SIEMENS Gamesa
RENEWABLE ENERGY

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Amendments to System Strength Requirements Methodology, System Strength Impact Assessment Guidelines and Power System Stability Guidelines

Dear Ms. York,

Siemens Gamesa Renewable Energy welcomes the opportunity to make a submission the Australian Energy Market Operator's consultation on the proposed changes to the System Strength Requirements Methodology (SSRM), System Strength Impact Assessment Guidelines (SSIAG), and Power System Stability Guidelines (PSSG).

Siemens Gamesa Renewable Energy Pty Ltd. (SGRE) is a trusted supplier of wind power and has an installed base of 122 GW globally. SGRE has world leading capabilities in both onshore and offshore wind generating systems and green hydrogen.

Siemens Gamesa supports AEMOs updates to the SSRM, SSIAG, and PSSG to address the Efficient Management of System Strength Rule Change (ERC0300) and encourages AEMO to take the feedback of all stakeholders on board.

Siemens Gamesa understands the intent of ERC0300 is to enable the efficient connection of the significant number of projects through centralized system strength planning. However, the proposed frameworks and methodology do not appear to support this objective and will result in proponents choosing to self-remediate rather than paying the charges for a more centralized approach. The proposed planning methodology is believed to lead to overinvestment and ultimately increase the cost burden on energy consumers.

Please find our detailed replies to the consultation questions below, feel free to contact us should you require any further information.

Yours Sincerely,

Amir Baf and Daniel Ryan

Detailed Feedback on Consultation Questions:

Minimum fault level requirements

1. Do Stakeholders have any alternative suggestions for the approach to assessment of projected minimum fault level requirements over the next decade? If so, please elaborate on techniques, requirements to implement, and potential benefits over simpler approaches.

SGRE encourages AEMO and NSPs to perform detailed protection studies including the contribution of IBR to determine minimum protection fault level requirements for the power system. This should form a hard baseline for any minimum fault level requirements moving forward. It is expected that with changing technology the system strength required for stable operation of the power system may vary dramatically over the coming years. However, a robust and clear methodology for assessing protection operation will provide a clear minimum that must not be exceeded.

Stable power system operation after a credible contingency event or protected event

2. Do stakeholders have any alternative suggestions for the approach to assessment of projected minimum fault level requirements over the next decade? If so, please elaborate on techniques, requirements to implement, and potential benefits over simpler approaches.

SGRE is supportive of the use of detailed PSCAD modelling in determining the fault level requirements for power system stability over short time horizons of 2-3 years. Over this short horizon the connecting plant and their expected capability is relatively well known and current PSCAD models can be substituted for connecting plant. These PSCAD studies will, in general, allow AEMO to detect potential issues at an early stage before projects are connected. This will allow a smooth and efficient connections process in line with the intent of the ERC0300 rule change for connecting generators and allow NSPs to provide insight at an early stage to generators looking to connect in poor network locations.

SGRE encourages AEMO to consider also using some detailed PSCAD modelling over the longer 10 year time horizon in addition to the other approaches suggested. However, considers that these long timeframe planning assessments are less critical and their outcomes should be applied very cautiously to any network investment, due to the large uncertainty involved. SGRE suggests using one of the alternative assessment methods proposed by AEMO such as AFL as a first pass. However, as these methods are less rigorous than detailed PSCAD modelling in nature they cannot be used alone. Once a first pass is made, some locationally specific PSCAD modelling can be undertaken to see how conservative or optimistic the requirement is, and then the requirement may be correct accordingly.

3. In the context of clause S5.1a.9 of the Amending Rule, what are stakeholders' views on the inclusion or exclusion of existing and forecast IBR in the assumptions for determining minimum fault level requirements?

SGRE agrees with AEMOs assessment that historic plant and those connected under the 'do no harm' regime should be considered for the minimum fault level requirements in the current iteration. However, SGRE believes that in future the assessment of fault levels should consider the rise of new IBR technologies, specifically grid forming asynchronous plant, which provide a positive contribution to the system and thus may reduce the minimum fault level requirements.

Protection system operation

4. What are stakeholders' views on how protection equipment requirements for minimum fault level can be assessed, both now and for the coming decade?

SGRE encourages AEMO and NSPs to perform detailed protection studies including the contribution of IBR to determine minimum protection fault level requirements for the power system at least over the short term. This should form a hard baseline for any minimum fault level requirements moving forward. It is expected that with changing technology the system strength required for stable operation of the power system may vary dramatically over the coming years. However, a robust and clear methodology for assessing protection operation will provide a clear minimum that must not be exceeded.

Voltage control system operation

7. Are there alternatives to the allowable voltage step change limit, according to the NER S5.1a.5, proposed by AEMO for testing that the minimum fault level requirements facilitate reactive control equipment operation?

SGRE encourages AEMO to frequently reassess any minimum fault level limits based on the switching of reactive plant through detailed power system analysis. It is expected that as generation with high dynamic reactive capability becomes distributed throughout the NEM, the requirement for large network reactive plant may be reduced due to very high levels of dynamic reactive support.

8. Do stakeholders hold different views on how best to incorporate the impact of new technologies on reactive control equipment operation?

NSPs must take responsibility for dynamic system studies to best understand how the switching of their reactive plant will impact the network as the generation mix evolves. The proposed method from AS/NZ 61000.3.7 is not forward looking and does not consider the evolution of the power system to incorporate a large amount of IBR which provides dynamic reactive power support, noting that this not only includes include batteries with advanced inverter capability, but should include almost all modern IBR.
SGRE believes that if any issues are foreseen with reactive plant switching addressing these in the minimum fault level requirements is an extremely inefficient process of management. Alternatives such as changing operational processes, modifications to reactive plant, expedited upgrades or de-commissioning of plant must be explored rigorously prior to increased minimum fault level requirements.

Maintaining synchronism of distributed energy resources (DER)

9. Where should planning responsibility for synchronism of distributed DER lie – in the minimum fault level requirement of the system strength standard, the stable voltage waveform requirement of the system strength standard, or elsewhere in transmission and distribution network service providers' planning functions?

SGRE is of the belief that DER should not be included in the minimum fault level requirement of the system strength standard. With current transmission system modelling tools used by AEMO the level of detail required to assess any impact of transmission system strength on DER operation at the LV level is not available. Any attempt to use current modelling tools and practices to assess this is highly likely to be highly inadequate and result in false system strength requirements.

- SGRE would support any rule changes proposed by AEMO to shift obligation on planning, management, and performance of DER generating systems to DNSPs, who are best placed to manage them and their connection requirements. Or any changes AEMO proposes to further improve DER technical standards, such as AS 4777.

10. Do stakeholders have specific proposals for how to assess how distributed PV impact available fault levels considering their sparsity, uncertainty and visibility?

Available fault level is already an imprecise calculation. SGRE does not believe adding further uncertainty in available fault level calculations by considering DER (while the actual impact of DER is in no way well understood) will provide any way expedite the connection of new IBR plant, which is the intent of the ERC0300 rule change.

Description of stable voltage waveforms

12. Do stakeholders consider the proposed description for stable voltage waveforms to be comprehensive? Are there any recommended additions or deletions? If so, why?

SGRE believes that an additional definition of “stable voltage waveform” by AEMO and many of the proposed concepts are already defined by various clauses of the NER. The term stable voltage waveform is wholly encapsulating and should not be used. SGRE encourages AEMO to consider separate names and definitions for the different power system phenomena that it is attempting to capture so that they may be used to accurately assess power system study outcomes.
This is important as some phenomena captured in the current definition proposed by AEMO may have more efficient technical solutions compared with simply increasing fault levels. If these terms are defined separately, it would allow the industry to capture and address the actual issues occurring more accurately.

Assessment of stable voltage waveforms in the future

13. To what degree should the SSRM indicate assessment processes that SSSPs may apply when assessing delivery of stable voltage waveforms for IBR connections and operation over the 10-year horizon?

The SSRM must be robust and accurate in defining how SSPs may deliver system strength. In the end the SSRM will be the driver of investment by the SSPs and thus charges to IBR. Any loose methodology is likely to lead to poor financial outcomes for interested parties.

14. What do stakeholders consider to be the pros and cons of the three proposed options for assessing future voltage waveform stability? Should any other options be considered? If so, what options?

SGRE believes that a combination of the proposed methodologies should be used depending on the timeframe of the planning. SGRE also encourages AEMO not to overlook widespread use of PSSE dynamic modelling within its planning studies, as is used in other jurisdictions notably the USA.

15. Given the multitude of possible approaches, does AEMO have a role in providing guidance through the SSRM to encourage consistency between SSSPs where appropriate?

SGRE believes that AEMO must play a firm and well defined role in ensuring that SSSPs provide consistent assessment and adherence to the SSRM guidelines throughout all regions of the NEM. SSSPs are likely to be beholden to conflicting incentives and allowing them to follow the guidelines with no strict oversight by AEMO is likely to lead to greatly varying outcomes for different NEM regions and significant overinvestment in infrastructure.

Quantity, type, and location of new generation and retirement

17. What locational detail should AEMO provide for new generation ISP – a REZ level or a specific network bus?

SGRE prefers connection projections to be provided for specific network buses. The outcome would be increased transparency to connecting parties, allowing participants to understand exactly where generation was considered in defining fault level requirements and to better locate their projects in areas that are likely to provide a faster connections process.

18. What (if any) additional detail for new connections should be set out in the SSRM, in addition to the location and total megawatts (MW)?

SGRE would prefer information on average, minimum, and maximum project sizes considered and the specific technology type to be included. For wind projects in particular, large project sizes can indicate significantly difference performance requirements and balance of plant design compared with smaller projects.

18. Do stakeholders have specific suggestions for how DNSP-connected generation plant could be incorporated, given that the ISP predominantly considers transmission-connected plant?

SGRE believes that AEMO should perform an assessment and release a public report of the impact of DNSP-connected plant on system strength and use this assessment for the basis of any decision to include or exclude DNSP connected plant from planning studies.

IBR projections used to determine the system strength requirements

21. Is this equation-based approach for projecting the level and type of IBR for setting the system strength requirements appropriate? If not, what alternatives should be considered, and why?

SGRE believes that if a co-incidence factor is applied by AEMO then it is likely that there would be some operating scenarios that result in curtailment of generating plant. Thus, this co-incidence factor should be applied sparsely and with great care.

Technical capability of future plant

22. Do stakeholders have specific alternatives to suggest in response to AEMO's proposed approach to projecting technical capability of future plant? If so, what alternatives should be considered?

In addition to different technology types considered in planning studies, SGRE encourages AEMO to consider uptake of the system strength service charge. It is highly likely that with the current rules many connecting plant would opt to self-remediate their general system strength impact. If this is the case and is not considered in AEMOs planning studies then it would likely result in an essentially double up of system strength services imposing extremely significant cost burdens.

Model selection is a critical component of any planning PSCAD studies to be performed. SGRE believes that planning PSCAD studies over time horizons of more than a couple of years should be completed in close consultation with equipment manufacturers as the product offerings of OEMs including SGRE are evolving extremely rapidly. SGRE suggests that AEMO may implement an individual engagement process with OEMs to understand their future expectations in terms of installed base, technology, and timeline. If requested, OEMs may also be able to provide AEMO, on a cost recovery basis, detailed PSCAD models and support for model tuning of representative future plant.

This level of engagement could have multiple benefits for both AEMO and the OEM,

- It would provide AEMO with models of future products in an expedited manner, allowing more accurate PSCAD study outcomes,
- It would provide AEMO with the necessary support and knowledge for configuration and tuning of these models to avoid misapplication,
- It allows the system impact of future technology to be assessed during the earlier stages of equipment design. This will provide the OEM with greater capacity to adapt the design to suit actual future operating conditions within the NEM,
- This will provide AEMO with a channel of communication with OEMs that facilitates open and level discussion about future technology without the time and cost pressures that are experienced during the project execution phase,

New System Strength Impact Definition:

29. Should a material threshold be defined for the purpose of general system strength impact assessment? If so, what should those thresholds be and why (for IBL, load types, individual or cumulative, as well as generators including LIBR, connected into transmission and distribution networks)?

SGRE believes that an appropriate threshold for inverter-based loads that does not inhibit the development of future medium scale load pilot projects in the NEM should be defined by AEMO. Currently, the low installed base of large inverter-based loads within the NEM means their impact on system strength and power system operation is not well established. Simultaneously, some future electrified load industries, such as electrolysis-based hydrogen production, are in their infancy. Adding an additional cost burden in these industries may stifle development of these technologies within Australia.

30. Are there any other issues relevant to the general system strength impact that AEMO ought to take into account?

SGRE encourages AEMO to consider actual transmission capacity when assessing general system strength impact. Due to transmission capacity constraints, restoring available fault level back to its pre-fault level may provide limited benefit to the system while imposing a significant cost burden on connecting generators.
The proposed methodology can give way to ever increasing installation of SynCons and an unnecessary increase in fault level, while other aspects of system operation including transmission capacity and inertia are limiting factors. Using absolute fault level values instead of AFL could provide a more robust criteria for assessment.

Proposed methodology for Preliminary Assessments

31. Should there be an engineering safety margin applied to the SCR withstand capability calculation considering limitations associated with SMIB based evaluation?

SGRE would encourage AEMO not to apply engineering safety margins to the SCR withstand capability of connecting plant. It is recognized that the original intent of the AFL calculation in the current preliminary impact assessment process is as a screening method for connections, thus a conservative approach was taken. However, in this case, any additional safety margin applied by AEMO would have an additional cost burden on the generator. It is likely that the AFL calculation is already conservative.

In addition to the comment above, it should be recognized that in general it is not possible for devices to operate at full output at very low SCR, regardless of technology type.

32. Are there any other issues relevant to the Preliminary Assessment methodology that AEMO ought to take into account?

SGRE believes that there is little merit in running a preliminary assessment as described as:

- There is always going to be a general system strength impact for grid-following IBR in this framework,
- SSLF, being a deciding and important factor, cannot be correctly calculated using AFL and in a SMIB environment,
- The SSQ calculation cannot be completed at the preliminary assessment stage as the tuning of the plant to meet its expected performance has not been carried out and negotiated.

SGRE believes that AEMO must publish a full methodology of the SMIB studies required for SSQ and SSLF calculations directed to proponents for indicative assessment to enable them to run the studies themselves when comparing OEM's or deciding on the pay or remediate.

Proposed methodology for Full Assessments

33. What criteria should be applied to determine whether a project is classified as a committed project for Full Assessment purposes? Why?

Projects can be considered committed for FIA purposes once their proposed performance standard has been approved.

34. How and when is it appropriate to include future network augmentations (new transmission upgrades, configuration changes, considered projects, system strength remediation upgrades etc.) into the Full Assessment? Why?

Network augmentations must be included as soon as accurate models are available and there is confidence with their commissioning relevant timeframes for commissioning of the project under study. If it is the case that a network augmentation, which is uncertain, could significantly impact the outcome of the FIA then it must be assessed on a case by case basis.

Proposed methodology for Stability Assessment

36. Is the proposed scope of a Stability Assessment appropriate?

SGRE believes that the proposed scope of the Stability Assessment is not appropriate. For the stability assessment it is critical that all information is confirmed not assumed before the study is carried out. The performance of a generating system after the fault is impacted by the performance during the fault so neglecting any changes in this will lead to inaccurate outcomes.

If the stability assessment happens before access standard negotiation, then what happens if/when control or plant changes are necessitated by the access standard negotiation.

37. What study assumptions could be recommended to ensure there is no "free rider" situation for (system strength services) non-paying Applicants?

SGRE believes that the current scope is unlikely to result in any "free rider" situation.

38. Are there any other issues relevant to the Stability Assessment methodology that AEMO ought to take into account?

SGRE believes that if the generator elects to pay the system strength charge, then the obligation should be on the NSP to ensure that the system is stable. Thus, if the outcome of the stability assessment is that the system is not stable then the obligation should be on the NSP to ensure that the system is modified to accommodate the connecting plant.

SGRE believes it will be an extremely difficult to define whether issues are in the scope of the NSP or connecting generator to resolve with the current proposed methodology. The proposed stability assessment methodology creates a conflict of interest for the NSP, who will be required to both determine the outcome of the assessment and the scope of work required by themselves.

Guidance on the calculation of SSLF

40. Are there any other issues relevant to the calculation of SSLF that AEMO ought to take into account?

SGRE believes that the calculation of SSLF must be revised from that proposed in the issues paper. The basis of available fault level for calculation of the SSLF is not suitable, simply using synchronous fault level would be much more suitable. AFL is not accurate enough to tie to system strength charges that impose a significant financial burden on connecting generators.

It is also important to note that AEMO has already excluded several grid-following IBR plant from it's System Strength Limits[1] calculation indicating that they have no contribution (either positive or negative) on the system strength outcome for South Australia. This indicates that AEMO is aware that some grid-following plant will not adversely impact system strength, and it would be manifestly unjust to charge all plants.

[1] AEMO Jan 2022 - Transfer Limit Advice - System Strength in SA and Victoria, https://www.aemo.com.au/-/media/files/electricity/nem/security_and_reliability/congestion-information/transfer-limit-advice-system-strength.pdf

Guidance on the calculation of AFL

41. What is the preferred methodology and pre-fault condition assumption for calculation of short circuit currents? Why?

Both system normal and N-1 pre-fault conditions should be considered.

42. Are there any other issues relevant to the calculation of AFL that AEMO ought to take into account?

This issues paper presents little insight into the co-efficient **α** in the proposed AFL calculation. However, this co-efficient can have a significant impact on the AFL outcome, without a rigorous description SGRE cannot fully infer the method being proposed by AEMO.

The available fault level calculation also appears to consider that a grid forming IBR used for SSS services increases system strength in direct proportion to its minimum SCR withstand capability. This leads to a perverse outcome. SGRE would encourage AEMO to consider how grid-forming IBR providing SSS services are considered in the AFL calculation.

SGRE considers the technology co-efficient in the AFL calculation is too simplistic and restrictive. It is not reasonable to expect zero impact (zero coefficient) on AFL with grid forming plant. As these plants are developed further it is likely that there will be significant differences in performance and capability between implementations and these must be considered.

Finally, in general, SGRE believes that AFL is always an indicative number and should never be used to calculate critical criteria with significant financial impacts like the SSLF. The industry is at a stage where a separation between network strength and synchronous fault level is required due to advancing technology, and although SGRE commends AEMO for attempting to address this it is clear they have been hamstrung by the required use of the available fault level in the ERC0300 rule change.

Guidance on demonstrating compliance with new minimum access standards

43. For (high SCR) connections where SCR may change over time, what would be a sensible process to trigger the need for GPS assessment or confirmation of compliance at SCR of 3.0?

While in general SGRE agrees with AEMOs proposed approach, it is unclear how general system strength impacts will be calculated and what charges/self remediation will be required if this standard is not assessed during connection.

44. Are there any other issues AEMO should take into account when considering compliance of affected plant?

SGRE noted that AEMO has modified the wording of S 5.2.5.15 (d) in a way that the performance of the plant is assessed and negotiated at its lowest claimed SCR capability. This will result in many parallel studies and tuning for different SCR levels (Min and operational) during the connection stage.

AEMO and connecting NSPs should provide some dispensation to connecting generators who elect to pay the system strength charge on certain performance clauses, in particular S 5.2.5.1 and S 5.2.5.5. It is expected that if the SSSP provides system strength using a SynCon then the device installed by the SSSP will provide significant reactive power capability and Iq injection, reducing the performance required by nearby plant to support the network. This will also incentivize connecting generators to pay the service charge rather than self remediating.