant is capable of withstanding the required switching and lightning surges to maintain the integrity of their equipment. **Solar Turbines – Partial support with clarification**	front overvoltages) are highly random. This would limit the scope of work (if any) needed to comply with the clause. Transgrid and ENA raised concerns about the location of the requirement within S5.1.4, as this relates to power frequency, not voltages that are other than power frequency. AEMO acknowledges this concern. Regarding Energy Queensland's comment on switching surges, the standard provides some indicative values for test levels for voltages up to 245 kV for lightning impulses and short-duration power frequency overvoltages. However, AEMO does not find anything to indicate that switching surges are not to be considered at those voltages. Transgrid preferred the rule to have the form at least 130%, which would be consistent with the voltage representation rest of the clause, and is consistent with their suggestion to use the IEC term "temporary overvoltage". AEMO acknowledges that switching between types of voltage representation does seem to be causing confusion, even though the standard defines the types of voltage described in the clause. AEMO also agrees with TasNetworks that for the 184% formulation, the rule would need to specify whether the value is phase to ground or phase to phase. AEMO notes that the rest of the clause does not specify whether the values refer to phase to phase or phase to neutral or phase to ground voltages either. Powerlink suggested including a requirement that protection settings not be timed to trip earlier than 20 ms. Transgrid supported the requirement for temporary overvoltage at least 130% for at least 20 ms. AEMO raised Powerlink's suggestion with OEMs and developers to gauge their response. Some OEMs raised concerns, for example, how a protection based on energy would be treated for such a clause. Other stakeholders considered there would always be a need for some instantaneous protection to protect a plant from damage. In light of this feedback AEMO proposes to incorporate the requirement only in the AAS for NER S5.2.5.8. Transgrid said that AEMO has not provided evidence as to why slow front overvoltages are more of a concern at these levels of voltages. The reason that switching surges are more of a concern than fast front overvoltages (lightning flashes) is that there is usually more energy associated with them typically, because of the longer duration, as described above. Of course, this is not absolute as there is a distribution of durations and magnitudes for switching surges and lightning strikes. Also, because switching surges can be repeatable, as they are affected by the design of the power system, there is higher probability that they

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	In reference to "AAS peak voltage of at least 184% of nominal voltage… and a fast overvoltage (lightning impulse) at the connection point": • This should correspond to a lightning event and associated protection and capabilities shall be addressed as part of the design of an electrical installation, correspondent AS or IEC std shall be used to define protection against overvoltages in such installation. The reference std provide much more detailed information associated to component capabilities than the indicated std • This has not to be addressed in a Grid Connection requirement except for introducing a reference to such std and the fact such protection shall be installed in the plant (other than the mentioned IEC 60071-1) • (Note that IEC 60071-1 refers to low voltage system up to 1 kV; point of connection is 66kV or above) **TasNetworks – Partial Support** TasNetworks agrees with the principle of points 1, 4 and 5. We would like to confirm that the first point should read "Require CUO for peak voltages less than 184 %" so as to be consistent with the fourth dot point. The draft rule should clarify whether the waveform measurement is phase-to-ground or phase-to-phase. NSPs should use good electrical industry practice when designing the insulation coordination of the network. This does not mean that every switching surge events will not lead to a peak voltage increase above 184%. Indeed, there is no way to guarantee this exceedance will never occur. Furthermore, with appropriately sized surge arrestors, spark gaps, etc, the risk to equipment can be acceptably reduced. TasNetworks does not believe NSPs will be able to meet this obligation under S5.1.4(a1), without significant investment. **Tesla – Opposes** Tesla has some serious concerns with this recommendation. It is unclear to us how the 184% requirement was calculated based on IEC 60071.1) We are also unclear as to the implementation risks of including this requirement. Will this result in additional testing and compliance certifications? We are unclear what is meant by permitting the plant to "block" for transient overvoltages. Does this effectively require plant to ride through these peak voltage requirements. Noting these concerns above, we do not support the revised change and remain supportive of our initial position provided in our previous submission to AEMO and extracted below: "Tesla would suggest an alternative that could be considered is to delete S5.2.5.4(a)(1) which would effectively create an upper bound of 130%. Alternatively we would be supportive of Option 4 which would see the introduction of an upper-voltage limit of 140%" **Transgrid – further consultation is required** • There are two very different types of over-voltages to be considered: – Temporary overvoltage for power frequency overvoltage – Transient overvoltage as defined in IEC 60071-1 • Temporary overvoltage:	will cause damage to equipment, as surge arresters have limits on operations. Tesla raised a query on the meaning of blocking. The intent was to allow some relaxation of the CUO requirement for very short durations for the plant to protect itself from damage. Following further OEM discussions AEMO understands that there may be a variety of measures that IBR plant takes to protect itself from extreme voltages which are more complex than simply suspending the supply or absorption of active power and reactive power, and that the transition back from the protected state to full operation might also need to be considered. Considering the potential to misinterpret this proposed change, and that it is not simple to describe the range of acceptable behaviour, AEMO has decided not to progress it further. **Final recommendation** Considering the above feedback, AEMO recommends modifications to the Update Report recommendation to: • apply an obligation on NSPs not to cause switching surges for connected plant, and amend the requirement to be for "repeated" slow front overvoltages. • rely on the requirements of S5.2.3 for insulation coordination and impulse withstand, but add a requirement (in that clause) on the Schedule 5.2 Participant not to cause repeated slow front overvoltages that would affect the NSP's equipment (complementary to the previous dot point) • require the plant remain in CUO for voltages at least 130% for at least 20 ms in S5.2.5.4 AAS. • specify that the voltages in S5.2.5.4 refer to rms power frequency quantities. • omit the previously proposed NER S5.2.5.4(e4). • In S5.2.5.8 AAS, add a requirement for no voltage-related protection settings less than 20 ms.

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	– S5.2.5.4 should only be for temporary power frequency overvoltages only. – Supports the inclusion of "at least" in defining the upper limit for temporary overvoltage limit up to 130% rms for one cycle. This aligns with the system standards in NER S5.1a.4. • Transient overvoltage: – This should be limited to gathering information from OEMs, including protection and inverter behaviour. This would be in addition to the temporary power frequency overvoltage over one cycle. – Additional consultation is required as AEMO did not make recommendations in its Draft Report. – There is insufficient basis for parts of the draft recommendation, including: ▪ Using a transient overvoltage limit of 130% of the temporary overvoltage limit multiplied by $\sqrt{2}$ is not related to the transient overvoltage, and is inconsistent with IEC 60071-1. ▪ The assertion that switching surges are of most concern is not substantiated. ▪ The use of IEC 60071-1 to define ride through requirements for generators. IEC 60071-1 is related to the voltage withstand of insulation and does not translate naturally to this application. Insulation is required to withstand conditions that generators should not be expected to ride though. ▪ PSCAD modelling of transient overvoltages - for accurate results that include the whole of the generation system, including surge arrestors and transformers, the setup of PSCAD models will need consideration of Balance of Plant details more commonly applicable to insulation coordination type studies. This exceeds current modelling requirements. ▪ Simulations to demonstrate compliance will involve applying representative transient overvoltage waveforms at the point of application (e.g. the connection point) and modelling surge transference down to the production unit level. While transformer models have been proposed in the literature for this type of assessment, they are complex and rely on input information pertaining to the physical construction of the transformer (e.g. detailed knowledge of the core and winding geometry). This information is not readily available, and modelling of this nature is not practical for generator connections. ▪ As per draft NER amendment proposed in Appendix A2, S5.1.4 (a1) includes new obligations on NSPs regarding network design to ensure switching of network elements does not cause connected plant to experience slow front (transient) overvoltage above a certain level. Issues with this requirement include: ▪ It has been included under "S5.1.4 Magnitude of power frequency voltage". The title of S5.1.4 clearly states that the clause is applicable to power frequency voltage. It is not appropriate to include transient overvoltage requirements under S5.1.4. ▪ The wording of S5.1.4 (a1) sets the requirement for "voltages above those described in clause S5.1a.4 of the system standards". S5.1a.4 of the system standards is valid	

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	only for power frequency voltages and does not define voltage limits for transient overvoltage. ▪ The requirement relies on the switching surge (a traveling wave) and the resulting transient overvoltage at the connected plant being directly related. This is not the case, the transient overvoltage at the connected plant is highly dependent on the design of the connected plant, most notably surge arrester specification and placement at the connected plant. – Transgrid designs network elements in accordance with the relevant international standards (including the IEC 60071 series of standards for insulation coordination). Connected plant must also be designed to IEC 60071 to meet the requirements of S5.2.3. In Transgrid's opinion, this issue is adequately handled by the existing rules and relevant international standards. Nothing further needs to be included in the NER regarding transient overvoltage.	
Clarification of continuous uninterrupted operation (CUO) in the range 90% to 110% of normal voltage	**Akaysha Energy – supports** **AusNet Supports with clarification** AusNet notes 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 is acceptable when assessing CUO performance. However, the response time of OLTC in transmission and distribution can differ significantly. In distribution networks, the response time of OLTC can be as high as 1 to 2 minutes, which may not be genuinely classified as a temporary response. To ensure a more precise definition of temporary response, AusNet suggests specifying the acceptable response time limits (e.g.,7.5s) rather than accepting performance to be corrected by OLTC. **Bo Yin - Opposes** The CUO requirement assumes the dynamic reactive power which is obtained without reliance on OLTC action. This is inconsistent with S5.2.5.1. **Caterpillar – Support with clarification** A linear reduction in the corners of the U-Q/Pmax (voltage-reactive power) profile is allowed as mentioned in NER S5.2.5.1. It is therefore proposed to consider NER S5.2.5.1 conditions as part of this CUO range. **CEC – no concerns raised** No comments on what is proposed in principle. **Energy Queensland - no concerns raised** Ergon Energy and Energex make no comment **Goldwind Australia** We are supportive of the proposed changes. We consider these changes to be important to enable efficient connection of newer technologies such as grid forming. **Powerlink – Supports with clarification**	The proposal to address this issue was generally well received. Powerlink suggests that there could be some level of reduction in reactive and active power permitted as part of the negotiation. AEMO notes that the proposed wording allows for some reduction in active power including "other factors that the Network Service Provider and AEMO consider reasonable in the circumstances". TasNetworks suggested that S5.2.5.4(e3) should read for voltage reductions greater than 10% within the range of 90 -110% of nominal voltage, temporary active power reduction and temporary reduction in reactive power capability corrected by tap-changing transformer action are permitted. AEMO has described the requirement as variation rather than reduction to account for scenarios in which the voltage rises, for example, from 0.99 to 1.1 pu. In its response on S5.2.5.1, Transgrid commented that the rule should not encourage Schedule 5.2 participants to enable limits that restrict the reactive capability of the plant. AEMO agrees with this sentiment, and will consider whether any minor changes to S5.2.5.4(e1)(2) drafting and S5.2.5.13 (2B)(iv) are required to make this clear. AusNet suggested that OLTC response in the distribution network may be as long as 1 to 2 minutes, and proposes that response should be corrected within 7.5 s rather than by OLTC action. AEMO understands that distribution networks are typically obliged to keep voltages within 5% and variations in excess of 10% should be rare. Voltages in distribution networks are more likely to be operated close to nominal voltage, so a voltage drop of more than 10% is more likely to go below 90%, in which case the requirement does not apply. In addition, mostly small plant is likely to be impacted, and the effect may be offset by some reduction in load affected by the same voltage disturbance. Considering all these factors, AEMO considers the previously proposed rule is sufficient for the purpose.

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	• We support the limitation of the assessment of maintaining active or reactive power to a maximum voltage change of 10%. • While not considered in AEMO's Update Report, Powerlink suggests that some level of reduction of active and reactive power at the connection point can be accepted as part of CUO and form part of a negotiated access standard, if agreed to by the NSP and AEMO. **Siemens Gamesa – Supports** • SGRE support these changes. **Solar Turbines – Support with clarification** Looking at Draft Recommendation, there is mention to reactive power capability within the normal voltage range (and outside it). It seems this is covered in S5.2.5.1. • Makes sense to have reference to S5.2.5.1 when it comes to voltage deviation. **TasNetworks – Supports, with clarification** • TasNetworks supports this proposed change. We believe the statement in the second dot point should read "voltage reductions greater than 10%…" rather than "voltage variations greater than 10% …" **Tesla – Supports** • Tesla is supportive of the revised AEMO recommendation. **Transgrid - Supports** • Transgrid supports the revised recommendation on the CUO that require plant to maintain reactive power capability, and active power output (with the exception of active power reduction due to transient response, losses, energy source availability and any other reasonable factors) for voltage variations of ±10% in the range of 90% to 110% nominal voltage. • Transgrid is in favour of removal of the ramp time requirement and the associated assessment methodology requirement in the Rules. • While Transgrid support the revised recommendation for voltage variations greater than 10% within the range 90% to 110% of nominal voltage, that allows the tap-changer response to occur, the term 'temporary' should be better qualified.	**Final recommendation** Considering the assessment above AEMO will retain its update report recommendation, and will review its proposed drafting for S5.2.5.4(e1)(2) and S5.2.5.13 (2B)(iv) to confirm it does not promote unnecessary limits on reactive power capability.
Combined frequency and voltage disturbances	**Hydro Tasmania – Alternative proposal** Hydro Tasmania acknowledges that AEMO recognises HT concerns of simultaneous >V and <f and that whilst a possibility would be rare, however there is no proposal to address this. AEMO notes "This means that technically a plant must be able to remain in CUO for combinations of abnormal voltage and frequency within the levels and durations of S5.2.5.3 and S5.2.5.4 if they occur simultaneously. "	Hydro Tasmania raised a concern about the requirement for CUO for combinations of voltage and frequency deviation for synchronous machines for which over-fluxing is an issue. AEMO notes that S5.2.5.3 MAS has a carve out in the MAS for V/f limitations. In addition it may be possible to specify a specific limitation under S5.2.5.5 MAS to cover off this issue, at least so far as the combination relates to multiple simultaneous contingencies. Another possible avenue open to a Schedule 5.2 Participant is that the they can propose to the AEMC under NER 5.3.3(b2) a plant standard

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	However, HT proposes that upon inspection of protection settings, few, or no synchronous generators in the NEM would be able to comply with this requirement, nor would be willing to comply with this requirement based on resulting plant damage. In terms of streamlining the connection process, the specific limitations for multiple contingency events causing high V/f ratios should be clear performance standards of a generator can be clearly documented. The typical fluxing capability as per AS/IEC 60034 or IEEE C57 could be referred for new generators.	that covers the capability and could be accepted as an alternative to part of an existing technical requirement. **Final recommendation** No changes are proposed.
NER S5.2.5.5 – Generating system response to disturbances following contingency events		
Definition of end of a disturbance for multiple fault ride through	**AusNet – partial support** AusNet believes that end of a disturbance for MFRT should be the first instance where voltage at point of connection reaches a level between 90% and 110% of the normal point of connection voltage. This approach differs from AEMO's draft recommendation, where end of a disturbance means voltage return within the range 90 to 110% of normal voltage at the connection point for at least 20ms. Implementing this proposed change would eliminate any ambiguity related to performance expectations, particularly in scenarios involving multiple voltage fluctuations within and outside the specified range. **Caterpillar – alternative proposed (not related to this issue)** It is proposed to relax the fault ride through (FRT) requirement, from 430 ms to 150 ms, for synchronous generators to consider the multiple fault ride through (MFRT) scenarios. There is a high risk of pole-slipping for synchronous generators as the fault clearing time increases. The proposed 150 ms is the fault clearance time for medium- and high voltage grids as given in most European grid code documents (Ref: EU 2016/631 alias NC-RfG and EN 50549). **CEC – No concerns raised** No comments on what is proposed apart from the fact that these studies have become mostly an academic exercise with no real-world context considered. **Energy Queensland – No concerns raised** Ergon Energy and Energex make no comment **Powerlink – Support** Powerlink supports this proposed change. **Siemens Gamesa – Supports** SGRE support these changes. **Solar Turbines – Alternative proposed** 20ms when voltage is within +/-10%Un seems too short, but also not consistent in defining the system in stable condition for active power recovery (most probably the voltage is still oscillating leading to associated power measurement oscillation). That would allow to consider the end of the disturbance when the voltage happens to just recover to 90% Un.	Most respondents supported the proposed change to add a definition of the end of a disturbance. AusNet preferred the simpler formulation of the clause, without the reference to 20 ms. Tesla suggested adding "and frequency recovers to the PFR deadband for at least 20 ms" to this definition. AEMO notes that the effect of frequency deviation is allowed for in the proposed changes for the CUO definition, and MFRT as presented in this clause is mostly about multiple faults. Caterpillar requested relaxing the fault ride through clearance time for MFRT to be 150ms instead of 430 ms, to allow for the risk of pole slipping. AEMO notes that in the proposed rule it has allowed Schedule 5.2. Participants to declare specific limitations which could include conditions that could lead to pole slipping. Solar Turbines commented that 20 ms seems too short, and recommends that the end of the disturbance be considered when the plant stops oscillating. However, AEMO considers that definition would tend to incentivise poor tuning, because the more oscillatory the response, the further apart the faults could be, which does not seem an appropriate outcome. Transgrid considered that overlapping or simultaneous faults should still be considered under this clause. AEMO considered this possibility as part of the draft report, but has not identified anything that would result in a different position. **Final recommendation** Considering all feedback, AEMO will retain its update report recommendation.

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	It is recommended that the end of the disturbance is normally considered when the voltage is considered back to stable condition (eg not oscillating and within +/-5%Un from nominal). This definition is needed to apply for any associated requirements. **TasNetworks – Supports** TasNetworks supports this proposed change. **Tesla – Partial Support with clarification** Tesla would suggest an additional change to the definition to refer to both voltage and frequency recovery. This would change the definition to "…following fault clearance, the voltage recovers to and remains within the range of 90 to 110% of normal voltage at the connection point for at least 20ms, and frequency recovers to the PFR deadband for at least 20ms" **Transgrid – General support** • In general, Transgrid supports AEMO's intent in providing clarity on "end of a disturbance". • In regard to AEMO's assertion that multiple faults occurring at the same time or with 0 ms delay being a technically possible but highly unlikely event, Transgrid notes that a series of 15 disturbances occurring within a five-minute period (as currently assessed under the AAS) is a low probability event in itself. Nevertheless, given the material impact of such an event to system security, it has been recognised that it is important to understand and record the plant capability to ride-through a multiple disturbance event. Therefore, in the same vein for the AAS requirement, at least two consecutive faults–where the second fault commences immediately after the clearance of the previous fault (i.e., minimum clearance between the two faults is zero milliseconds)–within the 15-disturbance sequence should be included. • Transgrid also notes that, the post fault voltage recovery behaviour in some instances may be heavily impacted by the generator response. For example, post-fault voltage dips spikes or oscillatory behaviour may be caused or exacerbated due to poorly tuned controllers causing the voltage to move beyond the specified 90%-110% range (i.e., prolonging the disturbance or causing subsequent disturbances), even though the original disturbance has been cleared. Transgrid's understanding is that if a disturbance is prolonged or exacerbated due to poorly tuned plant response, that will be considered as a non-compliance to the CUO requirement.	
Form of multiple fault ride through clause	**AusNet – Supports with clarification** AusNet supports AEMO's revised recommendation concerning NSPs developing extra connection-specific non-credible contingencies events that align with historical faults. Nonetheless, AusNet extends an invitation to AEMO to provide clarity regarding the specific criteria that qualify as "reasonable grounds" for an NSP to identify an inadequately disclosed limitation. Furthermore, AusNet holds the perspective that defining a baseline common suite of tests encompassing the MFRT requirements under the AAS and MAS would significantly enhance the value of AEMO's initiative. The evidence can be provided in the form of type testing or a hardware in the loop (HIL) report. **CEC – Partial support, partial opposition** • The presumption that an NSP requesting additional studies when there are reasonable grounds to believe there is inadequately disclosed information is unlikely to yield the desired	There are two parts to this change: • An allowance for specific limitations to be declared and carved out as part of a negotiated access standard, supported by evidence, and • Consideration of what studies should be done to support the proposed performance standard. The former was well supported in the draft report consultation. In the update report consultation it was also supported, though most respondents did not comment on it at that stage. Consideration of what studies should be done to support the proposed standard is more difficult, as the nature of the MFRT requirement is such that one cannot prove compliance.

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	outcome. For example, if a protection system which limits MFRT capability is not modelled, undertaking additional studies will yield the same results as previous studies. Hence the outcome would be an endless loop of studies being undertaken. • The focus should instead be on having a carveout to MFRT requirements by documenting specific technology limitations in the performance standards to avoid an endless loop of studies. • • In assessing this clause the NSP and /or AEMO should provide guidance on the nature of multiple fault expected based on previous events and /or considering the actual power system. **CPSA** – Partial support • We are concerned that these studies have almost become an academic exercise to run as many simulations & combinations as possible. • Where studies are required, the focus should be to consider actual power system operating conditions / limitations when assessing this clause. • The focus should be on having carveouts to CUO based on equipment limitations within the GPS and have the OEM declare these limitations (eg auxiliary supply limitations, dump resistor thermal limitations etc **ElectraNet –** Clarification sought • Further clarity is required from AEMO on the following proposed revisions: • 5.2.5.5(d)(1) requires that the NSP advise the "minimum three phase fault level at the connection" for tuning of the plant. This fault level is then applied as a threshold below which further disturbance ride through is not required. Noting that S5.2.5.13 refers to "apparent system impedance" and that the definition of this impedance is different from a fault level, it is considered important that the requirements in these two clauses be aligned. • S5.2.5.5(r2) requires that the NSP specify all combinations of multiple contingency events to be assessed by the proponent for the purposes of a Negotiated Access Standard. Clause (r3) then restricts the NSP from requiring the assessing any other events. Further clarity on this is required, specifically whether there is any restriction on the NSP undertaking their own assessments that may vary the sequence or combination of events in review of the proposed Negotiated Access Standard. **ENA** – Opposes limiting NSP capability to add studies for MFRT to "reasonable grounds" A fundamental principle of the current access standards and rules made by the AEMC is that proponents need to meet the automatic access standard or prove why a minimum or negotiated access standard is more reasonable. Given the power system is transitioning to lower emissions, there will be far more connections generating larger swings between minimum and maximum operational demand and delivery and commissioning of new network infrastructure. NSPs should have flexibility to request for additional studies for multiple fault ride through if deemed necessary, as per the negotiation framework, without requiring 'reasonable grounds'. 3 As such ENA does not support the inclusion of S5.2.5.5 r3) and suggest it is removed. The	Some stakeholders supported the proposed drafting, others opposed part or all of it. AEMO considers it is impractical to do exhaustive studies for this performance requirement, as there are too many possible combinations to consider, and compliance cannot be proven by studies. One option previously considered was to provide a test suite. The main advantage of this approach is simplicity and limited work. However, stakeholders pointed out that the lack of location-specific contingencies made this less useful. Some NSPs requested that they either be permitted to add or substitute studies relevant to the connection. Some stakeholders still prefer the test suite option, but AEMO considers that a smaller set of more targeted studies could provide better outcomes to identify the performance of the plant and its limitations in the surrounding network. AEMO agrees with CPSA, Powerlink and other stakeholders that the key value of this clause is to identify plant limitations. These may be revealed by studies, but only if the limitation is one that is modelled. Otherwise they will need to be identified by other means (such as information from the OEM). In the draft report AEMO proposed to give participants the option to seek guidance from the NSP on what contingencies they should consider. The rationale here is that the NSP has detailed understanding of their network, and the combinations contingency events that might cause a limitation to be revealed in the modelling. These do not need to be 15 faults, but could be, for example, a combination of contingency events known to lead to a large phase angle jump. There is no requirement for the advised studies to be complete or comprehensive, as that would also be impractical. On the other hand, AEMO proposed that the NSP could propose studies if there was something specific that they thought might show up as a limitation in a study or a limitation was not adequately described. While AEMO agrees with CEC that not all limitations will be revealed in studies, there are some limitations that can be observed that way. If the limitation is not in the model there is clearly no value in requesting a study. AEMO does not agree that the outcome would be an endless loop of studies being undertaken, as suggested by CEC. CEC suggested that past history should form the basis for identifying likely faults in the future. There is no correlation between historical and future faults. At best historical faults might be considered examples of what could happen. The proposal that if requested, an NSP could suggest faults that might be onerous, is in line with the considering the actual power system, as CEC proposes.

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	clause, including the provisions for "reasonable grounds" is likely to be problematic and create subsequent issues. **Energy Queensland –** No concerns raised • Ergon Energy and Energex make no comment. **Huawei Australia** – Alternative proposal We recommend that AEMO publish a test specification for MFRT so that OEMs can provide lab test reports and apply them to different projects. **Neoen – Opposes** Allowing the NSP to require additional MFRT studies – the introduction of MFRT requirement was to ensure that the generating plants have clear obligation in terms of remaining connected should multiple, consecutive faults occur. Increasing number of MFRT studies provides no clear benefits to the network owner. Comment from AEMO in the recent presentation that the NSP will only have a right to require additional studies if they suspect the proponent did not disclose all information about performance of their facility – if the information has not been made available it will also not be included in the models. Additional studies will not increase clarity. Regardless the standard should not introduce ambiguity – if the requirements are expanded for MFRT it should be clearly stated under what conditions NSPs can request additional studies. **Powerlink – Opposes** • We do not support this change. Powerlink understands the MFRT requirements were added to the technical standards to identify if there were any plant-level limitations (e.g. protection settings, auxiliaries, breaking register/chopper) that would force a plant to trip under MFRT when a power system could sustain those MFRT in the absence of the plant under consideration for connection. • Powerlink recommends that for multiple faults, AEMO, the NSP and connection applicant should check that the model can ride through multiple faults (which can be assessed in DMAT studies), with plant compliance assessed via OEM statements on capabilities (e.g. of auxiliary system ride through capability). Auxiliary systems may be the most limiting element of a generating system for compliance purposes, but may not be modelled. • Powerlink does not support S5.2.5.5 (r2-3), as this is not aligned with the intent of the multiple ride through capabilities of a plant. **Siemens Gamesa – Support with clarification** • SGRE Support these changes, with the understanding that the NSP will have the power to request additional studies (i.e. power system studies) to assess any potential limitation. However, that defining any hardware or prototype test specification in order to demonstrate a platforms capability will remain the responsibility of the OEM. • SGRE believe that the best approach would be for AEMO to release an assessment guideline showing a list of possible onerous multiple faults based on historical faults in NEM not specifically in a state, for example, incidents like in SA in 2016 or in QLD in 2021 could be good candidates for studying multiple fault ride through capability of a technology. The current	In response to clarification requested by ElectraNet regarding NSPs undertaking their own assessments, there is no limitation in the rules preventing that. In response to ENA's comments, it would not be in any NSP's interests to make requests that reduce the efficiency of the connection process or unnecessarily divert the NSP's own resources for no good reason. AEMO notes that there is nothing to preclude an NSP from undertaking their own studies should they consider it necessary. Powerlink also did not support (r2) and (r3), saying they are not aligned with the intent of the MFRT capabilities of a plant. AEMO notes that the intent of these clauses in combination is to focus on studies targeted to those conditions likely to be arduous for the plant, so as to reveal or better define specific limitations – where they are capable of being revealed in studies. Transgrid questioned what constitutes "reasonable grounds" and argued that they should have additional flexibility to request studies during the connection phase. As Transgrid notes, limitations are often not represented in models, so it would not be 'reasonable grounds' to request additional studies related to something that is not represented in the model. However, if the NSP knows, for example, of a firmware limitation that is likely to be exposed through the model (because the control is represented in the model) then there would be reasonable grounds to ask for studies to examine that point. AEMO suggest that the appropriate action in that case would be to discuss the possible limitation with the Schedule 5.2 Participant, so that they can design studies to identify if there is a limitation and it can either be resolved, worked around or documented appropriately. In summary, AEMO notes the lack of support for (r2) and (r3) from parties who are concerned these will lead to excessive studies or parties who consider it will limit their ability to require studies, **Final recommendation** Considering stakeholder feedback, AEMO recommends modifying the update report recommendation to remove (r2) and (r3) provisions. AEMO will retain other aspects of the update report recommendation, including relating to the declaration of specific limitations.

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	issue that most OEMs are suffering because it is difficult to test the technology's performance/robustness for the totality of scenarios that fall under the AAS. **Solar Turbines – Alternative Proposed (on a different issue)** • See above comments to the disturbances requirements described in S5.2.5.5(c). • 3-phase automatic reclosure shall be as part of the credible contingency event scenario, however they shall not separate (and reconnect) the generating plant to the grid • (4) the requirements in S5.2.5.4(a)(7) and a(8) foresees both voltage ranges (eg a(7) voltage between 80%Un and 90%Un and 10sec and a(8) voltage between 70%Un and 80%Un and 2sec) it is not clear if only one event shall be tested (ed 78%, 2sec) or two events need to be triggered. It seems the requirement is for a single event • It is possible to get a recommendation of the event to be tested, but as indicated above, it is recommended a credible contingency event scenario (single line diagram with grid representation) to be provided with the correspondent event and grid characteristic information. It is recommended involvement of manufacturers in defining such requirements. • It is recommended also to define a credible list of events pre defined sequence, however system information shall be as well properly defined. It is recommended involvement of manufacturers in defining such requirements. • S5.5.2.5 (l) (9) There is reference to a fault level for which the generating plant has been tuned. – It is recommended to better specify what "tuned" means (primary control mode vs secondary control mode? Protection settings?).. – Note also that normally fault level is considered the Scc or Icc (eg fault level specified for MV distribution), however it is not clear if this is the intention here. Whereas fault level is expected with a different meaning, it is recommended to replace "a three-phase fault level at the connection point" with "a 3-phase fault causing the voltage to drop at the connection point… **TasNetworks – Supports** TasNetworks supports this proposed change. The first dot point provides TasNetworks with the flexibility required to adequately assess multiple fault ride through in Tasmania. **Tesla – Opposes** As noted in our previous response, Tesla is not supportive of site-specific tests as we believe this will add cost and lengthy delays to projects. AEMO's revised recommendations will likely result in the NSP asking for multiple studies to be undertaken which would yield the same results. As an alternative we would suggest an allowance for NSPs to stage faults during commissioning in reference to site specific concerns. Otherwise, we believe that all MFRT requirements can be verified through modelling. **Transgrid – Supports** • Transgrid is in favour of AEMO's recommendation on disclosure of MFRT limitations, supported by evidence (preferably supported by laboratory tests or HIL tests).	

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	• Transgrid supports AEMO's intent in allowing NSPs to nominate alternative/additional combinations for MFRT if deemed necessary due to connecting location. However, Transgrid believes that AEMO should consider defining a common suite of tests that would exercise the models for MFRT requirement as proposed in Option 5 of the Draft Recommendation. While this suite of tests must not be considered as an exhaustive list, it will provide the OEMs and the developers a set of testing conditions that the plant should be designed to ride-through. This can be supplemented with additional combination of MFRT test scenarios if deemed necessary by the connecting NSP, due to the connecting location. • In circumstances where NSP and/or AEMO reasonably believe there is an inadequately disclosed limitation–that may be uncovered by specific multiple contingency conditions–both AEMO and NSP should have the flexibility to request for these additional studies to be considered. However, Transgrid notes that it is not clear on what is required to be provided as 'reasonable grounds' for the additional studies. If there are in fact inadequately disclosed limitations, those limitations will be only known by the relevant OEM. If the limitations are incorporated to the modelling (in most instances this is not the case), they may be uncovered by specific multiple contingency events. NSP's should have flexibility to request for additional combinations for MFRT at the Connection Application stage if deemed necessary.	
Number of faults and time between them	**AusNet – supports** AusNet supports AEMO's revised recommendation. **CEC – no concerns raised** No comments on what is proposed subject to review of rule drafting. **Energy Queensland – no concerns raised** Ergon Energy and Energex make no comment **Hydro Tasmania – support with clarification** AEMO notes Hydro Tasmania's previous comments on multiple fault impacts on synchronous machines and that "this is an example of a type of issue that the amendment is intended to address". HT is however still unclear on how this may be addressed given proposed MAS will require up to 6 disturbances. I.e There should be better guidelines and carve-outs in the MAS to allow for physical constraints governing the ability for synchronous machine multiple faults ride through where the effort is not in trying to demonstrate academic compliance, but moreover maximising plant capability within its physical limitations without concern of not realising an academic MAS (which may not even present a credible fault ride-thought [sic] scenario). **Siemens Gamesa – Supports** SGRE support these changes. **Solar Turbines – Alternative proposed** S5.2.5.5(c) calls for faults that belong to credible contingency events. Is this a realistic credible scenario?	Most respondents supported the proposed changes, which allowed for 6 faults within 5 minutes, with the potential for specific limitations which might impact of timing between faults. Solar Turbines suggested that 6 faults each within 200 ms does not seem applicable for a system based on reliable design. However, AEMO notes that the power system in Australia does have records of occurrences with multiple faults in the same area within a short time of each other, particularly associated with bush fire activity. Hydro Tasmania asks for better guidelines and carve outs for physical constraints. Considering the carve out for specific limitations, AEMO notes there is significant flexibility built into the proposed MAS despite the underlying requirement to ride through at least six faults. **Final recommendation** Considering all feedback, AEMO will retain its update report recommendation.

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	6 consecutive faults each withing 200ms do not seem applicable for a system based on reliable design. In addition no further detail regarding such events is provided. In general all events (faults) as they are described in S5.2.5.5(d) are expected to happen in a very short time in the proximity of the generating unit, which seems unusual. A different and more realistic approach is recommended. See comments above on event proposal and grid scenario proposal. **Tesla – Supports** Tesla remains supportive of AEMO's recommendation. **TasNetworks Supports** TasNetworks supports this proposed change. **Transgrid – Supports** Transgrid supports AEMO's revised recommendation to retain the MAS requirement, while allowing specific limitations to be carved out provided that the number of disturbances remains at six.	
Reduction of fault level below minimum level for which the plant has been tuned	**AusNet – partial support** AusNet supports AEMO's revised recommendation on recording the range of fault levels for tuning be advised by the NSP and recorded, in the RUG. However, to carve out the CUO for MFRT in AAS and MAS may not be consistent with the objective on streamlining the connection process. Given the rapid change occurring in the power system, to maintain the CUO for MFRT beyond N-1 and extending it to at least N-1-1, thereby accommodating crucial planned [outages], remains a paramount consideration due to the magnitude of concurrent projects being executed on the network. **CEC – Support, with clarification requested** No comments on what is proposed. It is unclear what the changes to S5.2.2 are in relation to making retuning requests 'more transparent'. Could AEMO advise? **Energy Queensland –** No concerns raised Ergon Energy and Energex make no comment **Hydro Tasmania – Partial support, clarification** • HT agrees that during and after multiple faults, the network condition could change significantly, including fault levels. However, since 6 faults within 200ms assessment is rather academic, it is unclear how this specification is going to be implemented to prove generating system compliance in reality. • HT is aware this clause was introduced in 2018 with supporting evidence based on simulation results and historical data, however, very limited information can be found since then. HT would encourage AEMO to put some effort in a guideline, including technical objectives, performance expectations, compliance evaluation practicality based on genuine system events (e.g. Callide event), to facilitate the technical understanding of this clause.	The proposed change considered that tuning of plant controls is affected by the fault level under which the plant is designed to operate. AEMO's proposal is to: • Assess the MFRT requirements considering the range of fault level for which the plant has been tuned, and • Document the relevant fault levels so that these can be compared against the actual fault levels on the power system to identify when the tuning might need to be re-examined for different fault level range. Some respondents requested clarity on what AEMO means by making the fault level more transparent. The proposed drafting includes a requirement for the range of fault levels for tuning purposes to be recorded in the releasable user guide (RUG). As the RUG is always available to NSPs and Schedule 5.2 Participants the tuning range can be referred back to after connection to flag the potential requirement for retuning due to changes in the power system. Having the fault levels recorded in the RUG avoids any need to change the GPS where settings need to be updated, but GPS performance requirements are not impacted. Settings changes can be undertaken through a request under S5.2.2. Note that a Schedule 5.2 Participant must comply with its performance standards regardless of the fault level, so it is the Participant's responsibility to update its settings through this process if needed to meet its GPS. Nevertheless, if there is a change to the power system that necessitates settings changes across multiple plants, it might be more efficient for the NSP to coordinate the changes.

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	Neoen – No change required This should be covered by S5.2.5.5(d)(7) and S5.2.5.5(l)(6) "provided that none of the events would result in: … the islanding of the generating system or cause a material reduction in power transfer capability by removing network elements from service". **Powerlink – Partial support; Alternative proposed** • For S5.2.5.5 (d) (10), Powerlink considers the plant should be expected to remain connected and stable (not necessarily providing full compliance) for fault levels that are below the minimum expected fault level for a single contingency (i.e. minimum fault level used for tuning purposes), down to the technical capability of the equipment (withstand SCR at the settings that are used for compliance tuning). • Powerlink supports the changes in S5.2.5.5 to make the conditions that might require retuning more transparent. **Siemens Gamesa – Supports** SGRE support these changes. **Solar Turbines – Opposes** This requirement is not clear not the draft wording or in the Draft Recommendation Update Report Specifically, it is not clear what is the lower range for which the plant had been tuned (primary control mode vs secondary control mode? Protection settings?). It is recommended to remove the requirement or better define the expectation or at least better define what is the expected tuning. **TasNetworks – Partial Support; alternative proposed** Generators should be required to nominate a minimum guaranteed floor for stable operation (down to a short circuit ratio of 3) and a level where they would be permitted to disconnect. **Tesla – Support** Tesla is supportive of the carveout provisions and the resulting inference that a retuning would not trigger a full 5.3.9. We would suggest that more detail is needed by the final comment that "the changes in S5.2.5.5 make the conditions that might require retuning more transparent **Transgrid – Supports with clarification** Transgrid suggests recording the lowest fault level (lower than the lower bound of the fault level range for which the plant has been tuned to achieve GPS compliance) the plant can operate stably and remain connected (even if GPS compliance across others performance standards are not achievable at this fault level).	This change was supported by AusNet and Powerlink explicitly and other respondents did not object to it. Transgrid suggested recording the lowest fault level at which the plant can remain connected and stable (even if GPS compliance across other performance standards are not achievable at this fault level). Neoen suggested that a lower fault level should be covered by reference to reduced power transfer or islanding. While those conditions are associated with reduced fault level, the underlying fault level prior to disconnection of any line element may also change over time, and a contingency event can also include trip of a generator, which may not of itself affect the power transfer capability but will reduce fault level. Powerlink considered the plant should be expected to remain connected and stable (not necessarily providing full compliance) for fault levels below the minimum expected fault level for a single contingency event, down to the technical capability of the equipment (withstand SCR at the settings used for compliance testing). TasNetworks suggested the plant should nominate the level down to which it is stable and can stay connected and Transgrid made a similar comment. AusNet suggested that the plant should maintain CUO for MFRT beyond N-1 extending it to at least N-1-1. AEMO notes that the fault level is very much influenced by the generation pattern, as well as the number of network outages. Considering Powerlink's comment, AEMO notes that the compliance testing for SCR under S5.2.5.15 does not require the plant to use the same settings as for normal operation. Considering TasNetworks' comment, there might be some value in knowing the fault level down to which a plant is stable. However, determining this for combinations of multiple contingencies might be an arduous task requiring many studies, as the minimum fault level could be different for different combinations of contingencies. This raises the issue of how NSPs determine and specify the range of fault levels for which plant is expected to remain in CUO, and for which they are tuned. The rules do not make this requirement explicit, at present. There is benefit to transparency and consistency of approach across all NSPs in setting the range. AEMO discussed the methodology applied by NSPs in a meeting with them, and use of the minimum fault level at the nearest fault level node in conjunction with a single network outage was identified as a way to apply a consistent approach. Hydro Tasmania said it is unclear how the specification of 6 faults with 200 ms between them could be implemented for compliance assessment. AEMO notes that 200 ms is the minimum time between faults. In practice, auto-reclosure is common within 5-10s of the fault clearance, so 6 faults within five minutes (e.g. associated with a severe

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		storm or bushfire), where fault level remains within the specified range for tuning, is not infeasible. Ongoing compliance against ride through clauses is assessed based on a review of actual power system incidents, in this case multiple contingency events. **Final recommendation** Considering all feedback, AEMO proposes to define the minimum fault level as the higher of the value equivalent to the SCR recorded for S5.2.5.15, and the level that would be achieved at the connection point considering the minimum three phase fault level at the nearest system strength node, in conjunction with a network outage that most reduces the fault level at the connection point. This value should also be consistent with the level for tuning of the controls, for which CUO is required. AEMO proposes to retain the requirement to document the range of fault levels for tuning in the RUG as previously proposed, to facilitate review of tuning ranges in the future, with a view to the possible need for settings changes over the life of the plant.
Active power recovery after a fault	**Akaysha Energy – Supports** The submission supports the consistent conditions for active power recovery post fault with a synchronous machine where GFM technology emulates synchronous and inertial responses. The submission also suggests that AEMO incorporate GFM voluntary specification details into the NER clause update, and references PFR. **AusNet – Supports, with clarification** AusNet supports AEMO's revised recommendation on amending the MAS to include reference to clause 4.4.2(c1) for primary frequency response (PFR) where S5.2.5.11 has been referenced regarding a frequency disturbance and include frequency response in the AAS. However, AusNet suggests allowing active power recovery should start at the first instance when voltage reaches a level to between 90% and 110% of point of connection normal voltage, instead of that voltage return stably into that range. **CEC – No concerns raised** No comments on what is proposed. **Energy Queensland –** No concerns raised Ergon Energy and Energex make no comment **Powerlink Support, with clarification** Powerlink supports this change in principle, noting the following caveats: There is difference between an actual frequency change compared to a measured frequency change. Measurement of frequency at the inception of a fault, during a fault, or at or immediately after fault clearance, can be extremely challenging. In general, controlled actions based on those measurements should not occur.	Most respondents supported the proposed change. Transgrid proposed a minor amendment changing "return" to "reaches". AEMO supports this amendment, and will include it in the drafting. Powerlink noted there is a difference between an actual frequency change and a measured frequency change. Measurement of frequency at the inception or during a fault can be challenging, and in general control actions based on those measurements should not occur. AEMO notes that it is difficult to distinguish between a response to angle change and frequency and there is a level of greyness as to whether response of virtual synchronous machines are controlled actions or not. It is difficult to be definitive about interpretation of results in the rules, so AEMO prefers to leave this as flexible as possible. As is often the case, AEMO recognises there is a balance to be achieved between specificity and flexibility. Akaysha Energy suggested that AEMO incorporate GFM voluntary specification details into the NER. AEMO would like to clarify that consideration of including the Voluntary Technical Specification requirements into the NER would be a subsequent piece of work, beyond this review. **Final recommendation** AEMO will retain its update report recommendation, with a minor modification to change "return" to "reaches".

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	Siemens Gamesa – Supports SGRE support these changes. **Solar Turbin–s - Opposes** See comments above. Active power recovery shall be expected after transient condition which do not corresponds necessarily to voltage within +/-10%Un and +20ms and +100ms. That's particularly true for system with inertia. **TasNetworks – Supports** TasNetworks supports this proposed change. **Tesla – Supports with clarifications** As noted above, we suggest that the MFRT end of disturbance definition refers to frequency as well as voltage. This definitional change should also flow through to active power recovery. **Transgrid – Supports with clarification** • Transgrid support amend the MAS to include reference to clause 4.4.2(c1) for primary frequency response where S5.2.5.11 has been referenced in regard to a frequency disturbance response in the AAS. • The ambiguity of the te'm 'return' is not addressed nor removed by the new "end of disturbance" definition. The definition of "end of disturbance" affects the start time of the active power recovery measurement (as mentioned above) but does not provide any clarity on the end time of the active power recovery measurement, hence the potential misinterpretation of 'return' remains. In Transgrid's experience, proponents have misinterpreted the end of active power recovery measurement to be when active power 'settles to 95%, not when it first reaches 95% of pre-disturbance value. Hence Transgrid suggested including definition of "recovery" to be the "first instance at which the active power reaches 95% of the pre-fault level" for instead of the ambiguous term "return". This is especially important to remove ambiguity of the performance requirements if the active power has overshoot/undershoot/oscillations while the voltage is stabilising in the 90% - 110% range.	
Rise time, settling time and commencement time for reactive current injection	**Akaysha Energy – Partial support** strongly supports recommendations based on recent reactive current MAS change. Positive/Negative sequence ratios are difficult to obtain. The submission recommends further consultation with OEMs on what to capture for unbalanced faults. **AusNet – Partial support** AusNet supports the draft recommendation on omitting the settling time requirement in AAS, which is further supported by changing the tuning objective to "adequately controlled" instead of "adequately damped". However, AusNet still has concerns that without some general criteria being defined in the AAS around damping, there may be protracted negotiations or the potential for degraded performance being deemed acceptable. **CEC - Comment**	More stakeholders supported this proposal than opposed it, but there was less support from NSPs and more support from generators and developers. There are several aspects to the change proposed: • Omission of settling time, consistent with the recent changes to the MAS • Inclusion of "step-like response" for rise time • Addition of a "commencement time" requirement • Addition of a definition of "adequately controlled" at the request of stakeholders from the draft report consultation. Powerlink objected to the changes, with specific reference to "step-like", on the basis that they can be dealt with by negotiation. AEMO is

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	No comments on what is proposed. We note that the term 'adequately controlled' is more qualitative in nature. As a general principle, the control transients should be assessed on what is required and/or desirable to maintain system security and reliability of supply. **Energy Queensland –** No concerns raised Ergon Energy and Energex make no comment **Neoen – Clarification on commencement time application and definition of adequately controlled** The benefit of shortening the response commencement time to 10 ms and how will this be assessed is unclear. The current injection is measured in response to % voltage reduction – the NER specification of voltage refers to power frequency voltage, which must be measured across a 20 ms cycle. How will the voltage reduction be measured under this clause to allow a response within half the cycle? For similar reasons it is also questionable whether existing technologies can meet this requirement. Currently network wide studies can only be run in PSS/e which is not suitable to analyse transient phenomena that occurs in very short timeframes – the 10 ms requirement will not be possible to verify prolonging and complicating discussions under this clause without a clear benefit to the network. The proposed definition for "adequately controlled" is required. **Powerlink – Opposes "step like"** Powerlink notes that this section of the Rules was recently updated by the AEMC. We consider the proposed changes are not required and these issues can instead be managed through the negotiated access standard. Being more prescriptive about the current injection response (e.g. "step like" function) risk bringing more complexity into the assessment of compliance on site and in simulations (e.g. no fault results in a step-like response). **Siemens Gamesa – Supports** SGRE support these changes **Solar Turbines – Comment (regarding synchronous machines)** • During fault and for synchronous generating unit, the initial generator reaction is based on the behaviour of a rotating machine, then the AVR reacts to a voltage input error by increasing the excitation current to support the voltage. • AVR dynamic behaviour can be assessed as step voltage response, however this behaviour does not consider the initial reaction of the synchronous generator during an event. • The reactive current injected is not a controlled variable, but a by product of the AVR reaction reading an input voltage error. AVR performance is not normally evaluated based on reactive current injection, but by measuring the voltage behaviour against a voltage setpoint step variation. **TasNetworks – Opposes the removal of settling time** As per our previous submission, the standard definitions from control theory for "rise time" and "settling time" should remain. The Dynamic Model Acceptance Test (DMAT) use a passive single machine infinite bus (SMIB) arrangement when assessing performance. Under this arrangement,	cognisant that, in many cases, a black and white interpretation of rules wording rather than reliance on engineering judgement has been a more common approach in access standards assessment in the NEM over the past 10 years. In reality each situation is nuanced and flexibility in the rules allows for an NSP and AEMO to agree results that are acceptable using engineering judgement, but without that flexibility would be rejected. AEMO does not agree that adding "step-like" to the description of the input adds complexity. The NER framework for compliance applies over the life of the plant and irrespective of voltage profile of the fault. It is unrealistic to expect an outcome from a test to be within defined bounds without also specifying the inputs to a similar level of detail. The addition of "step like" applies a common-sense measure to the input of the test, so that engineering judgement can be exercised within the rules framework to decide if it is a proper test for measurement of rise time. If the inputs are specified too rigidly, there will be no room for compliance assessment based on actual faults. On the other hand, if the test applies to an unspecified fault voltage profile, compliance cannot be demonstrated reliably because the input is not suitable in all cases. An alternative approach followed by many other jurisdictions internationally is to fully specify a test, and undertake it in a test facility. Ongoing compliance assessment is then not required. However, at present the NER does not have the concept of separate design and ongoing compliance requirements. TasNetworks objected to the removal of settling time for reasons similar in nature to the above, that with a passive single machine infinite bus system a simulation environment can be established to provide a step-like input suitable for assessing a settling time. However, AEMO notes that the application of this clause is not limited to well-behaved single-machine infinite bus systems. Transgrid also preferred to keep the settling time requirement, with similar amendments as proposed by AEMO for the definition of rise time (with specific test conditions), as it provides a quantifiable assessment criteria for steplike responses. AEMO could make the proviso of a "step-like input" apply to settling time as well, but the recent AEMC review of reactive current injection for the MAS demonstrated how problematic the calculation of settling time can be in a fault context, where longer-term dynamics can affect the results (and that was just in simulations using SMIB models). The material presented by the AEMC was focussed on wind farms, but similar observations can be made for grid-forming inverters. There is practically nothing wrong with changes above 10% of the fault response over the course of a fault, provided the

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	any dynamic response observed can only be due to the equipment under test and in this setting, the control theory terms are appropriate. For on-site "R2" testing, and in full model verification when other voltage regulation devices can impact the voltage profile, there is justification to relax the wording. **Tesla – Supports** Tesla is supportive of AEMO's revised recommendations. **Transgrid – Supports with clarification** • Acknowledge that the settling time is not a comprehensive measure as to the adequacy and stability of the reactive current response for complex disturbances. However, the settling time requirement provides good generalised and quantifiable assessment criteria for stability when applied to step-like voltage disturbances. Transgrid prefers to retain the performance criterion for settling time in the AAS with similar amendments as proposed by AEMO for the definition of rise time (with specific test conditions). Transgrid also notes that with the removal of the settling time requirement from the MAS, the rules are more flexible to negotiating this performance. • Transgrid supports the inclusion of the commencement time of no greater than 10ms in the AAS; however, it notes there is ambiguity regarding the response initiating condition in the proposed AAS. The current MAS under S5.2.5.5 (O)(2A) allows for the response initiating conditions to be agreed with the NSP and AEMO. Further comments on this are included under 'Commencement of reactive current injection' section. • Transgrid supports the inclusion of "adequately controlled" definition in the NER. However, Transgrid notes that proposed amendment S5.2.5.5 (a00) refers to plant response for transient over-voltage and transient under-voltage in defining "adequately controlled" response. As noted in our response under clause S5.2.5.4, transient overvoltage is defined in IEC 60071-1 as "short-duration overvoltage of few milliseconds or less, oscillatory or non-oscillatory, usually highly damped". The requirement under clause S5.2.5.5 is for the plants to provide an adequately controlled stable response for power frequency overvoltage or undervoltage disturbances that are typically cleared within 80ms to few seconds and is not limited to transient events. Further consideration needs to be given to consistent use of terminology, considering defined terms in relevant IEC standards.	response is adequately controlled, and meets other aspects of the requirements. In addition, the proposed changes restore consistency in approach between the minimum and automatic access standards, which can assist in the negotiation of performance standards. Several stakeholders commented on the definition of 'adequately controlled', which speaks to the tension between flexibility and specificity, as described above. CEC commented that the definition is qualitative, but this is necessary to maintain flexibility. It is attempting to document the principles that should be considered when assessing this clause. Nevertheless, AEMO observes that the proposed definition could reference the system standards, when considering the over voltage excursions caused by the plant. For under-voltages the system standards are silent, so the reference would need to be to S5.2.5.4 ranges and durations. The advantage of that would be that it would address a loophole that could allow a plant to cause a voltage excursion that then causes the voltage at its connection point to be outside the range under S5.2.5.4 for CUO. Defining such terms as "step-like" and "adequately controlled" is of limited value where all parties are equally able to exercise engineering judgement. However, AEMO does recognise that there is a range of engineering experience and capability in the NEM and that the energy transition will continue to provide resourcing challenges. In light of that AEMO proposes to define adequately controlled at stakeholder request, but does not intend to define "step-like", which should be understood in the context. Transgrid noted that the term "transient over-voltage" is not used in a manner consistent with the definition in the IEC standard. The wording could be expanded to transient or temporary over-voltage or under-voltage to be consistent with IEC 60050-614, which is also referenced in 610071-1. AEMO acknowledges that the IEC standards do have a definition of transient. However, the term "transient" is not used by reference to the IEC standard in this clause, so AEMO does not agree that it should conform to that definition, which is more prescriptive than intended by its use here. The addition of a "commencement time" criterion was made in the recent rule change on this clause for the MAS. The proposed change adds the criterion to the AAS. Stakeholders expressed support for the change, other than Neoen who questioned the value of setting 10 ms as the commencement time and indicated it cannot be tested in an RMS wide are model. AEMO suggests that, unlike rise time and settling time, this measure can generally be calculated in an EMT SMIB model without much difficulty,

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		and could also be demonstrated in hardware-in-loop tests. It reflects the benefit of rapid commencement of reactive current injection in response to a voltage drop, in arresting or opposing the voltage deviation. In AEMO's recent publication of a voluntary grid forming technical specification[1], grid forming inverters from various manufacturers demonstrated (in simulations) commencement times of around 3 ms, opposing a voltage deviation. **Final recommendation** Considering stakeholder feedback, AEMO recommends modifying the update report recommendation, by amending the "adequately controlled" definition to include not causing or exacerbating voltages beyond: • the more restrictive of the system standards and levels and durations agreed under S5.2.5.4 for overvoltages, and • levels and durations agreed under S5.2.5.4 for undervoltages and • not causing or exacerbating voltage oscillations that could adversely affect the ability of other schedule 5.2 plant to remain in operation during the disturbance.
Commencement of reactive current injection **and clarity on reactive current injection location**	**AusNet** AusNet supports AEMO's revised recommendation **Powerlink – Supports** Powerlink supports this proposed change. Typically, fault ride through current response is implemented at the generating unit level, as distinct from at the connection point. **Siemens Gamesa – Supports** SGRE support these changes. **Solar Turbines** It is recommended to indicate that the AVR shall be set to react above 85%Un in case of undervoltage and below 115%Un in case of overvoltage. **TasNetworks – Supports** TasNetworks supports this proposed change. • **Tesla – Supports** • Tesla remains supportive of this recommendation **Transgrid – supports with clarification**	Transgrid noted that there is some ambiguity in the location at which the reactive current commencement and rise time are to be measured. The current NER provides some flexibility around the measurement location for reactive current contribution. AEMO does not propose to modify this. AEMO agrees with Transgrid that reactive current commencement time and its measurement location should also be recorded in the performance standards. **Final recommendation** Considering stakeholder feedback AEMO will retain its update report recommendation with two minor amendments to: • Amend NER S5.2.5.5(u)(2) to clarify that reactive current rise time and commencement time can be measured at a location other than the connection point. • Amend NER S5.2.5.5(o1) to require all the elements of reactive current response to be recorded including the location for measurement of reactive current injection level as a function of voltage, the location of measurement of commencement time and rise

[1] At https://aemo.com.au/en/initiatives/major-programs/engineering-framework/reports-and-resources.

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	• Under the proposed AAS, there is some ambiguity in regard to the location at which the reactive current commencement and rise time is to be measured. Noting that S5.2.5.5 (g)(2) specifies the reactive current response requirements for a step-like voltage profile at the connection point, is the expectation that the reactive current commencement time and rise time is to be measured at the Connection Point for the AAS? Suggest providing further clarity on the location at which the reactive current commencement and rise time is to be measured for the AAS. • S5.2.5.5 (o1) MAS provides the ability for the reactive current commencement conditions to be agreed with NSP and AEMO and recorded in the performance standards. However, there is no such equivalent requirement under the AAS to explicitly record the reactive current commencement conditions such as response initiating condition or the location. Transgrid suggests adding an equivalent of subclause (o1) to the AAS to remove ambiguity.	time and the response initiating condition including the location at which it is measured, noting that rise time and commencement time might be measured at a different location.
Consideration of unbalanced voltages and clarity on reactive current injection volume	**AusNet – support, with clarification** AusNet supports AEMO's revised recommendation on requiring the control strategy to minimise voltage deviation on each phase from pre disturbance levels, for unbalanced faults. AusNet would like to stress that the negative sequence current control should not be overly prescriptive due to the X/R ratio being dictated by angle of the fault impedance. To have a constant negative sequence current injection objective might not be aligned with the objective of maximizing post fault voltage stability. **Caterpillar - clarification sought** It is requested to add (example) graphs showing the response of asynchronous units (inverters) for changes in positive- and negative sequence component of the grid voltage respectively. **Energy Queensland – no concerns raised** Ergon Energy and Energex make no comment **Huawei Australia** Do AEMO and the NSP have specific requirements for negative sequence current in unbalanced faults? **Powerlink Support with clarification** The control objective includes requirement to "minimise" deviation of voltage, which can be interpreted in different ways. For example, a plant that only has the ability to inject positive sequence current may consider that they minimise over-voltages by reducing positive sequence injection to a very low level; however, this may be at a level that still can't be accepted. We recommend that the term "minimise" is framed as "minimise subject to NSP requirements", because it is the NSP that is affected by high voltages. Some generating unit types inject current per phase (i.e. no particular negative sequence injection), and that those standards could be expressed on that basis (i.e. without reference to negative sequence voltage or negative sequence current). **Siemens Gamesa – Partial support; Alternative proposed**	The proposed drafting retained the requirement for the plant to have facilities for 4%/% reactive current injection and 6%/% reactive current absorption, but specified this for balanced voltages. The drafting also proposes a control objective to optimise the overall settings. Caterpillar suggested inclusion of example graphs in the NER, but as the solution is likely to be different from one model/type of plant to another, this is not feasible. Huawei asked if AEMO has specific requirements for negative phase sequence (NPS) in unbalanced faults. Powerlink also noted that the control objective could be interpreted as not requiring the plant to have NPS or phase imbalance correction. Transgrid noted that there is no quantifiable assessment criterion for unbalanced faults. AEMO acknowledges the omission identified by Transgrid, Powerlink and Huawei, and proposes to expand its recommended AAS to include a requirement for either inherent response or control response that opposes voltage unbalance during faults or temporary over-voltages. Transgrid suggested that the 4% and 6% apply to positive sequence injection for unbalanced faults as well. AEMO considers these levels as design criteria affecting the range of injection levels that can be considered for the optimisation. However, AEMO agrees that the requirement for positive sequence injection should also apply in unbalanced faults. Transgrid also noted an inconsistency in the draft S5.2.5.5(f) and S5.2.5.5(n) (i.e., between the AAS and the MAS for reactive current response). The AAS refers to positive sequence voltage deviations, while the MAS refers to voltage. This will be addressed by the amendment above.

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	SGRE support the recommended revisions to record unbalance fault in GPS. However, the assessment of volume of negative current injection in accordance with the negative voltage deviation could be difficult depending on the technology and may require significant additional effort during all connection stages. For example, with DFIG (similarly to synchronous machines) negative sequence current may be absorbed by the machine itself rather than as defined by a software control system so codifying the performance may not be clear and straightforward. SGRE also suggest to limit the matter of priority only to the positive sequence and active current vs reactive current **Solar Turbines – Alternative proposed** Note that synchronous generators and AVRs do not control reactive current injection on the single phases (unless the generator is 1-phase). It is recommended to define appropriate requirements considering synchronous generators technology. **Tesla – Support** Tesla is supportive of AEMO's revised recommendations. **TasNetworks – Supports** TasNetworks supports this proposed change. **Transgrid – support with clarification** • Supports retaining in the AAS 4% and 6% levels for injection and absorption. Suggest this is clarified to apply for each 1% positive sequence voltage deviation for both balanced and unbalanced faults and overvoltage disturbances. • Welcomes the S5.2.5.5 (u)(3) amendment requiring the response to unbalanced faults and overvoltage disturbances to be recorded in the GPS. However, there is no quantifiable assessment criterion for unbalanced faults proposed in the amended AAS (since S5.2.5.5(f)(1)(i) and (ii) are limited to balanced faults). While the proposed amendment under S5.2.5.5(f)(1)(iii) to minimise the deviation of voltage on each phase provides the broader intent and guidance for the required positive and the negative sequence reactive current response, it is ambiguous and open to interpretation. In Transgrid's experience, lack of clarity on unbalanced fault response requirements has resulted in prolonged plant tuning and negotiations so it is crucial that clear technical requirements are set in the AAS. Transgrid suggest applying clause S5.2.5.5(f)(1)(i) and (ii) requirement to both unbalanced and balanced faults (based on each 1% voltage deviation of positive sequence voltage) supplemented by proposed S5.2.5.5(f)(1)(iii) requirement to minimise voltage deviation on each phase. This should allow for the balancing of the voltages by providing appropriate level/s of positive and negative sequence current. • Inconsistency in the draft S5.2.5.5(f) and S5.2.5.5(n) (i.e., between the AAS and the MAS for reactive current response). The AAS refers to positive sequence voltage deviations, while the MAS refers to voltage. • Draft S5.2.5.5(o)(ii) specifies an overvoltage threshold of 115% of nominal voltage for the MAS which is the same as the overvoltage threshold specified under S5.2.5.5(g)(ii) for AAS. Given	The control objective should be considered the overarching requirement that sets the level of reactive power response for both balanced and unbalanced faults. Flexibility in how the response is described in the GPS needs to be retained as different algorithms and inherent responses can apply. Siemens Gamesa suggested that DFIGs may not be able to control negative sequence because they have an inherent response rather than a control response. AEMO notes that whether a response is inherent or control-based should not prevent describing a response characteristic, even if heuristic. Transgrid also noted that NER S5.2.5.5(o)(1)(ii) refers to 115% instead of 120%. AEMO agrees that this is a drafting error, which will be corrected in AEMO's rule proposal. **Final recommendation** Considering the stakeholder feedback, AEMO proposes to amend its update report recommendation as follows: • Retain the 4%/% and 6%/% as facility requirements in the AAS (unchanged intent, but minor redrafting is required). • In the AAS, amend the requirement for facilities to achieve 4%/% injection and 6%/% absorption of positive sequence reactive current for balanced and unbalanced faults, by removing "for balanced voltages". • Apply the control objective to both balanced and unbalanced faults and overvoltages (for establishing the settings, rather than as a facility) • Expand the AAS to include a requirement for either inherent response or control response that opposes voltage unbalance during faults or temporary over-voltages. • In NER S5.2.5.5(o)(1)(ii) correct 115% to 120% (drafting error).

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	that AEMO has not specified this MAS amendment in the recommendation report, it is assumed to be a typographical error.	
Metallic conducting path	**AusNet – oppose** As per the previous AusNet submission, AusNet's view is that this wording served a purpose, and that rather than omission entirely, an appropriate, clearer substitute should be included. **CEC – Oppose** Strongly recommend the wording remain as removal of it could require additional studies to assess high impedance faults (including faults with varying impedance). AEMO's draft report states that the 'existing wording does not appear to add anything useful'. We strongly disagreed and the fact that the wording exists, yet is not creating problems for the industry is a testament to the value that the wording provides. **Energy Queensland – No objection** Ergon Energy and Energex have no objection to the removal of this statement. **Neoen – Oppose** The original reason for including this term must be considered. It was originally intended to indicate a low impedance fault may practically evolve. **Powerlink – Support** Powerlink supports this change. **TasNetworks – Support** TasNetworks supports the removal of this clause. **Transgrid – supports** Transgrid supports the deletion of this subclause.	The proposal to remove the metallic conducting path reference received support (or no objection) from four respondents. It was opposed by three stakeholders who considered that it continues to serve a purpose or that its existence is not creating problems. Neoen suggested that it is intended to indicate a low impedance fault may practically evolve. AEMO does not agree that the clause speaks to the evolution of faults, although it certainly doesn't preclude low impedance faults. However, including or removing the clause would not change this understanding. AEMO considers that removing this clause would make no practical difference to the studies that would be needed. Practically, very high impedance faults are unlikely to trouble a generating system, and the clause already refers to the clearance of faults by protection, so it is clear that the faults referred to in the clause are sufficient to be cleared by protection systems. Whereas the description makes it clear that a fault for the purpose of this clause includes something that has a metallic path, it does not preclude a fault including something that is not a metallic path. Noting that a power system engineer would automatically interpret that a fault covered by this clause could have a metallic conducting path, the addition of this clause (a) does not limit or refine the application of S5.2.5.5 in any useful way. Further explanation of what faults apply for this clause could be provided in a guideline. AEMO considers that a substitute clause is not appropriate, because the original drafting of the clause simply states that faults considered by the clause included (effectively for the avoidance of doubt) a fault having a metallic conducting path. AEMO considers that there is no residual uncertainty that might otherwise lead such faults to be excluded, and therefore NER S5.2.5.5(a) can safely be deleted. **Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation.
Reclassified contingency events	**AusNet – comment** AusNet notes AEMO's response and suggests that if there are undocumented principles in use, that they should be formalised so that parties have clear and fair expectations of future compliance and changes. **CEC**	Most respondents agreed with the proposal in principle. Neoen objected on the grounds that uncertainty on credible contingency events at the design stage adds risk to the project. AEMO notes that under the current NER there is no limitation on the credible contingency events for which the plant must remain in CUO, and this would include reclassified events as well as credible

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	Additional study cases may be required however no further comments given the proposed wording incorporates those contingencies that are commonly reclassified and are ones that are likely to affect the connection point. **Energy Queensland – no concerns raised** Ergon Energy and Energex make no comment. **Huawei Australia - Support with clarification** We recommend that the NSP can provide detailed credible contingency events **Neoen – Oppose** Generating systems can't be re-designed as network events are re-classified – the Rules must be clear what events are credible before the design is underway. NSP should provide a list of credible contingencies in the response to the connection enquiry, credible contingency events must be consistent with the rule definitions and the planning and design of the NSP network. The project can't respond to re-classification once the work on application package preparation commences – this would introduce significant re-design and re-work which would have direct impact on level of funding required for the project. Should this change be introduced there needs to be a clear obligation on NSP/AEMO to outline the events that may be re-classified in near future and the risk this may introduce to the project. Note that a reclassified credible contingency event is a non-credible contingency event that AEMO has determined is now reasonable possible given abnormal system conditions. The system cannot be designed to always operate such that potentially reclassified events are always possible and the same goes for generating plant. Note that the event types defined in S5.2.5.5 already cover a number of non-credible contingency events there is no need to expand these conditions. The cost of doing so would be prohibitive and must be understood that a non-defined list of event withstand conditions imposes inefficient costs onto new connections that are passed on to consumers, with no benefit. **Solar Turbines** Solar Turbines comments include some general comments on credible contingency event assessment: • The requirement identifies fault condition, but it does not provide detailed information regarding clearing times and typical grid set-up and therefore it is not possible to assess generating unit capability in advance. The requirement is pretty generic so it is difficult to provide any answer, less a statement of compliance for manufacturers. • The requirements provide no obligation to look for an optimization on the protection settings by the relevant parties (including system operator) which is desirable for lifecycle of the generating unit and for the safety (availability) of the system. It is recommended to add a note in such respect (worst case scenario shall in any case be based on best achievable protection scenario for the generating unit, protection settings shall be set with the best possible configuration from generating unit perspective). • It is recommended to create a pre-defined grid system to be used as reference for proving compliance and correspondent system characteristics and clearing times. This shall be based on the list of events as described in the definition of credible contingency event in S5.1.2.	contingencies that change in size or nature over time. The proposed amendment therefore de-risks the project, when compared with the status quo. Another mitigating factor is that the power system is always reconfigured for a reclassification of a non-credible contingency. This typically involves one or more network constraints that, if binding, will reduce the flow on the affected element so that the impact on the power system is less onerous. Identifying and checking the commonly reclassified contingency events would allow the Schedule 5.2 Participant to identify and remedy any potential non-compliance, considered that these identified events have a higher likelihood of occurring than others. AEMO reports every 6 months on reclassification decisions. Considering Solar Turbines and Huawei's comments, it is not possible to define a one size fits all scenario for testing credible contingency events, under the "performance standards" approach adopted in the NEM, which applies site-specific conditions for the assessment. The connection applicant and NSP should discuss which reclassifications (and credible contingency events more generally) should be considered, as part of scoping their studies for connection application submission. AEMO notes that there are existing obligations on NSPs (for example in NER 5.3.2(f)) to provide technical information to Schedule 5.2 Participants. **Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation.

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	TasNetworks – Supports TasNetworks supports this proposed change. **Tesla – Support with clarification** Tesla would suggest additional wording in this clause that would also require the NSP to publish these additional commonly reclassified contingencies. If they are considered by NSPs, but not visible to developers and OEMs, it is unhelpful. **Transgrid – Supports** Agrees with the amendment rule in S5.2.5.5 (t1) to expand the term credible contingency by reference to specify credible contingency events selected by the NSP for the purpose of NER S5.1.2.1.	
NER S5.2.5.7 – Partial load rejection		
Application of minimum generation to energy storage systems	**AusNet – support** AusNet supports AEMO's revised recommendation **CEC – clarification sought** Note that the NER wording amendments do not seem to have been made in Appendix A2. To be revisited – members raised a concern that this may affect the serviceable life of Battery storage systems depending on how it is drafted. **ElectraNet – seeks clarification of need** S5.2.5.7 – It is not clear why this Clause has been specified for synchronous condensers. The original intent of this clause is understood to be requiring generators to remain online for loads down to Pmin for a large frequency disturbance. It is noted that the proposed drafting already obliges synchronous condensers to ride through frequency, voltage and power system disturbances (S5.2.5.3, S5.2.5.4 and S5.2.5.5 respectively), and it is unclear what additional performance is gained from this clause. **Energy Queensland – no concerns raised** Ergon Energy and Energex make no comment. **TasNetworks – Supports** TasNetworks supports this proposed change. **Transgrid – support with clarification** Note the amendment to minimum generation "the minimum sent out generation for continuous stable operation of a production system including each of its operating production units". The term "sent out generation" is defined in the NER as "In relation to a generating unit, the amount of electricity supplied to the transmission network or distribution network at its connection point". As AEMO asserted in the Approach paper, bi-directional units are not likely to have minimum generation for continuous stable operation; therefore, the proposed amendment in S5.2.5.7 (a0) should also apply to bi-directional systems.	Stakeholder responses generally supported the proposed change. Transgrid's suggested applying (a0) to bi-directional units so that they would be required to remain in CUO for system load reduction conditions when absorbing active power from the power system. AEMO agrees that battery systems are unlikely to have a minimum generation level. Note that the definition of bidirectional unit indicates that only those units capable of smooth transition between generating and consuming power are considered as bidirectional under Schedule 5.2. This means that they do not have a minimum generation, although they may still have a maximum load constraint. For example batteries may have a maximum charge level, where they cannot continue charging. Therefore it may be necessary to allow for constraints on load level for some types of bidirectional units, under some conditions (e.g. based on charge level). CEC expressed concern that the requirement may affect the serviceable life of a battery storage system. AEMO interprets this as a concern about a requirement to reduce output and begin absorbing energy. However, AEMO notes that the requirement in this clause is related to continuous uninterrupted operation rather than frequency response. ElectraNet questioned the application of S5.2.5.7 to synchronous condensers since they are required to ride through frequency, voltage and power system disturbances. The clause was originally drafted for synchronous generation, considering that some synchronous machines may have difficulty in maintaining their plant prime mover in stable operation for a load rejection event. The clause was extended to all types of generation in 2018, and more recently was modified under the IESS rule change to cover IRS.

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		Nevertheless, experience of the assessment of this rule over the past 5 years since it was extended to asynchronous plant, indicates that there has been little gained from the extension to asynchronous plant, and by the same logic there is little to be gained from applying it to synchronous condensers, noting that both types of plant must comply with voltage and frequency disturbances and contingencies. Noting the suggestions for changes needed to apply this requirement effectively to batteries, AEMO has revisited the provisions subsequent to the update report and concluded the most efficient outcome is to apply the clause only to synchronous generation, which is most likely to be affected by load rejection. AEMO has discussed this option with NSPs and received no in-principle objections. For developers, this change will reduce the time and resource requirements for compliance assessment.. **Final recommendation** AEMO recommends the application of s5.2.5.7 only to synchronous generation. On this basis it is not necessary to consider the operating conditions other than minimum generation level for stable operation that might need to be exempted from the ride through requirement.
Clarification of meaning of CUO for NER S5.2.5.7	**AusNet – support** AusNet supports AEMO's revised recommendation **CEC – clarification sought** Note that the NER wording amendments do not seem to have been made in Appendix A2. To be revisited – members raised a concern that this may affect the serviceable life of Battery storage systems depending on how it is drafted. **Energy Queensland – no concerns raised** Ergon Energy and Energex make no comment. **TasNetworks – Supports** TasNetworks supports this proposed change. **Transgrid – supports with clarification** • Support the addition of paragraph (h) "A relevant system is permitted to vary its active power and reactive power to the extent required to oppose a voltage variation or frequency variation" as it makes the performance requirement clearer. • Transgrid notes that AEMO has not incorporated the revised recommendation to replace the term "be capable of" with "remain in" in Appendix A2 Draft NER amendments for clause S5.2.5.7 (c) and (d).	Respondents to the consultation were either supportive or silent on the proposed changes. AEMO notes Transgrid's comment on drafting and confirms its intent to make the change from "be capable of" to "remain in" in this clause. **Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation (permitting active and reactive power changes within the concept of remaining in CUO).
NER S5.2.5.8 – Protection of generating systems from power system disturbances		

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Emergency over-frequency response	**AusNet – support** AusNet supports AEMO's revised recommendation **Caterpillar – Support with clarifications** • The revised recommendations include: • "A–S - reflecting a proportional response": Further clarification on the term "proportional response" is requested. Also, certain prime movers of synchronous generators (genset, turbines) are constrained in their speed of active power response. Therefore, it is proposed to specify a droop range for the response as 16.67% – 100% rated power (Pmax) per Hertz and a maximum ramp rate as 20% Pmax/minute. "NAS - ...specifically including rapid reduction by 50% by means other than tripping": It is requested to clarify that the response can saturate (settle) at the minimum operating level before a 50% Pmax reduction is achieved. Also, a maximum ramp rate of 20% Pmax/minute is proposed here. **CEC – support with clarifications** We note that AEMO has accepted our proposal to establish an AAS, NAS and MAS which is welcome, and the new wording provides flexibility for different plant types. • Recommend removing the capitalising of 'disconnect' for the NAS and MAS to allow disconnection other than at the connection point. • Reference to vector shift protection not operating for less than 20 degrees is questionable as desensitising vector shift protection to such an extent would likely negate its use as an anti-islanding scheme. Reliance on Vector shift protection for anti-islanding is questionable (there are better alternatives such as topology-based schemes). • Recommend clarification of 'disconnect' under the General Requirements. Use of 'disconnect' (italicised) requires opening the connection point circuit breaker and there should be flexibility for the generator to disconnect other than at the connection point (which would allow auxiliary supplies to be maintained and allow for faster restoration). **CPSA – Supports over-frequency treatment; opposes vector shift** • We welcome AEMO's inclusion of a new AAS and NAS as per CPSAs recommendation in our previous submission to capture different levels of performance for different plant types. • The use of / reference to Vector Shift protection is a pointless exercise given that setting this protection to >20 degrees effectively desensitises it and renders it ineffective for detecting islanding conditions. If anything, the use of Vector shift protection should not be allowed as it difficult to reliably set it. Topology based schemes are the most dependable anti-islanding schemes. **Energy Queensland – no concerns raised** Ergon Energy and Energex make no comment. **Hydro Tasmania** – Support with clarification	Most respondents supported the proposed changes to the over-frequency response requirements which clarify the preferred approach being a droop response, and retain tripping as the least preferred option as a minimum access standard. Caterpillar requested clarification of the words "proportional reduction". This is used in (b1)(1) in relation to the negotiated standard. It is intended to be a reference to droop response. However, AEMO acknowledges that the wording could be more precise – eg "a reduction proportional to frequency deviation" Caterpillar suggested specifying a specific droop setting in the AAS, because of plant limitations. AEMO considers that a proponent whose plant has such a limitation can seek to negotiate an appropriate access standard. There appears to be no benefit in specifying either maximum ramp rate or a specific droop setting, as all technologies are covered by these requirements, and different technologies and plants have different capabilities. Caterpillar also sought clarification of the interaction with the minimum operating level. AEMO agrees that a reference to minimum operating level needs to be added, to clarify that the 50% reduction in output is subject to the plant output remaining above the minimum stable operating level if any. CEC recommended that 'disconnect' not be italicised to allow a plant to disconnect other than at the connection point, while keeping ancillary plant in service The NER defines *disconnect* as the operation of switching equipment or other action so as to prevent the flow of electricity at a *connection point*. The definition does not specify the location of switching, but does specify the outcome ie "so as to prevent flow of electricity at a *connection point*". There may be, in some circumstances, some ambiguity in the definition as to whether it requires preventing all flow of electricity (including reactive power) through the connection point. However, in the context "disconnect" is combined with "the operating production units" so the intent should be clear. Nevertheless AEMO agrees that removing the italicising from the term here may improve clarity. AEMO prefers not to change the definition because it is used in many locations in the NER that are outside the scope of this review. Hydro Tasmania suggested it would be helpful to accommodate exemptions for plant that cannot achieve a 50% reduction due to safety or stability reasons. AEMO considers that the range of options for negotiation should accommodate more modest reductions and could

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	Would be helpful to accommodate exemptions in the NAS. In case the generating unit 'an't achieve rapid reduction by 50% due to stability or safety reasons (e.g. hydraulic limitations), subject to NSP assessment and agreement. In addition, HT notes that the mandatory PFR implementation was applied for units >30MW (e.g. dispatchable units), while Hydro Tasmania understands the new threshold e.g. 7MW proposed due to the Tasmania system size, there are handful units (between 7MW and 30MW) in the Hydro fleet will not automatically satisfy the over frequency response requirement based on PFR settings. HT would like to open a separated discussion to find a best practice to accommodate. **Solar Turbines – Alternative proposed** • Some comments to the drafted requirement • The AAS requesting a power reduction of 50%Pref in 3s is not realistic for synchronous generators with inertia of size of more than 4 MW (most probably even less), much less applicable for bigger power units. • Power reduction with such fast ramp rates does not necessary lead to stable operating condition and in general has consistent power undershoot. They can result in very nervous behaviour of the generating unit that will tend to initiate large power reduction also for limited frequency deviation ad associated instability. • The requirement as it is stated seems to be targeting only the Pmax and 3s scenario. It is recommended to re adapt the requirement (at least for synchronous generators) so that the generating unit/generating plant shall reduce its active output power as fast as technically feasible and such capabilities shall be documented and recorded, as also suggested in the presentation slides. • It is also strange that AAS specifies such a fast requirements that seems non practical for synchronous generators and other technologies, but almost slow for inverter based technology (eg in Germany inverter technology are expected to reduce power of 50%Pref in 2s, wind units are expected to reduce 20%Pref in 5s, while synchronous generator 45%Pref in 8s, but with the exception of Gas Turbine and reciprocating engine for which is requested a ramp rate of 20%Pref per minute). Note that the requirements does not describe any other condition different from power reduction in overfrequency, therefore std ramp rates are expected for any other behaviour. **TasNetworks – Supports** TasNetworks supports this proposed change. **Tesla – Supports** Tesla remains supportive of this change. **Transgrid – generally supports** • Support the prioritisation of response being: 1) continuous frequency droop control, 2) fast ramping, 3) disconnection, as well as changes to the wording on protection settings. • The Negotiated clause states that "A reduction in active power output should generally be achieved by fast ramping in preference to disconnection of production units." This does not	possibly be combined with tripping as a last resort. However, the NAS provision could possibly also include reduction of less than 50%. Solar Turbines suggested a power reduction of 50% Pref in 3 seconds is not realistic for large synchronous machines. AEMO notes that the access standards are not just for synchronous machines but apply to a range of technologies, and the negotiation framework allows for a longer response time where required. Solar Turbines also raised concerns that operating with such high ramp rates might lead to unstable operation. Once again AEMO notes that the negotiation framework for this clause takes account of plant limitations, which would include stability limits. Solar Turbines considered Australia's approach of technology agnostic requirements to result in unnecessarily slow responses from some inverter-based technologies that can achieve faster responses as well as being difficult to achieve for some technologies such as gas turbines. AEMO considers that the range of possible negotiated access standards adequately covers the range of technologies, without unnecessarily complicating the access standard. Not also that the performance standards should not be viewed as limiting plant capabilities – they are to be met or exceeded. Transgrid suggested that the NAS statement that a reduction in active power output should generally be achieved by fast ramping in preference to disconnection of production units." does not make it clear that droop response is the preferred response. However, AEMO considers that the proposed drafting is clear as to the order of preference, expressed within the AAS-MAS-NAS framework. **Final recommendation** Considering all feedback, AEMO will retain its update report recommendations with the following amendments: • Make the 50% reduction subject to the plant remaining above minimum operating level for stable operation. • Modify the wording of "proportional response" to clarify that response proportional to frequency deviation is intended. • Allow the 50% reduction and 3s requirements to be relaxed where AEMO and the NSP agree a relaxation is necessary for safe operation of the plant and preferable to tripping., but in any case, not unnecessarily delaying the commencement of the response • Remove the italics from "disconnect" or otherwise modify the definition to allow for disconnection somewhere other than the connection point.

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	make it clear that that "frequency droop" response is preferred over "fast ramping". Transgrid recommend including "frequency droop" in (b4) of the Negotiated standard to make this clear.	
NER S5.2.5.10 – Protection to trip plant for unstable operation		
Requirements for stability protection on asynchronous generating systems	**Akaysha Energy – supports with clarification** Submission supports the clarification of the S5.2.5.10 requirements, and the detection of instability based off POC measurements. Recommends the generator only disconnects on receiving a disconnect signal from AEMO or the NSP, as sudden disconnection may have broader risks for the power system. The submission recommends that minor instabilities should not trigger automatic disconnection of very large generation assets. **Amp Energy – concerns about contribution** Based on our experience, there is no proven commercially available product which can automatically accurately detect oscillations and work out if a plant is contributing to the instability or not. A common technique which has been used in some produces (most still in trial phase) is	The general nature of the feedback received suggests that earlier concerns around this clause are getting close to resolution. Most of the residual issues raised in responses on this issue focus on the following topics: • Generator disconnection because of unstable operation leading to broader problems for the power system • Concerns about the types of stability that are to be covered, and incomplete understanding of the mechanisms Some respondents also raised concerns about:

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	comparing Q and V phase differences but that technique has been shown to be less accurate or even completely unreliable with medium to high sub-synchronous oscillation frequency range (above 10-15Hz). Therefore, the revised requirement should be further reviewed. **AusNet – support** AusNet supports AEMO's revised recommendation **Caterpillar** – Support with clarification • The given set of AAS and MAS are non-exhaustive, and it is requested to add tables or flow-charts showing the requirements. For the MAS, an exhaustive set of requirements including tables with the min/max configuration settings and default thresholds are requested. • It is also proposed to allow for additional development time where there are project-specific protection requirements. **CEC – Partial support, partial opposition** AAS: • Members had concerns around automatically disconnecting via a system that has not yet been proven and the impact this can have on power system security and / or non-compliant with its performance standards. • Computing contributions to oscillations in real time is not a proven concept and this area is evolving. Hence mandating requirements in the Rules is not appropriate at this stage. • Requirements for production systems >100 MW to install a PMU and receive information from AEMO. It is unclear what information is provided, how often and what needs to be done with this information provided by AEMO. 6 • AEMO considering the need for a system-based approach to assessing control interactions which is generally welcome and is the most suitable way to identify control interactions. MAS: • If required by the NSP & AEMO, requirements for production systems <100 MW to install a PMU and receive information from AEMO. It is unclear what information is provided, how often and what needs to be done with this information provided by AEMO. It is also unclear what triggers would require an NSP/AEMO to request this hence the requirement should be on reasonable technical grounds. Generally: • There are concerns that a solution is being designed without truly understanding the nature of the problem or the symptoms. There are various failure modes that may result in unstable operation, all of which have different frequencies, magnitudes and variations in output quantities. For example, FRT re-triggering, PPC-INV communications loss, interactions between PV inverter MPPT & active power controllers, low SCR instability etc. Without understanding the nature of these issues and the resultant plant output, designing a scheme to detect this is at best a guess. • It is recommended that these proposed changes be omitted until a proven solution is agreed upon.	• Concerns that the technology to identify whether a plant is contributing to an instability is not well developed • Whether protection grade tripping (~100 ms) is required • Whether the detection and protection could be implemented in separate devices • The requirement to install PMUs for plant greater than 100 MW. **Generator disconnection** In relation to disconnection of generation, CEC and its members raised issues around automatically disconnecting via a system that has not been proven. Alternatives proposed were to raise an alarm but initiate manual tripping, or initiate tripping on a disconnect signal from AEMO or the NSP. Neoen considered that automatic disconnection for IBRs should not be required in any conditions as this could lead to unwanted and unexpected loss of generation/load leading to unnecessary network events. Neoen also suggested clear definitions of "unstable" and "oscillation" should be provided. Hydro Tasmania was concerned that disconnection of generating plant through a protection response always risks amplifying the issue, and supported a response hierarchy starting with control/blocking mechanisms, backed up by coordinated protection with reasonable time delay. Considering this feedback, AEMO proposes to clarify that in addition to the plant contributing to the oscillation, tripping should be restricted to oscillations at a level that would have an adverse impact on power system security. CT LAB proposed a multi-level strategy that includes alarming at lower levels and tripping at higher levels to be defined by NSPs, with a process for refining the settings for control and further refinement in the case of non-related contingency events. AEMO notes that whereas the AAS requires plant to have a protection system with disconnection capability, there is flexibility about whether it is enabled and the trigger for disconnection. This is more flexible than the current NER S5.2.5.10. **Clarity on whether disconnection means protection grade tripping** Powerlink considered that "disconnection" in the context of a protection system should be made clear in any Rules amendment. AEMO notes that there is sufficient flexibility in the proposed rule to allow for ramp back of active power and generation unit disconnection. The hierarchy of actions could also include sending alarms to NSPs, so there is sufficient flexibility to require SCADA to do this as part of this clause.

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	• The need to communicate information from the detection system to the NSP/AEMO control centre (if required by the NSP/AEMO). Clarity should be provided on the type, number of and refresh frequency for these signals. The proposed changes to this clause raised many concerns from our members. In particular, was the concern that mandating the need to trip for an unproven scheme would present a risk to system security and compliance with performance standards. A safer solution would be to raise an alarm but initiate manual tripping. Some OEMs advised that the setting of threshold and/or delays should be determined by the OEM as the technology provider. **CPSA – partial support – concern about tripping** • There is a lack of understanding of the various failure modes and the type of instability they create. It is recommended that this be understood and quantified prior to trying to apply a suitable protection system to detect instability. Some of the failure modes or control instabilities include, FRT re-triggering, loss of PPC to unit comms, MPPT / active power control interactions etc. • Automatic tripping of this protection function should be avoided until it has been proven. If the oscillations are not large, the issues is most likely a power quality issue and manual intervention in the short term would suffice. **CTLab – partial support** • A clear definition and preferably a standard defining instability and describing the measurement methods and its test protocols is required. • CT LAB propose the monitoring system be separate from the protection system, providing both system operator alarming and a control signal to a protection relay to initiate a trip action • CT LAB propose a multi-level strategy that includes alarming at lower levels and tripping at higher levels as defined by NSPs. In the early stages tripping should be disabled until the NSP has agreed upon practical tripping values and strategies. This will assist in refining the settings for control and further refinement in the case of non-related contingency events. • CT LAB propose a multi-level strategy that includes alarming at lower levels and tripping at higher levels as defined by NSPs. In the early stages tripping should be disabled until the NSP has agreed upon practical tripping values and strategies. This will assist in refining the settings for control and further refinement in the case of non-related contingency events. • CT LAB propose the use of reprogrammable measurement platforms that can adapt and grow with ever changing system needs and not to specifically call for PMU devices – rather call for the ability to stream PMU data to meet AEMO's need for synchrophasor data. **Energy Queensland - Support** • Ergon Energy and Energex are supportive of the hierarchy of actions and agree that technology maturity of these detection systems is a challenge. We note that the definition of	AEMO notes there might be some circumstances where instability warrants a fast protection grade response. For example, the instability might be associated with overvoltages or overcurrents, in which case protection might need to trip the plant rapidly to prevent damage. **Separate devices for monitoring and protection** CTLAB proposed that the monitoring system be separate from the protection system, providing both system operator alarming and a control signal to a protection relay to initiate a trip action. Powerlink also asks if the protection and detection systems are separate devices. AEMO notes that the proposed rule does not link the requirements of a protection system and a detection system to the same device to retain flexibility in the solution. AEMO does not intend that the rules should specify the devices to be used for protection system and detection systems, only that both capabilities should be features of S5.2.5.10 arrangements. **Contribution to oscillations** CEC said that computing contributions to instability in real time is not a proven concept so mandating in Rules requirements is not appropriate. Neoen suggested the Rules should only require capabilities which are proven sufficiently reliable and readily available on the market from a range of suppliers. However, AEMO's recommendation does not mandate assessing the contribution to oscillations, which is only referenced in the automatic access standard, and only in the context of not tripping unless a contribution to the oscillations is established. There are two mechanisms for establishing contributions in AEMO's proposal. One is a detection system within the plant. A second possibility is for AEMO to employ a PMU based centralised system[2] that identifies the source of an oscillation, and feeds the information back to the plant, with the plant responding based on the trigger conditions and actions recorded in the performance standard. Either of these systems could provide confirmation of contribution to an oscillation. Nevertheless, AEMO agrees that there may be situations in which there is no available information about the contribution for the type of stability. **Requirements for PMUs** Powerlink indicated that the reason for requiring PMUs was unclear. As described above and in the referenced paper, AEMO is trialling a central system to collect information about the instabilities and locate the source of an oscillation. Powerlink is concerned that the system might

[2] See also James Guest, Daniel Lavis "Widespread PMU Installation: Australian Experience" presented at the Cairns 2023 International Symposium 4-7 September 2023. SC-C2 Paper 1280. This paper describes a method of identifying the source of controller-based interactions using PMUs and its application in the NEM to identify the source of a 17 Hz oscillation.

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	'instability' must be clear for the NSP, the proponent and AEMO to effectively facilitate performance standard negotiation and design works. We support further clarification be provided in guidelines or in updates to the Power System Stability Guidelines. **Goldwind Australia – Support with clarification** No objections to the proposed changes to the rules, however it would be important to define oscillation assessment methodology/methodologies that are acceptable considering the limited number of options available at this time. **Hydro Tasmania – Partial Support; Opposes requirement for PMU and Opposes protection disconnecting plant** Protection response by disconnecting the generating plant from the network always has a risk to amplify the issue, particularly the instability is identified by multiple IRSs in a region. It is HT's view that a reasonable execute hierarchy should be start with control/blocking mechanisms, then backed up by coordinated protection with reasonable time delay. HT strongly opposes the AAS requirement for PMU. At this stage, without detailed technical specifications and verification, this requirement appears premature to be implemented in the rule change. In contrast, there is a dedicated document MASS to specify the technical requirement of FCAS, including logger specification to data requirement. It is HT's view that unless there is an absolute system security concern due to generating system performance, a PMU installation should be a negotiated outcome between the generator and NSP with the MAS requirement only, otherwise there should be no other obligation on the SG to install a PMU and/or any of the associated infrastructure without some form of reimbursement for installation and ongoing management and maintenance costs (this is very different from the FCAS infrastructure which essentially is recovered through FCAS markets). Or with the MAS requirement only to the extent of the SG to facilitate access and connection for a PMU to be installed by the NSP. **Neoen – Opposes automatic disconnection; guideline required; contribution identification not available from commercial systems** Coordinated and consistent approach to oscillation monitoring and detection is needed. Clear definition on what should be classified as an "oscillation" and how it should be detected and flagged is needed from AEMO – with the introduction of the detection mechanism in the MAS and lack of definitions on monitoring and detection algorithms for oscillations there is a potential for many different systems to operate in the future network. Variety of different mechanisms will provide information on a state of the network that will be difficult to interpret and will not aid in operation of the network. Comment from AEMO that it is impossible to establish a single definition of "oscillations" – if AEMO with full access to network information is unable to do so how can this be established and designed by others? Without a clear guideline this has a high potential for implementation of systems that will not provide any benefits. Under no conditions should automatic disconnection for IBRs be required as this could lead to unwanted and unexpected loss of generation/load leading to unnecessary network events. Neoen therefore recommends removing from this standard any requirement for this capability, and to change the name of the standard from "Protection to trip plant for unstable operation" to "Unstable plant operation" or similar, provided that clear definitions of "unstable" and "oscillation" are also	be expensive to implement. Hydro Tasmania also argued against making the PMU a requirement for synchronous machines. AEMO agrees that the cost of PMU requirements should be justified by the need, and proposed PMU installation in the AAS only for plant of 100 MW or greater, and in the MAS only if required by AEMO or the NSP for a plant of that size. CTLab suggested that AEMO allow for a device that streams PMU data. AEMO expects that its proposed wording would allow for the measurement unit to stream PMU data (noting that it would need to conform to the appropriate PMU standards). Some respondents sought more clarity on oscillations and stability covered by this clause. SGRE requested definition of "the plant's contribution to instability". Goldwind suggested defining acceptable oscillation assessment, considering the limited options available at present. The proposed drafting makes reference to the power system stability guidelines under NER 4.3.4(h), for the requirements and capabilities in this clause (including specific PMU requirements). AEMO's intent is to incorporate more detail into these guidelines which should address various issues raised by respondents. AEMO also notes that limitations on disconnecting should not preclude the plant disconnecting itself to protect it from damage due to the instability more generally (irrespective of causing it). **Final recommendation** Considering all feedback, AEMO will retain its update report recommendation, with amendments to the AAS requirement around disconnection and contribution as follows: • Amend " must have a protection system capable of disconnecting units for unstable behaviour…" to "must have a facility capable of disconnecting the plant automatically 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, having regard to the power system security impact of the oscillations or instability, where: • any hierarchy of actions that includes a requirement to trip plant must take account of available automated information on the plant's contribution to the oscillations or instability, and • actions are automatically and promptly actioned.

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	provided in the Rules. Furthermore, our understanding is that there will be a requirement for the plant to automatically establish its contribution to the oscillations – we are not aware of any technology that would be capable of doing that and suggest the Rules should only require capabilities which are proven sufficiently reliable and readily available on the market from a range of suppliers. **Powerlink – Partial Support (Opposes reference to contribution to oscillations in AAS)** Powerlink considers that "disconnection" in the context of a protection system could be interpreted to mean a fast protection grade ~100ms trip of circuit breakers, or a slower (say 1 or 2 seconds) ramp back of active power and generating unit disconnection. We recommend the meaning of disconnection is made clear in any Rules amendment. We consider the Rules should clarify if the intent is to have separate devices to detect an instability in voltage, active power and/or reactive power; and a protection system that is capable of disconnection. We recommend the automatic standard should include provision for SCADA signals and/or alarms as agreed with the NSP and/or AEMO. We do not support any reference to 'contribution to the oscillations' in AAS, as the methods to prove contribution from a given plant are still not mature and can create confusion for generator, NSP and AEMO. Furthermore, there are cases in the NEM where instabilities in one plant can be caused by another nearby plant. It can become a matter for debate as to which plant is the contributor to the oscillations. In relation to PMUs and the need for AEMO to receive PMU data, Powerlink considers the intent behind this requirement is not clear. Furthermore, meeting this requirement could become extremely costly for generators. For example, this could include a solution for the generator to provide high speed [non-SCADA] data directly to AEMO. **Siemens Gamesa – Support with clarification** SGRE request to define "the plant's contribution to instability" in the draft rule to avoid any dispute for an unnecessary disconnection of a plant. This statement should define what "the plant's contribution to instability" means regarding the duration, the deviation magnitude of voltage/active power/reactive power and etc. The current draft rule is vague and triggered conditions, thresholds and timeframes are immensely subjective. **TasNetworks – Support with clarification** TasNetworks agrees that actions to mitigate oscillatory behaviour should be agreed on by the NSP and AEMO, and agrees with the proposed structure of the minimum and automatic access standards (MAS and AAS). The meaning of "promptly" is vague and should be avoided. It is crucial that concurrent tripping of asynchronous generators with the ability to detect these oscillations does not occur, and while the NSP and AEMO are involved in the determination of the hierarchy, this issue should be avoidable. Additionally, the connecting plant's ability to determine whether it is contributing to an oscillation would be difficult for it to determine with certainty. Currently TasNetworks requires installation of phasor measurement unit (PMU) facilities for any asynchronous generator connection, regardless of size. PMUs are not just used for network monitoring, but also for anti-islanding schemes, and TasNetworks has required their	

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	use for both purposes previously. The proposed change to the AAS to only make this a requirement for plant with an active power capability of 100 MW is problematic in Tasmania. Using the same reasoning used to set the threshold for small connections TasNetworks requests the threshold is set to the minimum of 100MW or 5% of any maximum credible contingency event size specified in the frequency operating standards for the relevant region). **Tesla – does not support automatic disconnection; alternative proposed** Tesla would suggest additional changes to the third dot point to confirm that the disconnection follows a signal from AEMO and is not automatic. We remain concerned that the revised AEMO recommendation does not go far enough in confirming that the disconnection will not be automatic. **Transgrid - Supports** • The proposed NER amendment under S5.2.5.10 (a)(2)(i) 'have the capability to detect instability in voltage, reactive power or active power at the connection point' is a deviation from the draft recommendation which states 'Must have system that can detect an instability in voltage, reactive power and active power. The latter is a mandatory requirement to be implemented, while the former is ambiguous on the implementation requirement. Transgrid suggests that the AAS requirement be clear in the rules and for removing any doubt, replacing 'have the capability to detect' with 'must have systems that can detect'. • Suggest including a clear definition of "instability" or a clear reference to types of instability that is defined under the Power System Stability Guideline. • Suggest adding 'as per agreed configuration' at the end of (2) (iii)(A) to address any future disputes on 'contribution'. The agreed configuration is expected to be considered in the design phase based on R1 data. • Further clarity is required on what actions to be taken by the plant on receipt of the information from AEMO as per AAS (a)(3)(ii) and MAS (b)(2)(ii). Additionally, it would need more clarity on what 'form nominated by AEMO' in AAS (a)(3)(ii) and MAS (b)(2)(ii) would be. • Draft refers to pole slipping condition of synchronous condenser. Considering synchronous condensers do not a have prime mover, can AEMO clarify the conditions that pole slipping becomes relevant to syncon technology. • Recommend General Requirement (f) to include "remote enablement and disablement signals" in addition to the remote tripping signal.	
NER S5.2.5.13 – Voltage and reactive power control		
Voltage control at unit level and slow setpoint change	**AusNet – Support** AusNet supports AEMO's revised recommendation **CEC – Support with clarification** • No major comments on what is proposed. • Propose more specific wording that implementation of rate limited setpoint control is solely at the discretion of the generator.	Stakeholders who responded to this recommendation generally supported the proposed change, other than Powerlink, which did not see the need for it. Since the rules require a 5 second settling time for a setpoint change of 5% and settings are not permitted to be changed without agreement of AEMO and the NSP, it is unclear that ramp rate limiters are permitted (even though historically this was common practice for synchronous

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	Powerlink – Does not see the need for a change • Powerlink considers that rate limitations on a setpoint are an operational measure. We do not see the need to include this in the GPS or Rules. **Siemens Gamesa** – Support • SGRE support these changes. **Solar Turbines – Comment** Voltage Control response time is compatible with 2.5 sed for a 5%Un variation. However fine tuning of gains could be needed. **TasNetworks – Support** TasNetworks supports this proposed change. **Transgrid - Support** • Recommended updating to make it clearer that the setpoint rate-limiter can be bypassed/disabled during testing and compliance assessments. • Acknowledge AEMO's legal advice that the current drafting does not preclude unit level voltage control.	machines). AEMO therefore sees some value in making the allowance clear, so as to encourage the practice, which is also consistent with desired operation of plant voltage controls under the AEMO Voltage Dispatch System. Transgrid suggested specifically allowing the ramp limiter to be disabled for testing purposes. However, AEMO notes that changing settings specifically for testing particular aspects of controls is not unusual, and does not normally require special reference in the rules. **Final recommendation** Considering all feedback, AEMO will retain its update report recommendation.
Optimise power system performance over expected fault level (system impedance) range – Voltage control	**AusNet – Opposes** Considering the rapid transformations occurring within the National Electricity Market, AusNet acknowledges the intention on the introduction of a connection point-dependent performance index (i.e., dV/dQ and dV/dP) is to improve representation of network characteristics. While AusNet embraces the concept of capturing potential cross coupling effect of the grid, we also recognise the potential burden it could place on Network Service Providers. The practicality of calculating the minimum, maximum, and typical values of apparent system impedance, while factoring in generator dispatching patterns when setting up the study cases, raises questions. As a result, AusNet is of the opinion that the challenges presented by this change initiative outweigh the benefits it offers. This perspective contradicts the primary objective of this rule change, which seeks to streamline the connection process by eliminating obstacles that are not aligned with the Net Zero target. **Caterpillar – Alternative proposal** MAS: It is proposed to allow a settling time of greater than 10 s for reactive power (Q) and power factor changes. Q-response of synchronous generators are influenced by grid- and onsite conditions/components, which include the grid- strength, harmonics, asymmetry and OLTCs. **CEC – Clarification sought** AEMO's proposal is understood in principle in relation to an apparent system impedance. It is recommended that an example of calculation of apparent system impedance' be provided to ensure it is clear to all, else it may be interpreted differently by various stakeholders. **ENA – Apparent impedance requires justification**	The intent of the proposed changes was to reorient the clause to focus more on low system strength conditions, to ensure plant is stable for those conditions, where the power system is more likely to be under stress, and less on the speed of response for conditions under which the system is likely to be less stressed. Several parts to the proposed amendments relate to this issue, repeated here so that they can be separately considered: In the AAS: • Require a 2 second rise time of reactive power for 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). For a negotiated access standard: • Require that controls are 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. In the MAS:

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	It is not clear that the proposed concept of apparent system impedance will provide any benefit over the established method of using three-phase fault levels. The introduction of a new concept should be treated with caution, especially when it becomes a required performance standard and significantly deviates from the standard methodology carried out by both NSPs and proponents. AEMO has not provided clear and sufficient evidence to the industry that these changes to S5.2.5.13 are going to meet the 65onsidtives of the NEO or provide a material improvement to the process of tuning plant control systems. **Energy Queensland – clarification sought and propose alternative approach to apparent system impedance** In our view, is not clear what a "step-like change" is. Ergon Energy and Energex seek clarity from AEMO on what this means. While Ergon Energy and Energex acknowledge the power system is dynamic, in that the pattern of generation and load operating at any particular time can change how the settling time of the generating system presents, this change may introduce additional complexity in terms of assessment and ongoing compliance. Rather than assessment on the basis of an 'apparent impedance', we consider that it may be more appropriate to refine the way that compliance with this clause is assessed. For example, a simple 5% step may no longer be appropriate, given the volume of generation in the system. Rather, we suggest this should be tested in a similar way to compliance with S5.2.5.5 and matching the model performance to actual network conditions to demonstrate compliance. **Goldwind Australia** The concept of having flexibility on writing the GPS to cover a wide range of SCR operation is welcome. We think that the introduction of "apparent system impedance" is more representative of the actual small signal response of the network. However, we believe it would be important to limit the assessment only to the "apparent system impedance" range rather than traditional short circuit range. We recommend this is made explicit in the rules as lack of clarity on this will introduce grey areas where AEMO/NSPs can request additional studies based on the traditional short circuit range which just adds more unnecessary work to the industry. **Neoen – comment** It should be considered how rise time and settling time integrate together. The speed of response should be tuned with consideration of nearby machines and the state (e.g. strength) of the network. Much like the tuning of PI controllers – fast tuning of control systems in weak network can increase network instability. The rise time of reactive power should be matched with the system's strength not tuned to be as fast as possible or compliant with an arbitrary number of seconds. The response of all plant connected in proximity needs to be coordinated to ensure correct, stable and appropriate sharing of response. There should be no hunting due to significantly different response characteristics. **Powerlink – Partial Support: Supports >7.5s MAS settling time; opposes apparent impedance; Alternative proposed** • We strongly support inclusion of a longer settling time than 7.5s, to be agreed with the NSP, for a voltage disturbance up to 5% (for both synchronous and asynchronous plant) in MAS.	• 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) General requirements • Include an explanation of the concept of **apparent system impedance** (see note below) and require the minimum, maximum and typical values to be recorded in the RUG. The typical system impedance level should be reflective of typical unit commitment. **Use of apparent system impedance and the range of system impedances to be considered** The majority of comments related to the proposed concept of apparent system impedance, for which AEMO sought specific feedback from stakeholders in the update report. AusNet opposed the concept of considering highest, lowest and typical impedances on the grounds of the burden on NSPs to determine these values. CEC requested an example of the calculation of apparent impedance to assist interpretation. ENA indicated that AEMO has not provided enough evidence that the changes have material benefit. SA Power Networks also requested more clarity on how apparent impedance should be calculated and what is 'electrically close' to the connection point. Energy Queensland acknowledged the issue of different generation patterns introducing complexity in assessment and ongoing compliance, but rather than assessment on the basis of apparent impedance suggested compliance should instead be demonstrated by matching model performance to actual network conditions. Goldwind welcomed the flexibility to write the GPS to cover a range of SCR operation, and considers the apparent impedance is more representative of the actual small signal conditions. They consider it important to limit the assessment to the apparent impedance range rather than the traditional short circuit range. Powerlink did not support the proposed changes, as it considered the concept of apparent system impedance will devalue the core purpose of control system tuning and further complicate plant tuning for no material gain. Powerlink agreed with the concept of tuning to achieve stability at lower fault levels, but proposed that the tuning should be set to achieve stability for a 5% voltage disturbance at an SCR of 3. TasNetworks supported the concept.

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	• We do not support the proposed changes to S5.2.5.13. We consider that the concept of apparent system impedance for S5.2.5.13 will devalue the clause's core purpose of control system tuning and further complicate the plant tuning exercise for no material gain. For the power system, the main need from each generating system is to oppose the voltage change caused by external disturbances. Therefore, compliance assessment should, in plant operation, be able to be demonstrated in the context of multiple other dynamic plant operating, as distinct from assessing or calculating what the apparent system impedance is in the field. Powerlink considers that priorities are: (1) settling time (either into a limiter or not) requirements, to a 5% external disturbance (i.e. in the field and in a NEM model); (2) stability of the plant (either into a limiter or not), to a 5% external disturbance, at SCR = 3; (3) rise time (either into a limiter or not) requirements, to a 5% external disturbance (i.e. in the field or in a NEM model); (4) stable (adequately damped) performance for a 5% voltage reference change in a NEM model and in the field; (5) documentation of the settling and rise time of a 5% voltage reference change. For simplicity, this can be performed in a SMIB file, for a range of fault levels from synchronous sources (as agreed with the NSP, and documented in the GPS); and (6) a reasonability on voltage reference change for settling and rise time should be present as part of good tuning process. In the field operation outside of plant testing, most plants are not subject to 5% Vref changes, and even if they are, there are SCADA / EMS delays that result in delays in seeing any reactive power change. Powerlink agrees with focusing performance objectives on the lower fault level scenario. Stable plant operation (as distinct from full compliance) at fault levels below a N-1 minimum dispatch scenario, but bounded to a reasonable level (e.g. SCR = 3 / the technical limit of the equipment), can be an important tuning criteria for a plant. **SA Power Networks** – Clarification sought • It is unclear how "apparent system impedance" is to be practically calculated under what dispatch conditions as this differs from the standard calculation of fault levels and Thevenin equivalents. We would like to also understand what constitutes as "electrically close to the connection point". **Solar Turbines** – Alternative proposed Reactive power and Power Factor response time is normally expected longer being a secondary loop control. The requirements proposed in the Draft Recommendation Update Response of 2s seems to be unrealistic being faster than the requirement of the core loop (some AVR provide reactive power control as input to the voltage loop).	Transgrid opposed it on several grounds: • It doesn't provide enough benefit compared with using an OPDMS snapshot • It is a lot of work for NSPs • Using lower fault levels would be more robust (to achieve tuning stable for low system strength conditions) • Transgrid opposes the use of apparent system impedance in a performance standard as – The variability of nearby generation can have a significant impact on the "voltage stiffness" of the network for a given plant. The concept of what a typical network scenario would be for these surrounding generators is too vague, especially when the surrounding plant consist of different fuel sources. – The proposal in the draft wording that a plant would need to be compliant between the nominated highest and typical system impedance, is effectively the current negotiated access standard without the specification of what that typical system impedance is. AEMO has conducted some testing on the apparent impedance concept, and the study will be made available with this report. AEMO found that, while using apparent impedance instead of impedance based on fault level does lead to response times more closely aligned to the impact considering all plant in service, the effect of changing controls on a nearby plant significantly outweighs the difference from using apparent impedance compared with impedance based on fault level. This is because the dynamics of nearby plant has a significant effect on the response of the plant under test. This is consistent with Transgrid's observation about the variability of nearby generation having a significant impact. AEMO's conclusion from the study is that while the concept is valid, the benefits of using apparent impedance are not sufficient to justify the additional complexity. **Range of impedance levels to be considered** AEMO still considers there are benefits to considering a range of system impedances for the assessment, and for it to focus on the lowest system strength cases. AEMO agrees with Powerlink's comments that the most important considerations for tuning are: • settling time for voltage disturbances, • stability at low fault level (low system strength) conditions • rise time for a voltage disturbance of 5% (determined through modelling)

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	Typically fast response time is around 5s (eg typical value in Germany); shortest response time of 3s associated to Q(U) control could lead to system voltage oscillation (reactive power deviation on big units is able to modify the voltage inducing a counter reaction etc.). Not clear reference to impedance value in the Presentation slides (to be possibly explained) **TasNetworks – Support** TasNetworks supports this proposed change. **Transgrid** – opposes use of apparent system impedance, and removal of reactive rise for setpoint • It is unclear from AEMO's proposal that introducing the concept of apparent system impedance will provide any benefit over the established method of using three-phase fault levels: – Both methods result in the tuning/assessment of the plant using a network equivalent series impedance connected to a voltage source. The only difference in outcome appears to be that the resultant impedance calculated to represent the system would be different. It is difficult to see how the use of the apparent system impedance is going to add value to this process. – – AEMO notes that "AEMO is not convinced that fault level would give a suitable measure here that IBR plant tends to have limited fault level contribution, but capable of injecting reactive power up AAS level around target voltage level". Transgrid acknowledges the transient response of IBR plant and their contribution to the "voltage stiffness", but it is unclear how this is going to be adequately captured through the use of a static series impedance in a SMIB model. This comment implies that the calculated fault level is resulting in a lower level of "voltage stiffness" to which a plant is being tuned for. Transgrid believes this is a more robust approach, as the plant would be tuned to consider lower fault levels (higher system impedance conditions). – The proposal by AEMO is also likely to result in a significant amount of additional work for NSPs to calculate apparent system impedance quantities for proponents (in addition to the fault level quantities that are currently supplied). Transgrid doesn't believe sufficient supporting evidence has been provided by AEMO to demonstrate the benefit of using this method or adequate consultation has been carried out on this matter. • Disagree with the concept of a typical apparent system impedance for the purposes of specifying a performance standard: – The variability of nearby generation can have a significant impact on the "voltage stiffness" of the network for a given plant. The concept of what a typical network scenario would be for these surrounding generators is too vague, especially when the surrounding plant consist of different fuel sources. – The proposal in the draft wording that a plant would need to be compliant between the nominated highest and typical system impedance, is effectively the current negotiated access standard without the specification of what that typical system impedance is. For a negotiated access standard, at some point along the range of fault levels between low to high, a plant would exceed the AAS requirement of a 2 second rise time. The current rules requirement is that the negotiated rise time is specified in the performance standards, rather	Powerlink also suggested documenting settling time and rise time for a 5% voltage setpoint change for a range of fault levels from synchronous sources performed in a SMIB model. However, AEMO notes that the same issue as observed in AEMO's study of apparent impedance will occur here: i.e. the real power system will not match the rise time in the SMIB, because the response is significantly affected by the dynamics of nearby plant. Settling time may also be affected by nearby plant. In terms of complexity from having to assess typical impedance, AEMO suggests that a system normal snapshot can be used for a typical impedance case. To account for the impact of local plant, the considered projects would need to be integrated with the snapshot, especially anything nearby. AEMO does not agree with Transgrid's view that focusing the performance requirements on lower system strength cases is just the same as the negotiation process at present. The intent is to focus the AAS on the low to typical range of system strength (highest to typical system impedances). The current rules are silent as to the range or the focus for tuning and tend to favour fast response to achieve the AAS' 2 second rise time for low system impedance conditions. Targeting stable operation at an SCR of three as proposed by Powerlink in the AAS would certainly focus tuning more towards the low system strength cases, but might not be suitable for plant connected in strong parts of the network, as the impedance range might be impractical for tuning. Noting several stakeholders thought that a requirement to consider high, low and typical system impedances was too much work, AEMO proposes that the range of system impedances to be assessed is based on typical impedance (represented by a system normal snapshot) and a maximum system impedance (discussed below). AEMO intends the "typical" conditions to cover the types of conditions that would be found during commissioning of the plant. Transgrid commented that it is unclear whether the RUG can be updated at some later time to reflect a different range for tuning. AEMO considers that if the plant is later retuned for different range of system impedance, because of changes to the system, then it would be appropriate to update the RUG with the new values of system impedance. The goal would be to change the tuning settings to achieve the GPS requirements considering the changed power system conditions. This would, of course also mean updating the settings in the RUG to reflect their amended values at the same time. **AAS 2 second rise time for a power system disturbance of up to 5%**

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	than retaining the 2 second requirement and carving out a fault level (or system impedance) range for which the 2 second requirement is applicable. • Agree with AEMO that the response of nearby plant can have a significant impact on a plant's own response to both setpoints and disturbances: – Recommends the use of full network models such as AEMO's OPDMS snapshots and the Connections Simulation Tool, as these are much better placed to capture the interactions with surrounding plant. As noted above, it is unclear how the concept apparent system impedance is going to provide significant benefit over using the calculated fault levels. – Considers that these tools are likely underutilised by proponents for the purposes S5.2.5.13 plant/unit level voltage control tuning. • Disagrees with the removal of the reactive power rise time requirement for a change in voltage setpoint: – It is understood that for some plant, all else being equal, the existing AAS objective for a voltage setpoint can negatively impact the stability of the plant due to aggressive tuning. – Proposes that the reactive power rise time requirement be applicable for a change in voltage setpoint or a step change in the voltage at the specified location. That is, retain the existing requirement, but introduce the requirement for a step change in the voltage. This would then align with the requirements for settling time. – This proposal allows for the plant performance to remain readily testable during commissioning whilst also facilitating the possibility of a negotiated access standard, where a different rise time can be agreed to for setpoints and disturbances. – The above proposal also better accommodates unit level voltage control, as the plant level and unit level responses can therefore be tuned for different objectives (slower setpoint change and faster disturbance response). • The magnitude of the voltage step should not be specified as any voltage less than 5%: – Not including a limit on the minimum size of the disturbance is not recommended to avoid compliance testing and requirements for very small step changes in the voltage which would have a low signal to noise ratio. – The removal of the requirement for setpoint changes, as outlined above, also make this performance criterion difficult to test onsite. • It is unclear from AEMO's proposal whether the intention of the rules is to allow the NSP to provide updated minimum, typical and apparent system impedance advice to a proponent, after the performance standards have been agreed, to which the plant is then potentially required to retune their plant for: – It is unclear if AEMO's intent is that the RUG can be updated with revised system impedance values for which the plant will be required to remain compliant with, or whether the reference to the RUG in the GPS refers only to that version at the time of GPS agreement.	Transgrid suggested including a rise time requirement for a 5% step in system voltage and also retaining the rise time for a voltage setpoint change (as a testable parameter). Transgrid also proposed that a different rise time could be set for disturbances and setpoint changes, as a negotiated access standard. Transgrid also argued that this setpoint change requirement would accommodate unit level voltage control by having different plant and unit level objective (slower setpoint change and faster disturbance response). This would add another compliance assessment requirement. Not having a setpoint related rise time requirement would be better aligned with unit level voltage control. Transgrid also objected to a rise time requirement for a disturbance of less than 5% on the grounds that the signal to noise level may be too small. AEMO acknowledges that this can be a problem for field testing, and proposes to change this to 2-5%, to avoid the measurement difficulties around small changes. Powerlink agreed with the rise time requirement for a 5% system voltage step in a model or in the field, as a compliance requirement. Solar Turbines suggested that a response time of 2s is too fast, 3s is likely to cause voltage oscillations and 5s is a typical time in Germany. Energy Queensland suggested that rather than applying a voltage step in the field the compliance could be assessed like S5.2.5.5 (by means of assessment of actual disturbances over the life of the plant, rather than specific tests) matching the model performance to actual network conditions to demonstrate compliance. AEMO agrees that achieving a 5% voltage step in field testing is usually not possible. However, a 2 second rise time for a setpoint change is not aligned to best performance for the power system, notwithstanding that it is testable. AEMO agrees with Powerlink that it is the response to voltage disturbances that matters. AEMO also agrees with Energy Queensland that the response to a disturbance can be considered over the life of the plant. As illustrated by AEMO's study, a neighbouring plant can significantly affect the rise time for a setpoint change. This is because a neighbouring plant in voltage control opposes the change in voltage. Therefore, this metric is not a good measure for compliance assessment as it is adversely affected by external factors outside the control of the generator. Nevertheless, AEMO acknowledges that it is important to assess stability of the plant during commissioning.

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	• As noted in the previous submission, Transgrid believes that amendments to these aspects of S5.2.5.13 are much better suited as general guidelines for a negotiated access standard: – The introduction of a new concept should be treated with caution, especially when it becomes a required performance standard and significantly deviates from the standard methodology carried out by both NSPs and proponents. – AEMO has not provided clear and sufficient evidence to the industry that these changes to S5.2.5.13 are going to meet the objectives of the NEO or provide a material improvement to the process of tuning plant control systems. – The current rules already provide flexibility for a negotiated access standard to be agreed upon, though the rules should be updated to provide much clearer guidance for such a negotiated standard. – The current rules are not overly complicated as they don't carve out system conditions for when the plant is considered compliant. It is recommended that the rules be updated to provided better guidance for a negotiated access standard and better guidance as to how to appropriately tune the plant when the plant's connection point might experience a wide range of fault levels (or system impedances).	AEMO agrees that a 2 second rise time is not generally suitable for typical conditions, as suggested by Solar Turbines, as the plant will become faster and less stable for lower SCR conditions. AEMO notes that the rise time for voltage disturbance is likely to be faster if new plant connects nearby or if the system impedance decreases (for example, due to the retirement of synchronous plant). Therefore, the risk of non-compliance over time to a rise time requirement based on a system disturbance is lower than for one based on a setpoint change. Since the rise time is affected by changes in generation and network over time, and because a SMIB model is unlikely to result in rise times the same as measurements for the same system impedance, AEMO does not see value in recording in the GPS rise time (or settling time) for based on 5% setpoint change a range of fault levels based on SMIB model results, as suggested by Powerlink. **Maximum impedance condition** The power system will in general tend to be less stable at system strength conditions than for high system strength. Powerlink has suggested that the tuning should give a stable response down to an SCR of 3. While AEMO supports targeting stability for weak grids, a blanket requirement for compliance assessment at SCR of 3 might not be workable for plant (especially small plant, since SCR is a function of plant size) that is connected in parts of the grid that have high fault level for typical conditions. In particular the plant may not be able to achieve the required settling time at typical levels while also achieving stable operation at SCR of 3. Therefore, AEMO does not propose to link the requirement for stable operation down to SCR of 3. For the AAS AEMO considers that a reasonable compromise might be to consider for the low system strength case, the fault level at the connection point based on the minimum fault level associated with the electrically closest system strength node, in combination with the network outage that most reduces the fault level at the connection point. The minimum fault level condition would usually be higher than the equivalent fault level agreed under S5.2.5.15 for minimum SCR, but there may be some cases where it would be lower, in which case the value under S5.2.5.15 should be considered, as this is a design limit of the plant. Note that the minimum SCR agreed under S5.2.5.15 might also be less than 3 in some cases. For this maximum system impedance condition, AEMO suggests the plant should have a settling time of 5 seconds/7.5 seconds for a 5% voltage disturbance for operation not into a limiter and into a limiter

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		respectively. Since this condition is unlikely to occur in normal conditions on the power system, the assessment would necessarily be by simulation, rather than testing. **Operation out of limiters** In addition, AEMO proposes to extend the settling time requirements to conditions where the plant response is starting from a limited condition and the voltage or setpoint step causes it to exit the limit. This aims to test for whether wind-up of the controller is occurring. Wind-up of a controller is an undesirable behaviour, which in the context of a voltage controller, can cause a voltage excursion to be prolonged, by delaying the reactive power response. **Summary** In summary, the modified proposed rise time and settling time requirements for the AAS and voltage control are: • 3 second rise time for a steplike 2-5% voltage disturbance not into a limit for typical system impedance to maximum system impedance conditions • 5 second settling time (not into a limiter) and 7.5 s settling time (into and out of a limiter) for a 5% voltage setpoint change considering typical power system impedance conditions at the connection point • 5 second settling time (not into a limiter) and 7.5 s settling time (into and out of a limiter) for a steplike 2 to 5% voltage disturbance for typical to maximum system impedance conditions at the connection point • Maximum system impedance conditions at the connection point are defined with reference to the higher of the fault level corresponding to the performance standard agreed under S5.2.5.15 and the fault level at the connection point considering the fault level required to be maintained at the electrically closest system strength node, in conjunction with the network outage which most reduces the fault level at the connection point. In addition, AEMO proposes to make consistent impedance ranges for synchronous plant for the settling time criteria for synchronised operation (S5.25.13 (3) (B) and (C)), to address an omission in the indicative drafting provided with the update report. Note that the assessment conditions are based on the same criteria as for the minimum fault level in S5.2.5.5 for tuning and for MFRT requirements. AEMO can issue guidance to describe more fully what typical impedance conditions comprise, and the concept of steplike in this context. Use of a wide-area model (such as an OPDMS snapshot) is

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		more likely to capture the dynamics of nearby plant than a SMIB model for the typical case, which should enable comparison with model behaviour for testing. Typical impedance can change over time, so tuning settings might eventually need to change if the power system impedance characteristics change significantly. Referencing the values of fault level in the RUG (as discussed in S5.2.5.5) will assist future identification of when tuning might need to be reviewed. **Final recommendation** Considering all feedback, AEMO will modify the update report recommendations to: • change "apparent system impedance" to system impedance • change the rise time requirement from 2 to 3 seconds and not into a limiter • change to a 2-5% voltage disturbance performance requirement, rather an "up to 5%" requirement • add the requirement for settling time for steps out of a limit • omit reference to minimum (apparent) system impedance conditions (i.e. the range to be considered is from "typical" to maximum impedance conditions) • define maximum system impedance conditions, consistent with that proposed for S5.2.5.5 tuning range • apply the same range of impedances to synchronous machine settling time for voltage setpoint step and voltage disturbance into/out of and not into limiters. The MAS requirement for settling time is discussed below. The full list of rise time and settling time requirements considering these and other changes is provided in Appendix 4.
Minimum access standard for settling time	**CEC – partial support, alternative proposed** Member feedback was received where the 7.5 second settling time could not be met due to a network asset that had a very slow settling time, hence voltage would not settle within 7.5 seconds resulting in the generator being non-compliant. The MAS for settling time is 7.5 seconds for non-limiter operation. Recommend that the requirement for settling time in the MAS be removed to account for the above scenario. **Energy Queensland – Do not see a need** Ergon Energy and Energex do not support an open-ended settling time 'limit'. Ergon Energy and Energex are not aware of any technical reason why a 7.5s settling time cannot be achieved by new plant. **Powerlink – Supports**	The update report proposed an allowance for a system voltage disturbance of 5%, a settling time of 7.5s or greater number agreed with the NSP. This was based on a request from Transgrid in feedback to an earlier round of consultation. This change received some specific feedback. It was supported by Powerlink. The CEC requested removing the requirement altogether, but the specific condition described would be manageable with the change proposed in the update report. Energy Queensland did not see the need for the change. However, an NSP does not need to use the provision if they do not have the need, for

NER Schedule 5.2 issue	Summary of feedback provided – Schedule 5.2	AEMO response
	• We strongly support inclusion of a longer settling time than 7.5s, to be agreed with the NSP, for a voltage disturbance up to 5% (for both synchronous and asynchronous plant) in MAS.	this provision which is intended to provide additional flexibility for unusual situations. **Final recommendation** Considering all feedback, AEMO will retain the update report recommendation, for typical impedance and specifying the voltage disturbance to be "step-like". The full list of rise time and settling time requirements considering these and other changes is provided in Appendix 4.
Clarification of when multiple modes of operation are required	**Akaysha Energy – Support** The submission supports the simplification of reactive power control modes into primary and secondary modes. **AusNet – support** • AusNet supports AEMO's revised recommendation **CEC – Support with clarifications** • The concept of a primary and alternate control mode is welcome. This would reduce time and effort required for modelling as well as during commissioning where presently three modes are assessed. • The codifying of voltage control as the primary mode may preclude using other modes as the primary mode (eg power factor). Both for existing and well as legacy plant that may be currently operating in power factor mode that go through the 5.3.9 process. • Alternatively, propose that only two modes are required, a primary and alternate mode. • Unclear why settling time compliance for setpoint changes is carved out but for voltage disturbances it is retained. A generator would need to apply setpoint changes to confirm compliance rather than wait for a network event. **Energy Queensland – Partial support** Ergon Energy and Energex consider that if a secondary mode is required, that adequate tuning of that mode should be demonstrated. **Powerlink – Supports with clarification** Powerlink considers the NSP should be specifying the primary and secondary control modes. We agree that the secondary control mode should have reduced assessment requirements. However, secondary control mode assessment should include that the required reactive power target (or power factor) is met within a given tolerance. **Solar Turbines – Support with clarification** Signal leading to control mode switching shall be defined. This shall include how the switching shall happens. **TasNetworks – Supports** TasNetworks supports this proposed change.	The intent of the proposed changes is to reduce the AAS requirement for three modes of operation down to two, and to place more compliance emphasis on the mode of operation under which the plant will operate most of the time. The proposed changes seek to require, in the AAS a primary and secondary mode of operation. The primary mode is the mode that will be used most of the time, and the secondary mode occasionally. Conditions for use of the secondary mode might include testing or operation under planned network outages. The proposed changes contemplate reduced compliance requirements for the secondary mode. Additional considerations for this clause have been to focus the compliance requirements on measures that are appropriate for the desired outcomes on the power system and ensuring the outputs assessed for compliance are suitable for the characteristic that is being tested. As an example, the proposed drafting removes a requirement to assess voltage settling time for a reactive power setpoint step change, as voltage is not a controlled parameter for reactive power control. Reducing the number of operating modes to two, and the concept of a primary and secondary mode has received strong support from stakeholders over the draft report and in the update report and drafting consultation. Some stakeholders expressed different opinions on some detailed implementation issues, which are considered further below. **Specification of the primary mode** Powerlink and Transgrid suggest that the NSP should have the flexibility to specify different primary control modes, whereas the proposed rule has voltage control as the primary mode. Powerlink and Transgrid did not say why this would be preferred other than if the proponent proposes voltage as a primary mode, then the NSP cannot require an alternative mode as primary mode. AEMO agrees that if a proponent proposes voltage control as a primary mode, the NSP cannot object to it. CEC suggests that codifying voltage control as primary mode may

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	Transgrid – Support with clarification • Suggests retaining the existing rules requirement for the settling time for a step change in reactive power (or power factor) setpoint for the secondary control mode. The secondary control model should be appropriately tested during commissioning. Reference setpoint tests are important to verify that the plant has been turned appropriately for the mode. • Recommends that the rules have flexibility to allow for a different primary control mode, at the discretion of the NSP. The reason why this flexibility is important for the AAS, is because if a proponent proposes voltage control mode as the primary control and it is the AAS, then the NSP must accept that, as per the requirements of the NER.	prevent another mode from being primary mode, which might affect current and legacy plant that is going through a NER 5.3.9 process. AEMO notes that the proposed drafting does not preclude having power factor or reactive power mode as a primary mode as a negotiated access standard. AEMO considers power factor or reactive power mode would only be preferable where necessary to work around a technical limitation that cannot be otherwise resolved with voltage control mode. Note that there would be an option to limit the range of reactive power for voltage control purposes should it be desirable to have something closer to reactive power control. However, there may be some rare cases where, to resolve a network issue, specification of a mode other than voltage control for a primary control might be necessary. Therefore, AEMO proposes to permit the NSP, in consultation with AEMO, to specify a different primary and secondary mode to cater to special circumstances on the power system, but in that case to require voltage control as a secondary mode of operation. **Requirements for compliance assessment** There is a tension between demonstrating adequate tuning and the burden of time and resource from compliance assessment, validation during the connection phase, at commissioning and throughout the life of the plant. AEMO agrees with Energy Queensland that adequate tuning must be demonstrated both for primary and secondary modes. Transgrid suggested retaining the existing rules requirement for settling time for a step change in reactive power setpoint for the secondary control mode, and that the secondary control mode should be appropriately tested during commissioning. Transgrid preferred setpoint testing because it is something that can be done during testing. CEC commented that it is unclear why settling time compliance for setpoint changes has been carved out of the requirements for power factor and reactive power, and suggested that setpoint step settling time compliance can be assessed at commissioning rather than waiting for a voltage disturbance. Considering the last comment AEMO notes that having a setpoint step settling time requirement would not make any difference to the time required to confirm compliance with a voltage disturbance (which requirement AEMO proposes to retain). AEMO acknowledges that it is useful to be able to validate responses through testing. The concern with setpoint step testing is that a large setpoint step change of power factor or reactive power of the type described in the current rule is neither necessary nor desirable on the power system and is therefore not a suitable measure for compliance: A slower overdamped response to a setpoint change may have a long settling

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		time but this would be suitable for a reactive power or power factor mode of operation, so a 5 second settling time is not a suitable measure of a "good" response. As Powerlink indicated, the important control performance characteristic is the response to voltage disturbances, for which a shorter settling time is desirable. As a compromise, and to verify that the power factor and reactive power modes are stable, a requirement for the controls to be adequately damped could be substituted. Powerlink agrees that the secondary mode should have reduced assessment requirements but suggests that the secondary control mode assessment should include that the required reactive power target or power factor target is met within a given tolerance. AEMO agrees that tracking a target level to within a reasonable tolerance is an important performance characteristic, but notes that AEMO has not proposed any changes to the existing rules, which include regulation requirements, irrespective of primary or secondary mode operation. **Final recommendation** In the AAS: • Require two operating modes, a primary and secondary mode with the ability to switch between them • By default, the primary mode is voltage control, but permit the NSP under the AAS to require a primary operating mode other than voltage control, with voltage as the secondary control mode. • Where voltage is the secondary mode, omit the reactive risetime requirement. • For power factor and reactive power modes: – Remove the requirement to assess voltage settling time – Retain the requirement to assess reactive power settling time, and for power factor mode, active power settling time, for voltage disturbances, and – For a setpoint step not into a limit equivalent to at least half the range of reactive power agreed in S5.2.5.1 require that reactive power, if response overshoots or exhibits oscillatory behaviour, has a settling time of 5 seconds or less. • Where power factor mode or reactive power mode is the primary operating mode, require the same range of system impedances for each assessment listed above as for the voltage control assessment (described above).

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		• Otherwise, for a secondary mode, require the voltage disturbance step responses for that mode to be assessed for typical impedance that would occur in normal operation of the grid. • A ramp-limit on a setpoint change may be applied, where agreed with the NSP and AEMO (apply this to all three modes). Full detail of how AEMO's proposal would apply for risetime and settling time requirements across voltage, power factor and reactive power control, AAS and MAS and primary and secondary modes, is provided in Appendix 4.
Materiality threshold on settling time error band	**Transgrid – Partial Support; Alternative proposed** • Transgrid agrees with the introduction of a materiality threshold for active power settling time in response to a voltage step or voltage setpoint. • Transgrid agrees with AEMO's intent to "avoid the calculation where it is not meaningful...", yet AEMO doesn't appear to have considered that a fixed 3 MW materiality threshold can still lead to relatively small error bands being calculated for large plant, thus leading to potential calculations which are not deemed meaningful. Furthermore: – For a large plant, a 3 MW materiality threshold can result in an extremely small tolerance to which AEMO is expecting the plant to regulate active power within. For example, if a 500 MW plant exhibited a maximum change of 5 MW in response to the step, then this would require the plant to regulate active power to back within ±0.5 MW, or ±0.1% of the rated active power. This tolerance for the settling error band is not considered reasonable, cannot be readily verified through on-site testing and does not appear to serve a useful purpose as a performance standard. – If the induced change in active power is relatively small compared to the size of the plant but above the materiality threshold of 3 MW, then a plant controller's integral gain would need to be tuned relatively aggressively to regulate the active power to within such a small tolerance. Even with the added flexibility of the updated MAS for settling time, this is not deemed to be a reasonable incentive to speed up the active power controller's response time. – Such a small tolerance bands for large plant would also prohibit plant controllers from setting reasonable deadbands around the target setpoint or only allow setting dead them to be so small as to be of no value. • Transgrid recommends using the rated active power when determining the materiality threshold, potentially with an upper limit the maximum magnitude of the threshold. In addition, consideration should be given to an allowable deadband for the active power control response to a change in voltage setpoint. This would be in line with the setpoint accuracy requirement for reactive power control in S5.2.5.13, where the rules require that the plant only need to be able to regulate reactive power to within 2% of the rating (in MVA; expressed in MVAr).	AEMO agrees with Transgrid that there is often a deadband for active power, particularly within the power plant controller of a distributed generating system (eg wind or solar farm), but also on some other types of plant, in which the active power controller will not seek to control the active power. This means that active power variations due to internal (eg energy source) or external factors (eg voltage fluctuations on the power system) within the deadband will not be corrected. The rules do not specify an accuracy requirement for active power within the technical standards but rely on conformance with dispatch measures instead. AEMO notes that +/-0.5 MW is the smallest error band under this materiality threshold, (unless the active power output changed as a result of the voltage setpoint step, noting that a large active power change for a voltage disturbance step would most likely be non-compliant with S5.2.5.4). The proposed change was intended to address situations where the small change in active power in combination with background changes in active power or voltage mean that the settling time cannot be reasonably determined. Transgrid's concern is around the relative size of the plant to the threshold. **Alternative formulation** An alternative formulation would apply a an error band of: • ±0.5 MW; • ±2% of the maximum active power (or maximum demand, as relevant) agreed under a performance standard for clause S5.2.5.1; or • the value of error band calculated using the definition of settling time. Settling time would need to be calculated for larger deviations, but with error band thresholds modified to be at least ±0.5 MW for plant sized

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		up to 25MW, linearly increasing to be at least ±2MW for a 100 MW plant, ±20 MW for a plant of 1000 MW. **Materiality thresholds more generally** ElectraNet and Neoen observed, under responses to the proposed settling time definition change that this change made the error bands smaller for settling time generally. AEMO notes that that proposed change aligns the settling time for the two parts of the definition, but agrees that error band size can be too small for sustained changes of reactive power and voltage under S5.2.5.13 as well as active power. On consideration of ElectraNet and Neoen's comments, AEMO proposes to extend the consideration of error band threshold to all uses of this clause (voltage, reactive power and active power), and to make consistent error band allowances. **Final recommendation** Amend the NER as follows, for active power settling time: • Apply a settling time error band that is the largest of: – ±0.5 MW – ±2% of the maximum active power (or maximum demand, where relevant) agreed under a performance standard for clause S5.2.5.1, and – the value calculated under the settling time definition. Amend the NER as follows, for reactive power settling time • Apply a settling time error band that is the largest of: – ±0.5 MVAr – ±2% of the maximum reactive power agreed under a performance standard for clause S5.2.5.1, and – the value calculated under the settling time definition. Amend the NER as follows for voltage settling time: • Apply a settling time error band that is the larger of: – ±0.5% of nominal voltage and – the value calculated under the settling time definition.
Impact of a generating system on power system oscillation modes	**Akaysha Energy – Support with clarification** Akaysha Energy would like to understand the assessments required to support the MAS in the "do not harm" in the existing network damping. The submission supports the "call out" of the system strength framework, for IBR that pays for service to mitigate instabilities. The submitter is	The proposed amendments in the update report were to: • Modify the MAS to require the plant not to reduce the damping of any oscillation that is not adequately damped.

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	concerned that reference to oscillation modes relates to SSAT models, which may be difficult for new OEMs to produce. The submitter suggests the clause could be relaxed to reduce the barrier to entry of new OEMS. **AusNet – supports** AusNet supports AEMO's revised recommendation **CEC – No concerns raised** No major comments on what is proposed **Energy Queensland - Partial Support; Alternative proposed** Ergon Energy and Energex agree it is reasonable to include the performance of the system strength service provider, where relevant. We consider that plant should not reduce the damping of any oscillations and are supportive of removal of the reference to "is not adequately damped". **Hydro Tasmania – comment** HT is aware that the acceleration of the IBR has been one of the key drivers of the NER change, unfortunately, synchronous generator doesn't [sic] necessarily across in the issue, such as the unique 7-10Hz oscillation mode associated with the GFL inverter tuning experienced in the NEM as mentioned in the consultation draft report, despite synch condenser operation provides fault level support to mitigate the issue. So as big take away, HT would suggest that rather than relying on a consultation process to educate, update and discuss the emerging matters with the participants, can AEMO create a platform, so that the emerging issues, concerns, insights, rule change supporting evidence and discussion outcomes etc. can be shared and recorded in public, timely and traceable manner. As a result, to better engage with the participants and support the 3-5 years once NER change, ultimately, underpin the NEN transformation. **Powerlink – Support with clarification** In relation to: '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', Powerlink considers that the nature of a system strength solution planned by an SSSP to meet S5.1.14 can change between the planning and implementation phases. Mandating this approach in MAS could lead to tuning/assessment that may not be real. We therefore recommend this is included as an optional (i.e. may) instead of a mandatory (i.e. must) requirement, based on the NSP's requirements. **Solar Turbines – Comment** • The proposed modification/addition is not clear. Better clarification is needed to provide feedback. **TasNetworks – Supports** TasNetworks supports this proposed change. **Tesla – Support** Tesla is supportive of this revised recommendation.	• 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. AEMO's response below analyses these issues in turn: **Modification of MAS to require the plant not reduce the damping of any mode that is adequately damped** AusNet, CEC, TasNetworks, Tesla, and Transgrid supported this recommendation. Transgrid suggested reformatting the requirement to be clearer. However, after further consideration of the proposed change, and recognising that the current MAS includes a requirement not to degrade any mode of oscillation that is within 0.3 nepers per second of being unstable by more than 0.01 nepers per second, the existing rule seems to cover the proposed change sufficiently well. Therefore, AEMO does not intend to progress part of the proposed rule change. **Accounting for remediation by the SSSP in the assessment** Akaysha Energy, AusNet, CEC, Energy Queensland, TasNetworks, Tesla and Transgrid supported this change. Transgrid noted that paying system strength charge should not preclude the connecting plant from a requirement to optimise the plant design and control settings if stability issues are identified. Powerlink suggested that the nature of a system strength solution might change between planning and implementations phases. Powerlink suggested that this might lead to tuning and assessments that may not be real. Powerlink suggested the wording be changed so that it may (instead of must) take account of the performance to be required by the SSSP at the relevant system strength node. However, AEMO does not see that this would resolve the issue faced by the proponent, if the SSSP were to change its mitigation strategy. In any case, it would be anticipated that the level of support for system strength that the proponent is paying for should not be reduced to the extent that the plant becomes non-compliant with this clause. AEMO also acknowledges some more general comments made in response to this clause, but these are not specific to the issues under examination. **Final recommendation** Considering the stakeholder feedback, AEMO will:

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	Transgrid – supports with clarification • Supports AEMO's intent in modifying the MAS to require the plant not to reduce the damping of any oscillation that is not adequately damped. • Combining this requirement with the current S5.2.5.13(d)(ii)(A) as per the proposed drafting in Appendix A2 makes application of this requirement ambiguous. For clarity Transgrid suggests S5.2.5.13(d)(ii) to be amended to: "(ii) operation of the schedule 5.2 plant production unit does not degrade: (A) damping of any oscillation mode not adequately damped; (B) any mode of oscillation that is within 0.3 nepers per second of being unstable, by more than 0.01 nepers per second; and (C) any other mode of oscillation to within 0.29 nepers per second of being unstable; and" • Supports the revised recommendation requiring the assessments to consider the required performance from the system strength service provider at the relevant system strength node, noting that paying system strength charge should not preclude the connecting plant from being required to optimise plant design and control system tuning if stability issues are noted at the connecting location.	• omit the additional requirement on oscillations not adequately damped • retain its update report recommendation on accounting for remediation by the SSSP when the Schedule 5.2 Participant has elected to pay the system strength charge (under NER 5.4B(b1), other than to reformat the clause S5.2.5.13(d)(ii)(A) for improved clarity.
Definition – continuous uninterrupted operation		
Recognition of frequency response mode, inertial response and active power response to an angle jump	**Akaysha Energy – Commentary; supportive of allowing for phase jump and fast frequency response)** The submission highlights that GFM responds to phase angle jumps, regardless of whether the inverter enters FRT and in transient timeframes and that Very Fast FCAS contingency response is likely to be provided by GFM. The submitter strongly believes that requirements in CUO should not disincentivise fast frequency and virtual synchronous control features. **AusNet supports** AusNet supports AEMO's revised recommendation **CEC Support** No major comments on what is proposed. **Energy Queensland – Support** Ergon Energy and Energex are supportive of inclusion of provisions for inertial response **Neoen – clarification sought** 1. Is inertial response not adequately addressed in S5.2.5.11? 2. How is active power response and voltage phase angle response assessed in practi–e - i.e. for an operational facility? It is important to understand the difference between models and physical plant when looking at sub-cycle performance. **Powerlink – Does not consider this change necessary**	The proposed change sought to recognise frequency response mode, inertial response and active power response opposing an angle jump as legitimate behaviours, within the definition of CUO. Akaysha Energy, AusNet, CEC, Energy Queensland, TasNetworks, Tesla and Transgrid supported this proposed change. Powerlink did not see the need for it, commenting that the existing rules have been used to manage these issues. However, AEMO notes that clearer recognition of these behaviours as positive for the power system reduces the perception that they are not consistent with CUO. As previously noted, inertial response is programmed in IBR GFM technology not inherent. AEMO is seeking to remove impediments to their connection and speed up the process for connection. It is difficult to ensure that engineering judgement is always applied, when the rules can be literally read as preventing desirable behaviours. Neoen sought clarification as to whether inertial response is covered by S5.2.5.11. AEMO considers that S5.2.5.11 refers to frequency droop response, rather than inertial response. Neoen also queried how active power response to a phase angle jump can be practically measured. AEMO considers this could be observed in assessment of power system incidents, considering the phase shift

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	We do not see the need for this change. The current definition of CUO can be used to manage the issues raised in the Discussion Paper. The proposed changes appear to focus on 'how to apply engineering', which we do not consider a primary role of the Rules. **Solar Turbines – Supports / Comment** Natural behaviour for synchronous generating expected to be already in line with requirements. **TasNetworks – Supports** TasNetworks supports this proposed change. **Tesla – Supports** Tesla remains supportive of this recommendation. **Transgrid – supports** • Transgrid supports the amendments proposed to the CUO definition. • Transgrid has seen issues with application of CUO requirement in paragraph (d), when considering inadvertent disconnection scenarios (classified as credible contingency events under S5.1.2.1) for assessing feasibility of transfer trip schemes under clause S5.2.5.8(d). This issue is exacerbated by the lack of clarity in the system standards under clause S5.1a.4 on the allowable reduction in voltage of supply at a connection point due to a contingency event. There should be flexibility for the NSP to allow transient voltage variations below 90% of normal voltage for a limited period due to inadvertent disconnection of transmission plant, provided that there are no material adverse impacts to other connected plant	measured at the connection point, and the response of the plant. This type of response can also be observed in simulations. Transgrid also raised a separate issue about application of CUO paragraph (d) when considering inadvertent disconnection scenarios for assessing the feasibility of inadvertent disconnection scenarios. However, this issue is not one that AEMO proposes to address in the current review. We suggest that Transgrid might consider raising it as a separate rule change request. **Other changes to the CUO definition** The current drafting of the CUO definition is very focused on S5.2.5.5, whereas the other clauses also use this definition. AEMO has proposed some minor amendments that make the drafting more appropriate for other clauses. The drafting changes were reflected in the rules drafting provided for comment with the Update Report. No comments on these changes were received. **Final recommendation** Considering all feedback, AEMO will retain its update report recommendation, noting also the minor drafting improvements to make the clause more general.

4 Schedule 5.3a feedback

Schedule 5.3a Conditions for connection of MNSPs

Issue	Summary of feedback provided – Schedule 5.3a	AEMO response
NER S5.3a.1a Introduction to the schedule		
Alignment of schedule with plant-type rather than registration category	**Marinus Link supports** • Marinus are supportive of the proposal to remove NER S5.1 obligations from HVDC network elements that are covered by NER S5.3a. • Marinus notes an unintended consequence of the proposed drafting where NER 5.3.4B replaces Market Network Service Providers with Schedule 5.3a Participant, thus requiring all HVDC elements to pay system strength charges rather than only non-regulated HVDC elements. This is inconsistent with the text of the update report. Marinus suggest that the NER include an explicit statement in 5.3.4B that system strength mitigation requirements for HVDC systems owned by regulated NSPs should be addressed by means of the joint planning process. **TasNetworks support** TasNetworks supports this proposed change.	AEMO notes the support from Marinus Link for removing the NER S5.1 obligations from HVDC network elements that are covered by NER S5.3a. AEMO agrees that there is an inconsistency between the policy and drafting of NER 5.3.4B in regard to the payment of system strength charges by a regulated NSP that owns an HVDC link. AEMO considers that a NSP that owns and operates an HVDC link should not pay system strength charges on the basis that: • the HVDC project would be developed using the NER joint planning process: and • any system strength mitigation costs are included in the associated RIT-T. AEMO will review the drafting to be consistent with its policy. AEMO agrees that “voltage transformer” in NER S5.3.3(c)(1) and S5.3a.6(c)(1) should be italicised. AEMO notes the support from TasNetworks. **Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation.
NER S5.3a.8 – Reactive power capability		
Reactive power	**Marinus Link supports** Marinus is generally supportive. **TasNetworks support** TasNetworks supports this proposed change.	AEMO notes the support from Marinus link and TasNetworks. **Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation.
NER S5.3a.13 – Market network service response to disturbances in the power system		
Voltage disturbances	**Marinus Link supports**	AEMO notes the support from Marinus link and TasNetworks.

Issue	Summary of feedback provided – Schedule 5.3a	AEMO response
	Marinus is generally supportive. **TasNetworks support** TasNetworks supports this proposed change.	**Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation.
Frequency disturbances	**Marinus Link supports** Marinus is generally supportive. **TasNetworks support** TasNetworks supports this proposed change.	AEMO notes the support from Marinus link and TasNetworks. **Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation.
Fault ride through requirements	**Marinus Link supports** Marinus is generally supportive. **TasNetworks support** TasNetworks supports this proposed change.	AEMO notes the support from Marinus link and TasNetworks. **Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation.

NER S5.3a.4 – Monitoring and control requirements

Remote monitoring and protection against instability	**CTLab support** Supports alignment with S5.2.5.10. **Marinus Link supports** Marinus is generally supportive. **TasNetworks support** TasNetworks supports this proposed change.	AEMO notes the support from CTLab, Marinus link and TasNetworks. **Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation.

New standards

Voltage control	**Marinus Link supports** Marinus is generally supportive. **TasNetworks support** TasNetworks supports this proposed change.	AEMO notes the support from Marinus link and TasNetworks. **Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation.
Active power dispatch	**Marinus Link supports** Marinus is generally supportive. **TasNetworks support** TasNetworks supports this proposed change.	AEMO notes the support from Marinus link and TasNetworks. **Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation.

5 Multiple schedule feedback

Multiple Schedules

Issue	Summary of feedback provided – Multiple Schedules	AEMO response
NER Multiple clauses		
References to superseded standards	**Powerlink - Supports** Powerlink supports this proposed change. **TasNetworks – Supports** TasNetworks supports this proposed change.	AEMO notes support from Powerlink and TasNetworks. **Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation.

6 Structural amendments feedback

NER structural amendments

Issue	Summary of feedback provided – NER structural amendments	AEMO response
NER structural amendments		
Drafting principles	**Powerlink – Opposes; Alternative proposed** Flexibility to include components of S5.2 should be available at NSPs and AEMO at their discretion. (As noted above) **TasNetworks – Supports** TasNetworks supports this proposed change. **Transgrid – additional comment pending** Intending to provide further feedback on the NER structural amendments.	See comments under S5.2.1 regarding Powerlink's comments on inclusion of synchronous condensers in schedule 5.2. AEMO acknowledges TasNetworks' support of the proposed changes. No further feedback was provided by Transgrid.
Proposed approach	**TasNetworks – Supports** TasNetworks supports this proposed change. **Transgrid – additional comment pending** Intending to provide further feedback on the NER structural amendments.	AEMO acknowledges TasNetworks' support of the proposed changes. No further feedback was provided by Transgrid.

7 Consequential amendments feedback

Consequential amendments

Issue	Summary of feedback provided – Consequential amendments	AEMO response
Definitions		
production system	N/A	
Schedule 5.2 plant, Schedule 5.3 plant and Schedule 5.3a plant	N/A	
Schedule 5.2 Participant, Schedule 5.3 Participant and Schedule 5.3a Participant	N/A	
synchronous condenser	N/A	
synchronous condenser system	N/A	
active power capability	**Neoen – alternative proposed** Need to careful that the definition does not become circular. Consider using the term "maximum operating level" as defined in S5.2.5.11 rather than introduce another term. **Transgrid – changes proposed** • Active power capability: The definition refers to the term "bid-validation data" for scheduled plants. Transgrid suggests to use a term that refers to the physical status of the plant, for example the number of "in-service generating units". Bid validation data is also not available to plants that are in the connection process, and not yet connected. This term has been referred in multiple clauses such as S5.2.5.1, S5.2.5.10, S5.2.5.11, S5.2.5.13 and S5.2.5.15. Further consideration should be given to how this term is used across various clauses; it appears that in some clauses the term is used as a reference to the maximum amount of active power at the connection point with all generating units in-service, while in other clauses it appear to refer to a level of active power below the maximum active power.	The term is proposed to replace 'rated active power' for the purposes of the technical requirements for connection, because equipment nameplate rating is often not a helpful indication of the level at which plant can operate while meeting all its performance standards. Individual access standards The draft recommendation was to redefine the existing term 'active power capability' as: 'the maximum amount of *active power* that is permitted to be transferred to a *connection point* from a *production unit*, *generating system* or *integrated resource system* (as the case may be), specified or proposed to be specified in a *performance standard* or *connection agreement.* For a *production unit* that is a *scheduled resource*, the active power capability is equal to the maximum *generation* quantity specified in the *bid validation data*.' In: • S5.2.5.1 it refers to the maximum amount of power permitted to be transferred from the connection point, from a *generating system* or *integrated resource system* • S5.2.5.10 it refers to the maximum amount of power permitted to be transferred through the connection point, from a *generating system* or *integrated resource system*

Issue	Summary of feedback provided – Consequential amendments	AEMO response
		• S5.2.5.11 in regard to droop it refers to the maximum amount of power permitted to be transferred to the connection point, from a *production unit.* • S5.2.5.13 in regard to operation of the stator it refers to the maximum amount of power permitted to be transferred from the connection point, from a *production unit.*S5.2.5.15 it refers to the maximum amount of power permitted to be transferred through the connection point, from a *generating system* or *integrated resource system.*(with all units in service). As discussed in AEMO's response on the S5.2.5.1 issues, where the term is used in relation to a production system, AEMO will propose clarifications to ensure that, where relevant to the technical requirement, only the capability of the in-service (operating) production units is considered. In relation to Transgrid's concern regarding bid validation data, AEMO notes that a resource can only be scheduled (and hence this part of the proposed definition would only apply) once it has been registered and classified as such. The purpose of this provision is that bid validation data should match the recorded active power capability, not that the bid validation data dictates the active power capability. **Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation, subject to: • Clarification that the maximum value in the bid validation data should reflect the recorded active power capability in the performance standards, rather than the bid validation data defining the active power capability. • Including any necessary drafting adjustments in the proposed access standards to confirm the relationship of performance capability with the number of in-service (operating) units where relevant.
nameplate rating	N/A	
negotiated access standard	N/A	
normal voltage – definition removed	**Powerlink – Support on normal voltage deletion** Powerlink generally supports the proposed changes (e.g. to rise time and deletion of normal voltage), noting our comments on CUO above.	AEMO acknowledges Powerlink's support of the proposed changes.
performance standard	N/A	
plant	N/A	
rated active power - deleted	See 'active power capability'	
rated maximum demand - deleted	N/A	

Issue	Summary of feedback provided – Consequential amendments	AEMO response
reactive power capability	N/A	
rise time	**Powerlink – Support on risetime** Powerlink generally supports the proposed changes (e.g. to rise time and deletion of normal voltage), noting our comments on CUO above. **TasNetworks – opposes change to rise time definition** TasNetworks disagrees with changing the definition of "rise time". The proposed definition is open to different interpretations on how to calculate the mean sustained change. Unless the definition can be modified to remove this ambiguity TasNetworks recommends the definition is left unchanged. **Transgrid – supports in principle changes to the risetime definition** Rise time: As per commentary for S5.2.5.13 above, AEMO has proposed to amend the definition of rise time, such that longer-term dynamics and external influences following the step change are disregarded. Transgrid agrees with this in principle noting that there is ambiguity in what constitutes 'longer term dynamics'. In addition, AEMO should clarify whether an 'external influence' is separate to the Schedule 5.2 plant entirely or can be a separate control system within the Schedule 5.2 plant (separate to the main control system controlling the change output quantity). For example, the unit level voltage control response might be subject to slower dynamics of the plant controller.	The reference to external influence in the rise time definition is intended to mean external to the generating system. **Final recommendation** AEMO will clarify this in the definition to say: In relation to a control system, the time taken for an output quantity to rise from 10% to 90% of the mean sustained change induced in that quantity by a step change of an input quantity, disregarding longer-term dynamics and influences external to the generating system, following the step change.
settling time	**ElectraNet – opposes change in error band calculation in Settling time definition** Chapter 10, definition of Settling time - This change in definition has the effect of requiring much tighter tolerances for settling when the maximum change is large relative to the sustained change. It is unclear why this change is proposed. The new drafting materially affects the interpretation of performance standards under s5.2.5.13 and presents a risk to 5.3.9 proposals for existing generators. **Neoen – on settling time error band change** The proposed change appears to be halving the band for settling time. What is the benefit of tightening this band by so much and how will it be assessed? This is typically assessed in PSS/e which cannot provide this level of accuracy. The accuracy of the models (PSS/e or PSCAD) has its limits as well – halving the band will again prolong and complicate the S5.2.5.13 discussions without a clear benefit to network operation.	AEMO recognises that the change materially affects the tolerances for settling time when the maximum change is large relative to the sustained change. AEMO has considered this difference with the change to add a threshold to error band in S5.2.5.13 settling time assessment for active power, reactive power and voltage deviation during voltage steps. (See the section on materiality of settling time error bands under S5.2.5.13 above.) In conjunction with the proposed changes in S5.2.5.13, which provide wider error bands for small changes, a more standard settling time definition can be used. **Final recommendation** AEMO proposes to amend its final recommendation as follows: In relation to a *control system*, the time measured from initiation of a step change in an input quantity to the time when the magnitude of error between the output quantity and its final settling value remains less than 10% of the sustained change induced in that output quantity. Note that this change needs to be made in conjunction with associated modifications of error bands for active power, reactive power and voltage (as described under S5.2.5.13).
short circuit ratio	N/A	

Issue	Summary of feedback provided – Consequential amendments	AEMO response
voltage – definition deleted	**Marinus Link – supports un-italicising of voltage; flags drafting errors** MLPL supports AEMO's proposal to remove the definition of the term voltage on the basis that this term is best understood from an engineering perspective in the context where it is used. MLPL notes two instances in which the word voltage has been incorrectly un-italicised when part of the composite defined term *voltage transformer*. These are in proposed amendments S5.3.3.(c)(1) and S5.3a.6(c)(1).	AEMO thanks MLPL for its review of the drafting and acknowledges the oversights, which AEMO will correct in its rule change proposal. **Final recommendation** Considering the stakeholder feedback, AEMO will retain its update report recommendation with minor modifications to retain italicisation when part of the composite defined term *voltage transformer* (proposed amendments in S5.3.3.(c)(1) and S5.3a.6(c)(1)).
Technical changes		
Incorporating synchronous condensers	**Powerlink – Partial support; Alternative proposed** We consider there should be discretion, as agreed by the NSP and AEMO, as to which clauses are applicable. Please refer to comments above. **TasNetworks – Supports** TasNetworks supports this proposed change. **Transgrid – additional comment coming** Intending to provide further feedback on the consequential amendments.	See comments under S5.2.1
Additions to information provision	**Powerlink** We highlight our comments (with more detail) above, relating to: • S5.2.5.1 – mid-point voltage: This change does not appear to be required. S5.2.5.5 – lowest / highest single phase and three phase fault level and X/R: It is not clear how a NSP providing this information will add value to the compliance process. • Tuning for S5.2.5.5 should be based on minimum fault level/withstand capability level. An outage on the system with non-minimal fault level could have the worst-case X/R value, which may significantly differ from the X/R value at the minimum fault level. • S5.2.5.13 – lowest, highest and typical apparent system impedance: We do not consider these appropriate for compliance assessment purposes and therefore does not support their addition as requirements. **TasNetworks – Supports** TasNetworks supports this proposed change.	Powerlink's comments have been considered under the relevant clauses. **Final recommendation** AEMO will retain its update report recommendation.
Relevant system – in relation to small plants exempt from some requirements	**TasNetworks – Supports** TasNetworks supports this proposed change.	**Final recommendation** AEMO will retain its update report recommendation.
S5.2.5.8 Protection settings and relationship to ride through clauses	**Solar Turbines – Comment** Enlarging protection setting does not necessarily reinforce system resilience, but it could rather limit generating unit lifecycle and availability.	While AEMO notes Solar Turbines comments, review of schedule 5.1 for Network Service Provider is not within the scope of this review.

Issue	Summary of feedback provided – Consequential amendments	AEMO response
	In the document it seems there is not much emphasis in appropriate grid system design optimization or protection scheme optimization in order to limit the event and protect important assets as generating units. Some examples of possible improvements: • Optimization on fault clearing delay times associated to contingency event; • System optimization to reduce the occurrence of almost contemporary multiple events (protection scheme definition), if the requirements of so many multiple events in such a short time shall be considered credible) **TasNetworks - Supports** • TasNetworks supports the redrafting of S5.2.5.8	**Final recommendation** AEMO will retain its update report recommendation.
S5.2.5.8 Conditions for which the plant may trip and recording of conditions	**Powerlink – Support** Powerlink supports this proposed change. **TasNetworks – Supports** TasNetworks supports this proposed change.	**Final recommendation** AEMO will retain its update report recommendation.
S5.2.5.8 Network Service Provider liability	**TasNetworks – Supports** TasNetworks supports this proposed change.	**Final recommendation** AEMO will retain its update report recommendation.
S5.2.5.11 Minimum operating level	**Powerlink – Support** Powerlink supports this proposed change. **TasNetworks – Supports** TasNetworks supports this proposed change.	
S5.2.5.11 Response direction for bidirectional units taking power from the system	**TasNetworks – Supports** TasNetworks supports this proposed change.	**Final recommendation** AEMO will retain its update report recommendation.
Drafting changes		
Drafting changes	No specific additional feedback was received on other drafting changes	