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Thursday, 20 April 2023

Australian Energy Market Operator

By email: contact.connections@aemo.com.au

Dear Ms York,

AEMO review of technical requirements for connections

Transgrid welcomes the opportunity to respond to the Australian Energy Market Operator's (AEMO) proposed review of technical requirements for connections.

As the jurisdictional planner, operator and manager of the transmission network in NSW and the ACT, Transgrid supports reforms that will enable both energy and system security services to be provided to consumers at the lowest possible cost. To achieve this and remain consistent with the National Electricity Objective (NEO), the proposed technical amendments to the issues raised in the draft report would need to withstand a variety of foreseeable, present and future operating scenarios while promoting efficient and effective investment within the NEM.

Transgrid supports rules which facilitate a clear and balanced connection process which can be delivered within reasonable timeframes for all parties involved. Transgrid welcomes AEMO's revised recommendations for issues identified in the initial review. In our view, it is essential that the proposed amendments are appropriate and fit for purpose to enable connections to the network while maintaining a secure system.

The table in Attachment 1 to this letter provides comments on the individual items outlined in the Draft report Stakeholder feedback template provided by AEMO, whether Transgrid supports the proposed amendments, and the underlying reasoning for our response.

We appreciate the opportunity to comment on AEMO's draft report on the review of technical requirements for connections. If you would like to discuss this submission, please feel free to contact Malithi Gunawardana, Manager Network Connections, at Malithi.Gunawardana@transgrid.com.au.

Yours faithfully

Kasia Kulbacka
General Manager of Network Planning

Attachment 1

Draft report Stakeholder feedback template:

AEMO Review of technical requirements for connection (NER 5.2.6A)

Stakeholders making a submission on the recommendations set out in the AEMO draft report may use the below template to provide feedback. Please consider the confidentiality disclaimer at the end of this document.

Stakeholder: Transgrid

Schedule 5.2 Conditions for Connection of Generators

Issue	Schedule 5.2 Generator Recommendation feedback
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	Part A ▪ Transgrid agree with the recommendation to pursue Option 3, to ensure a consistent approach across the NEM on application of technical standards to synchronous condensers. Part B ▪ Transgrid supports Option 2 for application of NER S5.2 standards to synchronous condensers.
NER S5.2.5.1 – Reactive power capability	
Voltage range for full reactive power requirement	▪ Transgrid notes that the existing 5.3.4A negotiation framework already considers "the commercial and technical feasibility of complying with the automatic access standard with respect to the relevant technical requirement" under clause 5.3.4A(b1)(3). Historically, where reasonable, Transgrid has allowed for a reduction of reactive capability in the inductive region (absorbing) for certain voltages below the Normal Voltage, and a reduction in reactive capability in the capacitive region (exporting) for certain voltages above Normal Voltage, considering the voltage-dependent requirement for reactive power. Transgrid prefers that the 5.3.4A negotiation framework be further reinforced, noting that clause 5.3.4A(d1) and (g) of the rules require AEMO and the NSP to provide reasons for rejecting a proposed NAS as it pertains to the matters identified in 5.3.4A(b). This could take the form of amending the negotiated access standard framework

Issue	Schedule 5.2 Generator Recommendation feedback
	under S5.2.5.1 based on Option 3, that may be used as basis for negotiations for connections if required. In Transgrid's view, an amended negotiation framework for S5.2.5.1 based on Option 3 considerations would allow for the NSP to request a level of performance closer to the existing AAS if it is required to align with best power system performance for specific network connections. This would allow Option 3 to be still used as the basis for negotiations for most generators, streamlining the process, while not reducing power system performance for scenarios where performance closer to the existing AAS may still be required. ▪ One concern with the proposed Options 2 and 3 is that this could unintentionally encourage generators and IRPs to add voltage dependant reactive power limits that may restrict reactive power under transient events, when this may not be in the interest of the network. The current version of the rules encourages generators to restrict reactive power flow at the connection point based on S5.2.5.1 requirements even if the plant has the capability to provide more reactive power. Adjusting the AAS to incorporate voltage dependant reactive limits could make it standard practice to unnecessarily restrict reactive power flow at the connection point based on the connection point voltage also. This would potentially affect post-fault voltage recovery, particularly if the plant is controlling the voltage at an upstream bus that it is not directly connected to, which is a common control strategy in Transgrid's network. ▪ Transgrid also has concerns regarding setting a centre point for the 10% voltage range proposed for Options 2 and 3. Network voltages may change over the generator's life. Therefore, if the centre point and the associated 10% voltage range is set during the initial connection based on historical voltage profile, it may require future modifications to the GPS throughout the generator's life. <u>Summary of Transgrid Position</u> ▪ Transgrid prefers that the existing AAS requirements remain in effect and that the negotiating framework is reinforced and potentially amended. • Transgrid suggests including Option 3 as a framework for the negotiated access standard, depending on the technical requirements at the connection point and plant limitations.
Treatment of reactive power capability considering temperature derating	▪ Transgrid's existing approach for documenting the temperature derating in the GPS is based on interpretation 2, and consistent with the NER definition for rated active power and the reference to nameplate rating. However, if a plant cannot meet the full reactive power capability requirement (based on the rated active power) at higher ambient temperatures, Transgrid is of the view that if the reactive power requirement is scaled according to the derated active power level, then this would be treated as a negotiated access standard. Historically, Transgrid has been open to such negotiated standards, where appropriate, provided that the derating in active and reactive power is proportional. ▪ One concern Transgrid has with the current proposal is the lack of definitions relating to rated and derated active power for the generator. In Transgrid's view, the maximum capacity should refer to the maximum registered active power of the plant without any derating. The definition of the S5.2.5.1 active power of the plant when it is being derated should be separate to this definition to avoid confusion. ▪ Transgrid has historically required the behaviour of how the plant derates its active and reactive power capability to be captured in the GPS, consistent with Option 3. <u>Summary of Transgrid Position</u> ▪ Transgrid supports Option 2 and Option 3 and clearly defining rated active power, maximum capacity and derated power.

Issue	Schedule 5.2 Generator Recommendation feedback
Compensation of reactive power when units are out of service	▪ In Transgrid's view, there are two distinct aspects relating to plant performance and reactive power supply/absorption when not generating active power, and must be looked at separately for clarity. a) When all generating units are disconnected from the power system – this is covered under S5.2.5.1(g) where at present the performance standard is established under clause S5.3.5. b) When generating units are connected to the power system while not generating active power – the generating system will be required to have sufficient reactive power capability to compensate for the reactive power supply/absorption of the plant (aux load, reticulation network and harmonic filters), such that the net impact on the system voltage due to the plant at the connection point is minimal. ▪ Regarding Option 2, when allowing such exemptions, careful consideration must be given considering the cumulative adverse impact on the network over a period of time when multiple generators are connected in close proximity. ▪ When considering Option 5, it should be noted that for some plants such as solar farms, Q-on-demand type modes of operation reflect the plant's operation during 50% of the year. It is important to investigate how the plant behaves when operating in these modes with appropriate compliance assessments and testing. Transgrid acknowledges that extensive compliance assessment as conducted for the normal operation of the plant is not required, as it is likely that only a reduced number of generating units will be in-service for these modes. The NER currently does not include any requirements or guidance on operation under Q-on-demand type modes, and as a result NSPs have their own preferences and expectations. To streamline the requirements across NEM, Transgrid suggest including some guidance on this in the Rules. <u>Summary of Transgrid Position:</u> ▪ Transgrid supports Option 5 - where the NSP requires that the steady state reactive power levels are to be maintained within the required range, this can be treated as a secondary operating mode. ▪ Transgrid supports Option 6 - the maximum active power consumption in respect of auxiliary load and the corresponding reactive power range permitted at the connection point, to be documented.

S5.2.5.1, S5.2.5.5, S5.2.5.7, S5.2.5.8, S5.2.5.10

Simplifying standards for small connections	<u>S5.2.5.1 AAS</u> ▪ Transgrid recommends either using the current framework and reduce the AAS requirement or adopt one or more of the proposals presented under Section 3.2.1 (for example, option 2). ▪ The cumulative effect of multiple generators and system strength can make it difficult to quantify the 5% voltage step change requirement proposed (or other magnitude). <u>S5.2.5.3 AAS</u> ▪ Transgrid supports AEMO's proposal to do nothing. <u>S5.2.5.5 AAS and MAS</u>

Issue	Schedule 5.2 Generator Recommendation feedback
	▪ Transgrid does not support exempting generating systems < 30 MW from all assessments related to current injection. ▪ Rather, Transgrid recommends exempting small generating systems from the AAS. Thus, only establishing a MAS for these generating systems. This would still encourage these smaller generating systems to provide dynamic voltage support to the network using their latent capability but would also reduce the negotiating process to establishing the performance standards. S5.2.5.7 AAS and MAS ▪ Transgrid does not consider there to be any issue with the current rule, even for small connections. Transgrid proposes to do nothing. S5.2.5.8 MAS ▪ Please refer to Transgrid response on clause S5.2.5.8 [response to Section 3.8 of the AEMO report].

NER S5.2.5.2 – Quality of electricity generated

Reference to plant standard	Transgrid supports the recommendation to remove the reference to the superseded standard.

NER S5.2.5.4 – Generating system response to voltage disturbances

Overvoltage requirements for medium voltage and lower connections	• Transgrid supports Option 2, to specify the point of application of over-voltages to be the nearest HV transmission location, for MV connections without an onload tap changing transformer. • Regarding the proposed Option 3, we note that there's already flexibility in the negotiated access standard to vary the 100 MW limit with the agreement of AEMO and NSP. Transgrid prefers to retain the existing S5.2.5.4(c) requirement and negotiate this clause as appropriate on case-by-case basis, if necessary. We also note that giving effect to Option 2 will also reduce the requirement to negotiate clause S5.2.5.4.
Requirements for overvoltages above 130%	▪ In Transgrid's view, the current rule requirement for "over 130% of normal voltage for a period of at least 0.02 seconds after T(ov)" should not be interpreted to mean "over at least 130% of normal voltage for a period of at least 0.02 seconds after T(ov)" and is not preferred as a solution. ▪ Transgrid acknowledges AEMO's point that it is impractical to expect generating systems or IRS to remain in continuous uninterrupted operation for overvoltages without an upper bound, for durations up to 20 ms. However, we note that there should still be a requirement that provides coverage for switching and lightning surges. ▪ We note that Option 5 + Option 6 provides comprehensive coverage against slow front over voltages, subject to the drafting providing clear technical requirements for assessing compliance. Further consideration should be given to Option 5 and Option 6. Summary of Transgrid Position:

Issue	Schedule 5.2 Generator Recommendation feedback
	▪ Transgrid supports Option 4, to implement an appropriate ceiling voltage for the 20 ms requirement. ▪ Transgrid also recommends adding appropriate drafting to outline the requirement to specify performance (beyond the Option 4 ceiling value) for slow front over voltages and lightning surges considering any instantaneous protection of the generating system (and relevant equipment) under the general requirements. This could be in the form of giving effect to Option 5 and/or Option 6 under general requirements.
Clarification of continuous uninterrupted operation in the range 90% to 110% of normal voltage	▪ Transgrid current approach to assessing CUO for voltages in the range 90% to 110% of normal voltage is based on voltage variations up to ±10% voltage steps. Transgrid acknowledges the alignment of the ±10% criteria with the TNSP obligations under NER S5.1a.4 system standards. ▪ However, Transgrid disagrees with the recommended timeframe for assessing the variation in voltage (noting that ramp time of 2 seconds is stated under the 'Description' section while ramp over 5 seconds is included in 'Options' section). Rapid changes in voltages can occur in the timeframes of milliseconds rather than seconds due to switching of reactive plant and other system events; therefore, if applying a ramp is necessary for this assessment, we propose the ramp time to be in the order of milliseconds. ▪ It is also worth noting that in Transgrid's experience, a voltage step response test is a more appropriate test to assesses the grading of inverter-level Fault Ride-Through (FRT) thresholds, when compared with a slower voltage ramp. Triggering of FRT when the connection point in the normal operating voltage is often undesirable. A slower voltage ramp is typically responded to by the PPC voltage controller and thus lessens the voltage depression seen at the generating unit terminals. Triggering of FRT when the connection point in the normal operating voltage is often undesirable. If the generating units do not enter FRT mode, then it is unlikely that there will be any material difference in steady-state response if the plant is subjected to a voltage step or a voltage ramp. ▪ In the description of this issue, it is suggested that some plant may not be able to remain stable for a step of 10% while they can tolerate a ramp over 2 s. This seem to be used as a justification to not require application of 10% voltage step to assess CUO. In Transgrid experience, step-like voltage variations in the order of 5-10% can occur in certain parts of the network due to switching events and certain disturbances. If a plant is unable to remain stable for a voltage step of 10%, using a ramp over 2 seconds or 5 seconds purely for assessment purposes will mask the plant limitations in actual operations. <u>Summary of Transgrid Position:</u> ▪ Transgrid is in favour of Option 2, excluding the recommended ramp of 5 seconds. If applying a ramp is necessary for this assessment, we propose the ramp time to be in the order of milliseconds.

NER S5.2.5.5 – Generating system response to disturbances following contingency events

Definition of end of a disturbance for multiple fault ride through	Transgrid supports AEMO's intent in providing clarity on "end of a disturbance". However, we note that it is possible to have multiple fault events to occur at the same time or with 0 ms delay (for example, lightning strikes causing transmission line outages) and should be considered in the assessment of MFRT capability. For the AAS, Transgrid suggest considering at least two 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) with the 15-disturbance sequence.

Issue	Schedule 5.2 Generator Recommendation feedback
Form of multiple fault ride through clause	▪ Transgrid supports Option 2 (disclosure of MFRT limitations) and Option 5 (AEMO test suite), with priority for amendments to give effect to Option 2. For Option 5, allowance should be made for NSPs to request additional MFRT scenarios if deemed necessary, based on proposed connection location. ▪ Transgrid notes the requirement in the DMAT to provide confirmation that the plant model is fit for multi-disturbance application and evidence provided in the form of type tests or hardware-in-loop. Therefore, Transgrid suggest further consideration be given to Option 4 (HIL) as a form of compliance evidence, given the limitations of simulation models. Note that this can form part of the Option 2 evidence.
Number of faults with 200 ms between them	Transgrid supports Option 2: leave requirement for up to six faults and 200 ms and combination criteria as is but allow specific limitations to be carved out of these requirements.
Reduction of fault level below minimum level for which the plant has been tuned	▪ Transgrid agrees that assessment of MFRT capability in a SMIB environment without considering the reduction of the system fault level due to multiple outages could lead to overtly optimistic results for MFRT assessments. ▪ Transgrid acknowledges that it would be good to assess the lowest fault level the plant can operate stably and remain connected, with the plant settings tuned to achieve compliance for the minimum and maximum fault level range stipulated by the NSP. ▪ Transgrid supports Option 6 to having flexibility to request an amendment process if there is a risk that the plant will be non-compliant due to further reduction of fault levels.
Active power recovery after a fault	▪ Transgrid supports Option 2 to change the AAS to be consistent with AEMC's draft determination for the MAS (equivalent to this clause). ▪ However, Transgrid suggested to include 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 and settling time for reactive current injection	▪ Transgrid prefers Option 3 "Keep settling time but specify conditions for assessment" instead of Option 2 "omit settling time for AAS". Omission of settling time for AAS, especially if the MAS settling time is removed, will remove a quantifiable criterion against which the plant can be tuned and assessed against. Option 2 will also remove incentive for generator applicants to provide justification for proposed performance capability and prolong the negotiations on the proposed performance as it will be subject to individual interpretation of adequate control. Retaining the AAS (which may be modified as suitable) provides a clear criterion for performance and incentive for the justification to be provided for negotiation purposes. ▪ Transgrid supports the inclusion of Option 4, to replace "adequately controlled" with "adequately damped", provided that "adequately controlled" is clearly defined in the NER to avoid ambiguity over what is now a qualitative performance assessment (as opposed to the quantitative assessment of adequate damping). ▪ Transgrid supports Options 5 and 6, however the starting time of the reactive current commencement time (in Option 6) needs more clarity, or the option to define it in the GPS. <u>Summary of Transgrid Position:</u>

Issue	Schedule 5.2 Generator Recommendation feedback
	▪ Transgrid recommends Option 3, which may be modified as appropriate for AAS. ▪ Transgrid supports Option 4, provided that "adequately controlled" is clearly defined in the NER. ▪ Transgrid supports Option 5 and Option 6, noting that reactive current commencement time in Option 6 needs more clarity, or the option to define it in the GPS.
Commencement of reactive current injection	Transgrid supports Option 2 for AAS to specify that reactive current response needs to commence above 85% of normal voltage for an undervoltage event, and below 115% of normal voltage for an overvoltage event.
Clarity on reactive current injection volume and location and consideration of unbalanced voltages	▪ Transgrid supports Option 2 to retain the AAS criteria but finds the suggested clarifying statement to be ambiguous. The requirement to achieve best outcome considering plant and power system stability should be covered in the negotiated access standard (and to an extent is already covered broadly under clause 5.3.4A negotiation framework). ▪ Transgrid is in support of the considerations outlined in Option 3, however the appropriateness of Option 3 being included as an AAS criterion may need re-consideration. ▪ While in support of Option 5, Transgrid would like the NER to provide clear criterion on the reactive current strategy requirements for unbalanced faults. In our experience, majority of the connection applicants currently do not have clarity on this requirement resulting in prolonged negotiations on this performance standard. Providing clear technical requirements and assessment criteria will assist with streamlining the connection process. <u>Summary of Transgrid Position:</u> ▪ Transgrid supports Option 2 for AAS, excluding the suggest clarifying statement. ▪ Transgrid is in support of the considerations outlined in Option 3, however appropriateness in including this under AAS should be considered. ▪ Transgrid supports Options 4 and 5.
Metallic conducting path	Transgrid supports Option 2: Removal of NER S5.2.5.5(a) on the basis that existing wording does not appear to add anything useful to the clause.
Reclassified contingency events	Transgrid supports Option 2 to amend the rule 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	Transgrid supports the proposed Option 2 to amend the clause to resolve the issues identified.

Issue	Schedule 5.2 Generator Recommendation feedback
Clarification of meaning of continuous uninterrupted operation for NER S5.2.5.7	Transgrid supports the proposed Options 2 and 4.

NER S5.2.5.8 – Protection of generating systems from power system disturbances

Emergency over-frequency response	▪ Transgrid supports Option 2 (disconnecting the generating system within 1 second) to only apply if the generating system does not provide PFR. ▪ Transgrid supports Option 3 (0.5 Hz less than the upper limit of the extreme frequency excursion tolerance limit). ▪ Transgrid supports Option 4 (remove the "not less than the upper limit" statement) ▪ Transgrid supports Option 5 (allow for a carve out for the 3 second requirement, where agreed) ▪ Transgrid supports Option 6 (to apply the same size threshold, regardless of technology type)

NER S5.2.5.10 – Protection to trip plant for unstable operation

Requirements for stability protection on asynchronous generating systems	Issue 1 ▪ The oscillation magnitude is heavily impacted by the fault level, the lead-lag phase between relevant power quantities, configured droop ratio and other factors. Therefore, the magnitude of unstable behaviour, that is a relative quantity, cannot be considered as a robust indication or quantity that defines which generator is causing/contributing more or less to the instability or the oscillation. Hence the solution provided to address issue 1 may not be practical to adequately address the issue. One solution to avoid the noted issue is staggering the disconnection between different generators using different disconnection/alarming threshold and contribution criteria (how much in-out of phase behaviour is observed at the time). Additionally, it may also be worth adding a clearer definition for the word "promptly" under chapter 10 to avoid misinterpreting it as "immediately". Issue 2 ▪ From control system perspective, step function contains a wide range of frequency, so it has a high chance that these frequencies are close to natural frequency of other generator which then be excited by the step function. On the other hand, ramp function only contains a narrower frequency range (mostly low-order ones), so it imposes less possibility to excite other generator's modes. As a result, ramping down is preferred even if it is a fast ramp rather than trip. This is not contradictory to "disconnecting promptly". The generator can ramp down first and disconnect. ▪ The control mode change is a potential solution which requires a careful investigation due to the risk associated with it. Transgrid notes that implementing this mode change requires extensive model validation in wide area environment. It should be mentioned that the prerequisite of the NEM wide validation of this method is that all the involved OEM models support this mode change during the simulation run. Issue 3

Issue	Schedule 5.2 Generator Recommendation feedback
	▪ Transgrid is of the view that S5.2.5.10 could independently refer to the type of applicable instability for asynchronous generators. We also acknowledge that the PSSG is due to be updated, not only to match with the updated IEEE reference but also better match the changes in the grid. It is worth noting that stable operation of the generator, especially in the context of voltage control which refers to the key context of asynchronous generator under S5.2.5.10, has a clear definition in power system. If the definition of voltage stability is explored in the context of S5.2.5.10, there will be less challenge across the industry for implementing the corresponding protection in a real-time controller. For voltage stability definition/condition (which is one of the most common types of stability for asynchronous generator), Power System Stability and Control written by Kundur can be referred to. Issue 4 We agree with the noted fact that NER does not mention causality or contribution for asynchronous generators. ▪ MAS: Transgrid supports AEMO's intent in not requiring contribution detection in the MAS. However, Transgrid notes that with this proposal, there is a risk that network could end up with many generators which either do not take any action in the event of unstable behaviour or disconnecting with no consideration of contribution. This is significantly more critical for the cases that AEMO/NSPs may consider for disconnecting action (extreme cases). Transgrid is of the view that no disconnection must be allowed automatically without considering the contribution detection feature. ▪ AAS: Transgrid supports the idea of establishing the centralised platform which can receive, analyse and manage the generator disconnections in the event of instability; however, in the absence of such platform, it is necessary for the generator to provide the solution that NER mandates as generator's responsibility under S5.2.5.10. Perhaps when the future centralised system is designed, established, tested and become operational, NSPs and AEMO can use the existing S5.2.5.10 decentralised solution only as a backup plan or even as an input to the centralised platform. Moreover, Transgrid believes AEMO who has access to wider range of data (all NEM generators, not one NSP) will be in a better position to establish this centralised solution. Issue 5 Regarding the remote disconnection capability, it should be noted that for some small projects in embedded networks which are non-scheduled, it may be challenging to have communication facilities that make the remote disconnection possible. Issue 6 Transgrid also sees the great benefit in having access to (nearly) real-time PMU data for the generators connections and support this requirement to be added. <u>Summary of Transgrid Position:</u> From the technical perspective, currently there are two key challenges for this clause in industry: ▪ Definition of instability in the context of S5.2.5.10 for asynchronous generators. Transgrid suggests NER to be updated specifying what category (out of all categories introduced from IEEE) apply to asynchronous generators and they must detect and act for. Then in NER clause S5.2.5.10 (and/or PSSG) formulate the contribution detection methodology (or any other method) stating how the protection relays can be programmed to detect these conditions. ▪ Lack of experience of the whole industry with stability detection devices suitable for asynchronous generating systems.

Issue	Schedule 5.2 Generator Recommendation feedback
	Transgrid suggests the outcome of solution to issue A remains limited to alarming until the confidence in configuring these relays and coordinating them are gained. From then onwards, subject to NSP and AEMO's agreement, extreme instability scenario can have the disconnection functions enabled but for non-severe instabilities alarming function can remain enabled, with appropriate corrective actions.

NER S5.2.5.13 – Voltage and reactive power control

Voltage control at unit level and slow setpoint change	▪ Transgrid acknowledges AEMO's point that certain implementations of unit-level voltage control for asynchronous plant can result in interactions with plant level voltage control. It should be noted though, that this interaction isn't inherent to unit level voltage control but is due the implementation of the internal control system. That is, certain implementations/designs can avoid this interaction. ▪ Transgrid supports Option 2, to amend the S5.2.5.13 to allow for the voltage, reactive power and power factor control to be implemented at the unit level. Typically, Transgrid dictates the normal voltage control strategy for a given project, though this added flexibility in the rules is generally supported. ▪ Transgrid supports Option 3, such that rate-limited setpoint changes can be utilised operationally, though we suggest that consideration be given to including flexibility in the rules to allow for such response, which specifically relate to speed of response. This is in line with the recommendation outlined below. ▪ Transgrid suggests that consideration be given to decoupling the response time requirements for setpoints and disturbances, such that there can be different performance standards for each: o This would help facilitate negotiations for plant which have fast unit level voltage control (for which the performance standard itself can still be assessed at the connection point) and at the same time allowing for longer rise and settling times for plant level setpoint changes. o This also allows for the current rule requirements to still be met where the response to setpoints and disturbances are mostly due to the plant level voltage controls and are thus very similar. o This can also allow for slower responses to setpoint changes whilst allowing for faster responses to disturbances, whether at the plant level or unit level.
Realignment of performance requirements to optimise power system performance over expected fault level (system impedance) range – Voltage control	▪ Transgrid acknowledges that tuning the plant for a wide range of fault levels can be challenging and that careful consideration should be given to defining the performance standards for rise and settling time which are appropriate for this range. The current framework requires that the performance standard be specified as a ceiling value such that the plant must be compliant for that range of fault levels. With proper testing, tuning and assessment over the range of fault levels for the connection, this ceiling value can be set to an appropriate level by following the negotiating framework. Insufficient consideration of the performance under different fault levels is a deficiency in the tuning and assessment, rather than a fundamental issue with the rules itself. ▪ Historically, Transgrid has been willing to accept a negotiated standard for rise and settling times (rise time in particular) where sufficient evidence has been provided that the plant operates adequately and stably as per its voltage control strategy. The performance standard would be set as the ceiling value which accounts for the variability in performance over the range of fault level conditions. Transgrid believes that differentiating performance standards based on fault levels would be more appropriate as general guidelines for a negotiated access standard. Transgrid's experience with S5.2.5.13 does not indicate that these particular requirements cause significant

Issue	Schedule 5.2 Generator Recommendation feedback
	issues for generating systems. Rather, it is the lack of guidance in the rules as to how these should be negotiated that causes some confusion. ▪ Careful consideration should be given when specifying maximum and minimum system impedances (fault levels) in the RUG for which the plant is only tuned to, as this might be interpreted as the boundary conditions beyond which the generator is not obligated to meet its performance standards. This interpretation is not correct and therefore the recording of these system impedances could be misleading. At present, if the Generator does not comply with its GPS, it will trigger a non-compliance and thus opens the opportunity to rectify (for example, re-tune plant settings) the non-compliance via a plant alteration process. Given the significant transformation that the NEM is currently undergoing, it is vital that we allow for plant re-tuning and optimisation required due to changes in network conditions to achieve best power system performance. ▪ Specifying the performance standards for rise and settling time based on a specific system impedance would mean that the performance requirements are undefined for all other fault levels, which significantly impedes the ability to verify compliance through onsite measurements. ▪ Regarding the reference to 'typical system impedance', in Transgrid's view it is challenging to define a typical system impedance as it is dependent on multiple variables, including dispatch profile over different periods during the day or year. Transgrid finds the reference to typical dispatch levels to be ambiguous. <u>Summary of Transgrid Position</u> ▪ Transgrid believes that the amendments proposed in Options 5, 6, and 7 relating system impedances and the requirements for rise and settling times are more appropriate as general guidelines for a negotiated standard. This will help generating systems better tune their plant and provide evidence for their performance standards, whilst not carving out a significant range of operating conditions for which the performance standards are undefined. ▪ Defining performance standards only for very specific network conditions will not provide clear metrics for commissioning and ongoing compliance. It will likely add further complexity to the performance standards and connections process (this is especially true for Option 7) and thus contradicts one of the key objectives of this review which is to streamline the connection process. Meeting the objective of "aligning with best system performance" is believed to be better served by reinforcing the negotiating framework and general guidelines. ▪ Transgrid recommends consideration be given to providing flexibility in the MAS for settling times to be agreed to a longer value, with agreement between AEMO and the NSP. This flexibility is in line with the draft determination by the AEMC for the S5.2.5.5 minimum access standards (Efficient reactive current access standards for inverter-based resources). ▪ As per the comments above in Section 3.10.1 (Voltage control at unit level and slow setpoint change) where Transgrid recommends that the settling time requirements be decoupled for setpoints and disturbances, this added flexibility can better facilitate the negotiation process whilst also achieving good power system performance outcomes.
Materiality threshold on settling time error band and voltage settling time for reactive power and power factor setpoints	▪ Transgrid agrees with AEMO's view that for small variations in active power in response to a voltage step, the assessment of settling time for active power is no longer meaningful. Transgrid also supports the view that consistency and clarity are important for these assessments. ▪ In Transgrid's experience, plant do not normally exhibit issues meeting the settling time requirements of voltage for reactive power / power factor step tests. There can be instances though, we auxiliary reactive power plant can be switched to provide reactive power

Issue	Schedule 5.2 Generator Recommendation feedback
	support to achieve the setpoint. This switching can result in voltage transients which might be better assessed from looking at the voltage settling time, rather than reactive power itself. Summary of Transgrid Position ▪ Regarding Option 2, Transgrid's preference would be to retain the requirement to assess the settling time for reactive power and voltage for both reactive power and power factor step tests, with a potential amendment to the rules such that where the NSP and AEMO agree, the voltage can be exempt from the assessment. ▪ Regarding Option 3, the application of materiality thresholds to active power should be dependent on plant size. For small generator connections, the proposed threshold of 5 MW is not appropriate as active power variations/oscillations could occur below this threshold. It is recommended that the threshold be based on a percentage of the generator's capacity, with a cap at 5 MW (for example). This value can be specified in the performance standards as part of the general requirements.
Clarification of when multiple modes of operation are required	▪ Transgrid supports the intent of Option 2, that is, to have a primary and secondary control mode. Though it should be at the NSP's discretion as to what the primary mode is, as this might not always be voltage control, as stipulated in Option 2. There should be flexibility in the rules to accept/specify other primary control modes as a part of the automatic access standard. ▪ Transgrid prefers that the requirement for settling time should be retained in the AAS for reactive power and power factor control modes and thus, the secondary control modes. The setpoint performance can relate closely to the response to a voltage disturbance, therefore there is merit to keeping it as a directly testable and controllable performance criterion.
Impact of a generating system on power system oscillation modes	▪ Transgrid supports Option 2, to require facilities capable of providing positive damping for critical modes of oscillation. However, we have concerns with identification and provision of critical modes of oscillations being part of this clause requirement given that: o the critical oscillation modes can change with the addition of the connecting plant. o the critical oscillation mode can change over a period of time. o critical modes of oscillation can be inter-area oscillations where the NSPs may not have visibility into ongoing connections in a different region and their impacts on the oscillation modes. ▪ Regarding Option 3, is the intention to retain current requirement under clause S5.2.5.13 (d)(1)(ii) while incorporating Option 3 to the MAS? Transgrid supports retaining some level of tolerance as in the current rule requirements for S5.2.5.13 (d)(1)(ii). ▪ Transgrid does not support Option 4. Oscillations sensitive to system strength can still be improved by plant tuning and functionalities such as inverter level voltage control. While it is the obligation of the SSSP to provide system strength to the required level, electing to pay the system strength charge should not allow poorly tuned IBRs to be connected, which does not align with promoting efficient investment as per the NEO.
Definition – continuous uninterrupted operation	

Issue	Schedule 5.2 Generator Recommendation feedback
Recognition of frequency response mode, inertial response and active power response to an angle jump	▪ Option 3 (modifying individual clauses) is not preferred as the flexibility of the definition should apply to all clauses where CUO is a requirement. Carving out requirements for each clause is not deemed an efficient update of the rules. ▪ For the detailed drafting, AEMO might need to clarify that incorrect activation of PRF on clearance of a fault is not considered to be CUO compliant. Summary of Transgrid Position ▪ Transgrid supports Option 2, that is, to modify the definition of CUO to allow greater flexibility in the types of acceptable responses. ▪ In addition to Option 2, if there was a specific requirement not captured in the updated definition for CUO in the glossary, then this could be captured for that applicable clause. ▪ 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 because of a contingency event. In Transgrid's view, 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.

Schedule 5.3a Conditions for connection of MNSPs

Issue	Schedule 5.3a HVDC Recommendation feedback
NER S5.3a.1a Introduction to the schedule	
Alignment of schedule with plant-type rather than registration category	No Comment
NER S5.3a.8 – Reactive power capability	
Reactive power	No Comment
NER S5.3a.13 – Market network service response to disturbances in the power system	
Voltage disturbances	No comment
Frequency disturbances	No Comment

Issue	Schedule 5.3a HVDC Recommendation feedback
Fault ride through requirements	No comment

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

Remote monitoring and protection against instability	No Comment

New standards

Voltage control	No Comment
Active power dispatch	No Comment

Multiple Schedules

Issue	Multiple schedule Recommendation feedback

NER Multiple clauses

References to superseded standards	Excluding the dates from the references to the relevant standards could result in different versions of the standard being used across the industry. Noting that NER 1.7.1(i) may not be widely known in the industry, if dates are excluded from the reference, a clarifying statement should be included to indicate that the latest version of the standard is referred.