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30 May 2022

Ms Merryn York
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Via email: planning@aemo.com.au

Dear Merryn

SUBMISSION ON AMENDMENTS TO AEMO INSTRUMENTS FOR EFFICIENT MANAGEMENT OF SYSTEM STRENGTH RULE – ISSUES PAPER

Powerlink Queensland (Powerlink) welcomes the opportunity to provide input on the Australian Energy Market Operator's (AEMO's) Issues Paper regarding amendments to the instruments for Efficient Management of System Strength Rule (Issues Paper).

Changes to AEMO's current system strength instruments are required to implement the recent rule change made by the Australian Energy Market Commission (AEMC), which enhances the regulatory framework to facilitate more efficient and timely provision of system strength for the NEM.

AEMO is consulting on amendments to its System Strength Requirements Methodology (SSRM) and System Strength Impact Assessment Guidelines (SSIAG), as well as consequential changes to the Power System Stability Guidelines (PSSG).

Our submission to this Issues Paper reflects our commitment to continue to provide safe, secure, reliable and cost-effective transmission services to our five million Queensland customers.

System Strength Requirements Methodology

In developing amendments to the SSRM, Powerlink would like to highlight the following key points:

Minimum fault level

- Powerlink supports AEMO adopting the existing minimum fault level requirements and to only reassess these if there is a major change in the power system that impacts the fault level required for secure operation.
- Minimum fault levels should be planned such that any constraints on Inverter Based Resources (IBR) plant due to system strength limitations do not pose a risk to the jurisdictional reliability obligations, when either:
    - Returning the system to a new secure state following a credible contingency or protected event; or
    - Operating the power system in a secure manner with a planned outage.

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- The minimum fault levels should also be sufficient such that under planned outages or when returning the power system to a new secure state, fault levels remain adequate for continued operation of protection systems.

Efficient level of system strength

On this matter we recommend that:

- AEMO only forecasts the capacity of IBR plant at the Renewable Energy Zone (REZ) and/or zone level. This includes forecasts for the installed capacity of wind, solar, battery energy storage systems (BESS) and IBR loads. System Strength Service Providers (SSSPs) will model the location of plant within a REZ or zone taking account of relevant local knowledge such as connection enquiries and connection applications, their connection market intelligence, joint planning with Distribution Network Service Providers (DNSPs), and any jurisdictional access reforms that may apply.
- AEMO should not specify the technology type of the IBR (i.e. grid forming versus grid following) as part of their forecast. The allocation between technology types should be based on discussions between the SSSP and prospective BESS proponents with consideration given to potential system strength and/or inertia services that may incentivise grid forming technology.
- Greater flexibility than the minimum of an annual review process contemplated by the Amending Rule, given the speed of the energy transformation. Powerlink also emphasises the importance of joint planning to effectively forecast the level of IBR investment (both generation and load).
- The efficient level of system strength should be based on 100% availability of the forecast level of inverters and wind turbines. The SSSP can then determine how to appropriately account for the expected diversity in MW output between IBR plants within and between adjacent REZs (including the impact of REZ and/or transmission limitations) when determining the efficient level of system strength.
- The efficient level of system strength should consider that, the requirement of AEMO to resecure the network within 30-minutes following a credible contingency or protected event. If the magnitude of constraints on IBR plant required to return the system to a secure state is such that reliability obligations cannot be met, then the efficient level of system strength needs to be increased. It should be noted that some level of IBR constraints will be economically efficient. However, this assessment should lever off AEMO's longer-term locational forecasts for IBR plant and scale efficient system strength solutions to ensure that overall benefits to customers are maximised.

These points and responses to a number of the specific questions raised in the Issues Paper are discussed in more detail in Attachment A.

System Strength Impact Assessment Guideline

In developing amendments to the SSIAG, Powerlink would like to highlight the following points:

- To avoid the unintended consequences of this new framework, the materiality threshold for 'adverse system strength impact' should be maintained as it is currently defined in the existing SSIAG. A Reduction in Available Fault Level (AFL) due to a new connection should only be calculated if a new IBR connection is shown to have an adverse system strength impact as per the criteria in the existing SSIAG. In the absence of the materiality threshold that is based on adverse system strength impact, all small IBR plants connecting remote from the system strength node will be forced to connect small synchronous condensers or grid forming batteries irrespective of the technical need. This additional cost (irrespective of the need) will impose significant impediments to small IBR plants connecting to the distribution network.
- Due to the critical interdependencies between the Generator Performance Standard (GPS) and Full Impact Assessment (FIA), Powerlink agrees with AEMO that a Full Assessment should be carried out prior to finalising the GPS.
- To avoid the possibility of banking system strength capacity, an appropriate threshold criteria should be applied prior to considering a project as 'committed' for the Full Assessment purposes. Powerlink has experienced projects that achieve GPS (5.3.4A/B) acceptance, but yet do not proceed to connect. Powerlink recommends that a pre-requisite for a project receiving 'committed status', from a system

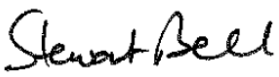
strength perspective, should include a formal acceptance of the connection offer and a 5.3.7(g) response to AEMO from the connecting NSP.

- We recommend that stability assessment should include both fault ride through and steady state response.

These points and responses to a number of the specific questions raised in the Issues Paper are discussed in more detail in Attachment B.

Powerlink is willing to further discuss these matters with AEMO in one on one meetings. If you have any questions in relation to this submission or require further clarification, please contact Sachin Goyal.

Yours sincerely,



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Attachment A – Feedback of the System Strength Requirements Methodology

1. Do stakeholders have alternative suggestions for the approach to determining minimum fault level requirements?

   Powerlink supports AEMO's approach of recognising that the existing minimum fault level requirements across the NEM support the secure operation of the power system under system normal conditions and allow continued operation of protection systems.

   The minimum fault levels should be planned such that if constraints on IBR plant are required to manage system security under planned outages or when returning the system to a new secure state, then these constraints do not pose a risk to reliability of supply. If reliability standards cannot be maintained under these conditions then the minimum fault levels need to increase.

   The minimum fault levels should also be sufficient such that under planned outages, fault levels remain adequate for continued operation of protection systems.

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.

   Powerlink recommends that the minimum fault level should only be reassessed if there is a major change in the power system that has an impact on the fault level required to maintain secure operation and continued operation of protection systems. Examples include, but are not limited to:

   - Technology advancements that are less reliant on fault level;
   - Future uptake of Distributed Energy Resources (DER);
   - Changes in the synchronous generation forecast; and
   - A major change in network topology, including voltage level and/or technology (e.g. HVDC).

   Any such changes to the minimum fault level must be done based on appropriate detailed EMT-type analysis. Therefore, such changes would only be made within the short to mid-term planning horizon when there is a clear line of sight of the emerging structural and/or technological changes to the power system. Otherwise the minimum fault levels should be maintained.

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?

   Powerlink agrees that the existing and committed IBR plant (prior to March 2023) should be included in the minimum fault level requirements and that the system strength required for all new IBR plant (post March 2023) should be accounted for under the 'efficient level' of system strength.

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

   Protection systems are designed and managed by NSPs.

   The current minimum fault levels defined within the NEM adequately support the operation of existing protection systems.

   Powerlink does not support NSPs being asked to determine the minimum fault level below which protection systems will not function correctly. Rather, when a case for reducing minimum faults (based on the triggers described in question 2) is being assessed, then the scope of the investigation must consider the continued operation of protection systems. It does not naturally follow that protection problems uncovered, as part of this investigation, would drive higher minimum fault levels. The cost of modifying the impacted protection systems should be assessed such that the most efficient overall solution for customers is identified.

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?

   Allowable voltage step change limit is managed by NSPs to meet the system standards. AEMO should be guided by NSPs if there is any additional fault level requirements for NSPs to maintain the system standards.

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

   Powerlink agrees with the assessment methodologies proposed by AEMO. To incorporate the impact of new technologies it is likely that dynamic power system analysis will be required to assess compliance against the system standards.

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?

   Powerlink recommends that the fault level requirements for DER synchronism is best captured in 'minimum fault level' requirements. As DER investment, such as rooftop PV, electric vehicles and household batteries is driven by electricity customer preferences it is appropriate that the power system fault level needed to support this DER is included in the minimum fault level requirement. The cost of meeting this minimum fault level is then recovered from electricity consumers.

11. What other issues need to be taken in to account when considering the application of the minimum fault level requirements in an operational context?

    The minimum fault levels are planning standards determined at system strength nodes and account for credible contingencies and protected events only. Therefore, there remains the possibility that such levels may be violated operationally due to unexpected generation availability/dispatch and/or status of the transmission system due to planned or unplanned outages.

    In such circumstances limit advice would be provided to AEMO to ensure the secure operation of the power system. This may include curtailing the output of IBR plants. Minimum fault levels should be planned such that these operational constraints do not pose a risk to the respective jurisdictional reliability standards. The minimum fault levels should also be sufficient such that under planned outages, fault levels remain adequate for continued operation of protection systems.

    Violation of either of these criteria may necessitate an increase in the minimum fault levels.

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

    Defining the stable voltage waveform separately could represent unnecessary duplication and may result into misinterpretations. We suggest that system standards defined in S5.1a of the NER are considered adequate to define a stable voltage waveform. If the system is meeting the system standards, then the voltage waveform should be considered as stable. As such, there is no need to define any additional metrics for a stable voltage waveform.

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?

    Powerlink considers that option 1 (use of generic EMT models) is the only method suitable for assessing future voltage waveform stability (IBR stability). The other high-level metrics proposed in options 2 and 3 provide no insight into the system strength issues that need to be assessed and understood to determine the efficient level of system strength necessary to meet the forecast of IBR plant.

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?

    The solution for the system strength could heavily dependent on the assessment methodology and assumptions considered in the modelling. We believe that consistent methodology for system strength planning across NEM is important.

    We suggest the method of the assessments as per option 1 (use of generic models) and AEMO should provide some general guidance on the type of generic models that should be used by the SSSP. The SSRM should provide guidance and not be prescriptive. Assessment as per options 2 & 3 do not provide sufficient confidence in voltage waveform stability that is important of the stable operation of IBRs.

16. Under what conditions, if any, do stakeholders consider that AEMO should deviate from the ISP's 'most likely scenario' for the purposes of the system strength requirements?

    Powerlink considers that the ISP is a good starting point but other inputs must be taken into account when forecasting the future IBR plant. These inputs include, but are not limited to:

    - Jurisdictional Government policy that may influence the quantum and speed of decarbonisation of the electricity system and that of the broader economy. To the extent that this outlook differs from the ISP's inputs and/or outcomes, there may be material impacts on the timing and quantum of the required IBR to build out this lost capacity.
    - Jurisdictional REZ development initiatives may deviate from those (timing and size) anticipated by the ISP
    - The timing, location and size of new large block loads and/or electrification of existing customer energy use is very difficult to forecast. However, these demand side impacts can also be very material and impact the timing and quantum of IBR required.

    The uncertainties on both the supply and demand side can change very quickly and impact the required investment to procure the efficient level of system strength services.

    The annual review cycle specified in the Amending Rule may not be frequent enough to capture these step changes and maximise the time available for the SSSPs to procure the required system strength services. To minimise this risk AEMO should be able to update the IBR forecast outside this annual cycle.

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

    Powerlink recommends that AEMO only forecast IBR at the REZ and/or zonal level. This can include forecasts for wind, solar, BESS and IBR loads. The local TNSP/SSSP will model the location of plant within a REZ or zone taking account of relevant local knowledge such as connection enquiries and connection applications, their own connection market intelligence, joint planning with DNSPs, and any jurisdictional access reforms that may apply.

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)?

    Powerlink recommends the following specification:

    - Plant type (e.g. Large Scale solar farm, wind farm);
    - Timing;
    - REZ allocation (more specific only if agreed under joint planning); and
    - MW/MVA size.

19. Do stakeholders have specific suggestions for how potential new loads should be incorporated in the forecast?

New loads can have different impacts on the required level of efficient system strength:

- Non inverter-based loads can simply increase the load base and advance the investment required in IBR generation to meet the respective RET and/or carbon emission targets.
- Whereas inverter-based load (e.g. electrolysis technology) will not only have the impact as described above, but may also require system strength to operate stably.

Joint planning between NSPs and AEMO is required as part of the load forecast process. NSPs manage the connections of new and existing loads. Through these relationships, NSPs are at the forefront of understanding plans for expansion and/or electrification of existing energy usage. NSPs are also responding to a large number of new large load enquiries and may for their own internal planning processes be engaging consultants to inform macroeconomic projections. Whilst still preserving required confidentiality requirements, AEMO should have visibility of this additional information so that these views can be reconciled against any top down forecast that AEMO (and/or their Consultants) develop.

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

    AEMO's ISP forecast of IBR plant is aligned with Renewable Energy and decarbonisation targets and also takes into account the decommitment of synchronous generators.

    As recommended in question 17, AEMO should forecast at the REZ or zone level only. The allocation of IBR generation between the TNSP and DNSP networks should be informed by Joint Planning between the respective NSPs.

    Powerlink understands that it is not the intent of the Amending Rule to guarantee system strength for all IBR plant located anywhere within a DNSP network.

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?

    AEMO should only forecast the capacity of wind, solar, battery and IBR load connecting into REZs and/or within zones. The SSSP should determine the efficient level of system strength based on 100% availability of inverters and wind turbines. The SSSP can determine how to appropriately take account of the expected diversity in MW output between IBR plants within and between adjacent REZs when determining the efficient level of system strength. This may also consider the impact of REZ transmission limitations and/or upstream transmission limitations. The relevant local knowledge such as connection enquiries and connection applications, their connection market intelligence, joint planning with Distribution Network Service Providers (DNSPs) should be considered by the SSSP while planning for the efficient level of the system strength. The SSRM should not be prescribing how the SSSP determines the efficient level.

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?

    Powerlink recommends that the technical capabilities of future plants should be defined by SSSP based on their market intelligence, customer engagement and commercial negotiations.

23. Is including only committed and anticipated network augmentation projects suitable for forecasting system strength requirements?

    Powerlink considers network augmentations that are consistent with the assumptions of where new IBR plant are located and required for efficient market outcomes should be included. These augmentations may be informed by the ISP or other market analysis performed by the jurisdictional planner and should be included when assessing the required level of system strength. Ignoring this may lead to over investment in system strength.

    These decisions sit with the SSSP when designing the efficient level of system strength to host the forecast levels of IBR. The SSSP in consultation with TNSP (through joint planning where TNSP is

not the SSSP) should also consider likely reinvestments in the network (as per their respective TAPRs) as assets reach end of technical life. The SSSP will need to balance this likely reinvestment in network (that may increase fault levels) against the possibility that non-network solutions may (in full or in-part) be the preferred solution. These decisions rest with the SSSP.

25. Do you consider that the proposed selection criteria will allow for an appropriate set of system strength nodes to be selected? If not, please provide specific alternatives or additions.

    Powerlink agrees with the considerations and criteria put forward by AEMO to select and review the system strength nodes. Powerlink highlights that system strength nodes will need to include nodes where system strength for the forecast levels of IBR will be sourced.

27. Are there specific changes that should be considered to the AEMO approach to what a 'critical' planned outage should be, and the potential thresholds for those outages? If so, please note alternatives.

    The AEMC's Final Determination confirms that the scope of the SSRM is broad enough for AEMO to take a critical planned outage into account when setting the minimum fault levels.

    Powerlink agrees that critical outages include those network elements that have the greatest impact on system strength and the hosting capacity of IBR plant. This can include outages on interconnectors and on major intra-regional grid sections. In all cases though the outage has the effect of decoupling source of system strength from the impacted IBR plant.

    An outage should also be considered as 'critical' if constraints on IBR output due to this outage pose a risk to reliability of supply, or the fault levels under the outage are not remain adequate for continued operation of protection systems.

Attachment B – Feedback of the System Strength Impact Assessment Guideline

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)?

    General system strength impact has two parts;

    1. adverse system strength impact and
    2. reduction in available fault level.

    The materiality threshold for adverse system strength impacts should remain the same as it is currently defined in SSIAG. However, the threshold for a reduction in AFL should be carefully considered. Even remote IBR plants can have an impact on the AFL at the connection point of another IBR plant. Therefore, a reduction in AFL should only be considered as general system strength impact if connection of new plant is causing an adverse system strength impact.

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

    The purpose of the preliminary assessment is to assist with advising proponents their likely System Strength Charge and therefore there is no need to include any safety margin.

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

    Once the GPS has been agreed and the applicant has accepted a connection offer, a project should be considered committed.

    We do not agree that a material change in the proposed generator should revert the committed status to uncommitted. Instead, a project should follow the 5.3.9 process and reassess the general system strength impact.

37. Are there any studies, contingencies, and evaluations that should, or should not, be part of a Stability Assessment? Why?

    Performance during a fault is very much dependent on System strength and on the plant design (e.g. not enough voltage support at fault recovery, slow active power recovery time etc.) System strength cannot be separated from the fault ride through response and only considered for post fault control interactions.

    If plant is showing acceptable performance in the RMS domain and through SMIB at the defined SCR, it should be considered that plant stability issues are due to the lack of system strength. If the SSSP considers that by some control tuning, stability can be maintained, generators should be coordinating this with the SSSP.

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

    Projects that require additional system strength support (in additional to minimum fault level) and their respective system strength support should be excluded from the assessment.

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 planning for the efficient system strength, if the SSSP believes that a plant that was originally tuned for higher SCR could be retuned at a lower SCR and that would minimise the amount of system strength needed for the future IBR plants, the SSSP should be able to require the plant to change its settings under S5.2.2.