AEMC

Investigation into system strength frameworks in the NEM

STAKEHOLDER SUBMISSION TEMPLATE

The template below has been developed to enable stakeholders to provide their feedback on specific questions that the Commission is interested in due to the discussion paper. It is designed to assist stakeholders provide valuable input on those questions the Commission is interested in. However, it is not meant to restrict any other issues that strakeholders would like to provide feedback on.

SUBMITTER DETAILS

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CHAPTER 2 – KEY ISSUES WITH THE CURRENT SYSTEM STRENGTH FRAMEWORKS

Section 2.3 – Key issues of the minimum system strength framework	
1. Do stakeholders agree with the AEMC's assessment of the issues of the minimum system strength framework?	Yes.
2. Have stakeholders identified any other significant issues as a result of the minimum system strength framework?	Yes. The definition of the system strength needs further refining according to modern applications and no longer should be defined as fault current rather impedance of frequency generating units (either power conversion based or mechanical) should be considered (in line with modern power electronics based synchronous generator units). The current method of calculating system stregnth by the market operator and network service providers typically only consideres the impact of mechanical synchronous machines and therefore limits opportunities for more modern solutions to be considered.
Section 2.4 – Key issues of the "do no harm" framework	
3. Do stakeholders agree with this assessment of the issues of "do no harm" framework?	Yes

4. Have stakeholders identified any other significant issues as a result of the "do no harm" framework?	Yes. The definition of system strength should be defined in terms of impedance not fault current. The current market experience is that the method used by the network service providers to calculate the system stregnth fault level short fall typically only consideres the impact of mechanical synchronous machines and therefore limits opportunities for more modern solutions to be considered.
Section 2.7 – Conclusion	
5. What are stakeholders views on the Commission's proposal to consider evolving the framework to a more integrated approach for system strength in the NEM?	Modern power system designs should consider advancements of technolongy which allows system operation with power electronics based synchronous generating units. The discussion paper mainly makes reference to mechanical generators and provides little provisions for power electronics based synchronous generating units.

CHAPTER 3 – CONSIDERATIONS FOR PROVISION OF SYSTEM STRENGTH

Section 3.1 - What is system strength?	
6. Do stakeholders agree with the Commission's characterisation of system strength?	No. The definition of "System Strength" should be reconsidered and should be defined as an impedance level of the system from frequency generating units. The change in definition plays a key role in order to apply for modern technology and increase the robustness of the network.
7. Has the Commission set out all the necessary considerations for defining a system strength service? If not, what additional considerations could be included?	No. The definition of System Strengh for both real inertia ("i.e. inertia provided by units with synchronous capabilities), and system strength with impedance provided by units with synchronous generating capabilities should be considered rather then considering a fault level at a particular node. The network fault level should only be associated with the protection requirements of the power system and not used a measure for system strength.
8. Do stakeholders consider the regulatory definition of system strength should be updated/changed? If not, why not? If so, how could this be done?	Yes we recommend the regulatory definition of system strength should be refined as a specific characteristic of the network being voltage stability defined by the network impedance level. Currently the definition is used as a catch call and includes multiple meanings including inertia and fault level which is not giving a clear signal to the market and hence is limiting the opportunities for new technology to be considered as viable solutions to improve network system strength. We recommend update of definition of System Strength as per above items 6 & 7 defined above.
9. Do stakeholders consider that the system strength definition should recognise active and passive system strength procurement? If not, why not? If so, how could this be done?	Yes the definition of system strength should consider both active and passive procurement. The regulator should consider separate definitions for system strength relating to voltage stability, inertia relating to frequency stability and fault level relating to network protection to allow each active and passive procurement to be categorised based on the provided service level.

10. Do stakeholders agree that clarifying the NER system strength service definition is likely to contribute to more/broader options for the system strength provision?	Yes. As detailed in item 9 updating the definition will allow system strength services to be categoried based on the service level provided and will allow solutions to be tailered to the specific networks shortfalls.
11. Are there any additional sources of fault current in the NEM that can contribute to meeting system strength needs?	Yes. Use of the term "fault current" or "fault level" can be misleading when used as a measure of network system strength. Industry practice "Fault Current" or "fault level" is used for proper operation of network protection system. However, for system strength relating specifically to voltage stability, system impedance provided by synchronous generating units (both power electronics based and mechanical) should be considered as the true measure. "Fault current" from a pure current contribution point of view can and is provided by both grid following (PV / Wind inverters) and grid forming inverters. However, only inverters with synchronous generating capabilities can provide system strength contribution and is measured based on the impedance level at the point of connection.
12. Are there any other technologies in the NEM that can contribute to meeting system strength needs that should be consideredi?	Yes. Inverters with synchronous generation capabilities are able to contribute to system strength. The SIEMENS SINAMICS S120 Inverters have been modelled in PSCAD to demonstrate these capabilities.
Section 3.2 - Why is system strength needed?	
13. Do stakeholders agree with why system strength is needed?	Yes
14. Are there any additional reasons for why system strength is needed in a power system?	No.
15. Do stakeholders agree with the characterisation of the impact of inverter-based generation on system strength?	No. Currently the fault contribution of grid following inverters is not considered in fault level calculations on the NEM as the grid following inverter technology is unable to contribute to system strength, even though the grid following inverters do provide fault current. The issues raised in item 11 identify that the current definition of system strength is used as a catch all term and does not acknowledge the system strength contribution of the asset unless it provides all three requirements (voltage stability, frequency stability and fault current). The refinement of the system strength definition will allow the contribution of each assest to be considered on its merits and establish a clear criteira for retaining network stability which will allow for more optimised solution development and establish measurable benchmark requirements for the procurement of system strength services. Please refer above comments (item 12).
16. Are there any additional impacts on system strength that should be taken into account?	System strength should also consider post fault network recovery. Currently synchronous condensors are considered to be the primary solution to system strength short falls. However while synchronous condensors provide system strength from voltage stability point of view, post fault the large inertia of the synchronous condenser may cause longer frequency recovery time post fault.
Section 3.3 - The provision of system strength in the NEM	

17. Do stakeholders agree that with the characterisation of system strength thresholds?	Yes.
18. Are there any additional thresholds or alternative characterisations that might be included in the investigation?	Yes. Clear definition for power electronics based synchronous generators is required to establish alternative technologies to mechanical synchronous machines to improve system strength.
Section 3.4 - The provision of system strength in the NEM	
19. Do stakeholders agree with the system strength attributes?	No. The current definition of the system strength and its attributes detailed in Section 3.4 relate to the inherit characteristics of a synchronous machine when synchronoised to the network. This definition is dated and can no longer be considered accurate in a network with a growing level of asynchronous generation. The system strength of a modern grid is based on three key pillars (voltage stability, frequency stability and fault current) and should not be categorised by the inherit features of one form of generation.
20. Are there any additional attributes of system strength that the Commission should be aware of?	Yes. As per above definition of system strength should be more aligned to modern and future networks, which is best to be characterised by system impedance for voltage stability, inertia for frequency stability and fault level for network protection as opposed to a catch all definition of system strength measured purely on "fault current".

CHAPTER 4 – EVOLVING SYSTEM STRENGTH FRAMEWORKS

Section 4.1 - Approach to developing a new framework	
21. Do stakeholders agree with approach (Plan, Procure, Price, Pay) to developing a new framework for system strength? Are there additional steps/concepts that should be explored?	Yes. The planning process must allow for the integration of other forms of system strength remediation (both passive and active). The current planning process only allows for the consideration of synchronous machines and this limits the ability of other more modern solutions to be considered.
Section 4.2 - Models for delivering system strength	
22. Do stakeholders agree with the summary of the potential capabilities of each system strength model in Table 4.1?	YES
Section 4.3 - Model 1: Centrally Coordinated	
23. Do stakeholders agree with the characterisation and assessment of a centrally coordinated model? Are there any other advantages and/or challenges?	Yes
Section 4.4 - Model 2: Market based decentralised	

24. Do stakeholders agree with the characterisation and assessment of a market based decentralised model? Are there any other advantages and/or challenges?	Yes
Section 4.5 - Model 3: Mandatroy service provision	
25. Do stakeholders agree with the characterisation and assessment of a mandatory service provision model? Are there any other advantages and/or challenges?	Yes
Section 4.6 - Model 4: Access standard	
26. Do stakeholders agree with the characterisation and assessment of an access standard model? Are there any other advantages and/or challenges?	YES
Chapter 4 - General	
27. Are there other model(s) stakeholders think should be explored?	NA
28. What combiantions of models (i.e. hybrids) should be explored further?	NA
29. Do stakeholders have any suggestions as to how any/all the models set out could be implemented or modified? Please comment on any and all models possible.	NA

CHAPTER 5 – SYSTEM STRENGTH IN DISTRIBUTION NETWORKS

30. What factors make system strength provision in distribution networks unique from transmission networks?	Distribution networks by design have a much lower system strength compared to traditional transmission network and therefore consideration must be given to the types of solutions implemented to provide system strength solutions to distribution networks for the integration of asynchronous generators on the distribution network. Moving to a 100% renewable energy integration must make provisions for application of modern technologies with clear and accurate definitions.
31. What are the key issues for system strength in distribution networks, including the magnitude and urgency of system strength issues in distribution networks?	One of the major issues is the original design of most distrubtuion networks on the NEM were not designed for the scale of distributed generation we are currently seeing and are likely to see in the future. Distribution networks also have very strict operating requirements to maintain voltage stability compared to tradition transmission networks so there are additional challenges in coupling utility scale renewables on smaller distribution networks. Advances in inverter technology specifically within the grid forming space have the potential to unlock a lot of capacity in the distribution network if the regulatory frameworks are update to reflect the impact this technology has on system strength.

32. How should any system strength issues in distribution networks be addressed? Are any model(s) from Chapter 4 appropriate to address system strength provision in distribution networks?	The refinement of the definition of system strength has the potential to provide more flexibility to the distribution network service providers to articulate the network short falls which then can be addressed on a needs basis. The current catch all definition of system strength limits the markets ability to prescribe a suitable solution.