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Energy Policy WA (EPWA)
(via email to energymarkets@deed.wa.gov.au)
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Re: Power System Security and Reliability (PSSR) Standards Review

L & K Engineering supports this review, in particular the aims to:

- achieve a consistent picture over the relevant planning documents (Whole of System Plan, WEM Electricity Statement of Opportunities, Transmission Planning updates, etc.)
- provide a clear delineation of responsibilities between AEMO and Western Power and other parties
- Clarify the responsibilities and approach to system strength in the SWIS, and partially addressing this by encouraging technology with Grid-Forming capabilities.

The PSSR consultation paper is extensive, so we have mostly limited our comment on proposals to those relating to the technical aspects of the proposed changes (ESM Rules, Appendix 12).

Overall, we believe that the rules should aim to be technology agnostic (as far as practical), particularly in regards to the Minimum performance standard. If the aim of the review is to increase system security and reliability, namely through increased uptake of grid-forming technologies, the requirements to connect a grid-forming facility should not be more onerous than those to connect a grid-following facility. In many cases the difference between these may only be a firmware change. If not, a potential grid-forming facility may be commissioned in grid-following mode purely to facilitate an easier, faster or cheaper connection – we believe this would be a bad result.

L & K Engineering's responses to questions raised in the consultation paper are provided below.

Proposal 4 – Point of compliance with user facility standards and hybrid facilities

The proposal mostly deals with loads, and for that purpose we are supportive of the changes. However for a facility which consists of mixed grid-forming and grid-following technologies there is no clarity provided by the proposed changes in terms of assessing compliance against

Appendix 12. The proposed differences between performance requirements for each technology may mean that it is not possible to determine the required performance standard at the Connection Point.

It is quite likely that hybrid facilities will mix grid-following and grid-forming technologies at a single site. An example of this arrangement would be a Wind Farm (Grid Following) that is unable to meet the SCR requirements alone including a behind the meter BESS (Grid Forming) to improve the withstand SCR of the facility. The proposed rules changes imply that two GPSs would be required (one for the Wind Farm and one for the BESS), as each technology has conflicting requirements under Appendix 12, and there is no process defined for determining a common assessment criteria. Assessing each component separately to demonstrate compliance would defeat the purpose of the BESS as any benefit is not captured in the assessment of the Wind Farm.

We agree that the assessment should be completed once at the point of connection for the combined facility (the default case in the proposal), but this requires a single set of criteria to be set regardless of grid forming/grid following technologies.

This follows the NEM approach, where assessment is at an agreed point for the whole facility regardless of grid forming/grid following technology.

However, we would also like to highlight that assessment at a single point may cause issues for assessing fault-ride through capabilities. The flexibility to assess these at the generator terminals should remain. Otherwise it may not be possible to meet the Minimum commencement/rise time requirements due to the impact of the balance of plant.

Alternatively, these requirements would need to be relaxed so they can be met at the Connection Point (or alternate assessment point). In either case the required performance standard should apply to both grid-forming and grid-following technology.

Proposal 6 – Withstand Short Circuit Ratio (SCR)

We agree that a Minimum Withstand SCR should be defined, and agree that a value of three is reasonable. However, we have identified some issues with the proposed requirements for withstand SCR, these being

- Grid-forming and Grid-following have different Minimum withstand SCR requirements
- Assessment requires the same settings for assessing the withstand SCR and other GPS clauses.
- The conditions under which WP/AEMO may relax this requirement are not clearly defined.

- The opportunity to contractually address SCR shortfalls are different for grid-following and grid-forming facilities.

Further details are provided below:

Minimum withstand SCR requirements

As the WEM does not require a System Strength Impact Assessment we believe the minimum withstand SCR should align with Western Power's system strength framework. In this sense, the minimum withstand SCR is interpreted as the minimum SCR that the NSP (Western Power) undertakes to maintain at the connection point into the future (the existing/current SCR may be above this level). If this is the case, it is not clear why a grid forming facility is offered less system strength compared to a grid following facility. As an example, if a grid forming technology has a minimum withstand SCR of 2.1 (above the proposed minimum of 2), it is not able to connect to the network. However, if the same technology is commissioned in Grid Following mode (meeting an SCR of 3), it can be connected. This potentially discourages connection of grid-forming technologies and results in higher consumption of system strength – and goes against the intent of the changes.

We think that the minimum requirements should be technology agnostic, or at the least agnostic towards grid-forming/grid-following.

Single set of settings for tuning and withstand SCR

We believe any tuning should be done to achieve the best performance at the project specific connection point, while the withstand SCR provides future proofing and reduces the system strength consumption of the connected project. Our understanding is that the withstand SCR reflects the minimum SCR for which the facility must remain connected and maintain stable operation.

We note that it is not possible to meet all the GPS requirements at the withstand SCR value. For example, at a SCR of 1.2, the network capacity will not allow full dispatch of active power. As such, supporting studies would need to be performed at a reduced output or with connection of a fictitious load. These approaches are not an acceptable basis for GPS studies and tuning of the control system(s).

The tuned settings approved in a GPS are used for system studies and for commissioning of the facility. If the tuned parameters are significantly different to the actual SCR at the physical connection point stability and GPS compliance issues are expected in any simulation and actual operation. Tuning parameters to meet the GPS standard at the withstand SCR makes this much

more likely to occur.

We think the WEM should adopt a methodology detailed in the NEM's *System Strength Impact Assessment Guideline* to assess the withstand SCR. The actual SCR at the connection point should be used for other GPS clauses. This approach would be consistent with the NEM.

The conditions for adopting different settings for tuning and withstand SCR are not well defined

The proposal attempts to address the mismatch between actual and withstand SCR by adding the following provision:

> Flexibility should be provided for AEMO and the Network Operator to consider accepting the use of different settings if there are sizeable differences between the minimum anticipated SCR and the withstand SCR.

The above statement does not clearly define what constitutes 'sizeable differences' and this may need to be agreed on a case-by-case basis. Potentially this adds to the timeframe and cost of a project, and as a result any investment risk.

We believe this clause is not required if the expected Connection Point SCR(s) is used for GPS studies and the withstand SCR demonstrated separately (as suggested above).

Opportunity to contractually address SCR shortfalls (adopt NER clause 5.2.5.15(e))

The proposal states

> Adopt a clause that mirrors the NER clause 5.2.5.15(e) which provides other means for a grid-following inverter to connect although it is unable to meet the required minimum SCR.

It is not clear why this pathway is only available for grid following technology. We believe that this solution should be available to all projects and technologies.

Proposal 7 – Voltage phase angle jump

The proposed phase angle jump of 60 deg is excessive and this value could be close to a stability limit. We see a high risk that many grid-forming technologies will not be able to meet this criterion. Also, where a technology is capable of meeting this requirement, the parameter settings needed to meet it will result in lower performance of the facility, ie. by operating with a significantly lower inertial response.

We note that the UK National Grid is used to support this requirement. Our reading leads us to understand that the ability for grid-forming inverters (in general) being able to meet this requirement is still an open question[1]. We also understand that national grid intends to include a market based approach for procuring GFM resources (and a cost-recovery pathway for the participants).

The UK-grid ESO grid-forming best practice guide [2] emphasises that it is necessary to check that 60 degrees is achievable, and that this requirement exists for legacy reasons and for a small number of cases.

The requirement to accept a 60 degree phase angle shift is not related to system strength or inertia. As system strength and inertia are a key driver for the uptake of grid-forming technology in the SWIS, we are not sure what this requirement achieves. We also note that synchronous machines, while provide system strength and inertia, may not be able to meet this limit.

We suggest reducing this to 25 degrees as the Minimum requirement, consistent with grid-following facilities. [3]

Proposal 8 – Active and reactive current response during and after contingencies

We are supportive of the majority of the changes under this proposal. However we would like to comment on two aspects:

Speed of response

A commencement time of 10 ms is very short for grid-forming inverters. We believe a response time of less than one cycle will create significant challenges for both accurate simulation and physical monitoring of a facility. We propose a commencement time of 30 ms to allow more than one cycle to capture the response. In keeping with the aim of technology agnostic rules, we believe the rise time requirement for grid-forming inverters should be the same as that for grid-following inverters.

[1] Phase 3 of the 'NOA Stability Pathfinder' includes this value in its specifications, but to assess whether a 60 degree requirement is achievable.

[2] "Great Britain Grid Forming Best Practice Guide", p45., available at https://www.nationalgrideso.com/document/278491/download

[3] If it is known that a new connection point is subject to a higher phase angle jump requirement, the GPS grid input pack should include this information and a value higher than the minimum requirement should be negotiated to cover the project specific requirements and remove any network stability risk.

Negative Sequence Current Control

Grid-forming inverters have an inherent response to unbalanced faults and prioritising between positive and negative sequence current is not possible. We suggest to remove this requirement, noting that the main purpose of negative sequence current injection is to prevent over voltage on the healthy phases during a fault.

Frequency of Current injection

The frequency of current injected by grid-forming technology will be based on the frequency of the internal voltage source. This may be different to the network frequency during and immediately after a disturbance. We propose to remove this requirement for grid-forming inverters.

Oppose fast changes in voltage magnitude

While a grid-forming technology will provide this functionality, it is very difficult to monitor and confirm compliance in the physical facility. We don't see any benefit by including the inherent response of a technology in the GPS. Hence, we suggest removing this requirement from the proposed changes.

Proposal 10 – Damping of power system oscillations

We support this change as it rectifies issues with the existing rules when assessing the damping ratio requirement.

Proposal 11, Proposal 12, Proposal 13, Proposal 14, and Proposal 15

We support these proposals and the resulting changes.

Proposal 16, and Proposal 20

It is not clear in the PSSR Consultation Paper whether clauses not listed in Table 15 were also to be adopted from Western Power's September 2023 proposed Technical Rule changes. In the event that Section 2.5 of the Technical Rules are to be adopted, we would like to make the following comment (and acknowledge it is potentially outside of the requested feedback).

Facility Size Limit

The proposed Technical Rule changes substantially altered the 'TRANSMISSION SYSTEM PLANNING CRITERIA' compared with the prior (current) version. In particular with regards to gen-

eration, Western Power introduced (effectively) a maximum facility size for the SWIS, through clause 2.5.3.1(b), "*for the purposes of transmission system design and planning, the maximum infeed loss risk limit is 400 MW.*". Clause 2.5.3.1(c) in theory allows this size to be varied, but this limit has already been flagged as a maximum facility size limit when discussing connection options for future facilities.

Under proposal 16, the increased coordination of forecasting between AEMO, Western Power and EPWA, should mean that this limit is determined based on the relevant planning outcomes and not be a fixed value, and not be directly included in the Technical Rules. Beyond the planning horizon, we would expect that the Dynamic Frequency Control Model (DFCM) used by WEMDE is able to dynamically manage this infeed risk, without an explicit limit being required.

If the entirety of the Technical Rules changes proposed in September 2023 are to be adopted, these clauses should be amended so that a fixed value for indeed is not specified. If the infeed risk is to be specified, it should be made by reference, to allow it to reflect the most results of the planning processes.

L & K Engineering thanks EPWA providing an opportunity to provide feedback on the proposed changes to the planning and operation of the SWIS. We hope that the final rules that are adopted encourage the uptake of grid-forming technology in the SWIS, and appreciate that the changes to the planning process should provide a clearer and consistent picture of its future development.

Yours Sincerely,

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