11 May 2020

Dr John Pierce
Chair
Australian Energy Market Commission
Level 6, 201 Elizabeth Street
SYDNEY NSW 2000

Contact: james.hyatt@aemc.gov.au

Dear John,

Re: Investigation into system strength frameworks in the NEM (EPR0076)

We appreciate the opportunity to provide a submission on the AEMC's discussion paper on the *Investigation into system strength frameworks in the NEM*.

We are party to Energy Network Australia's submission, which contains the network sector's response to this review. This submission provides some additional commentary and perspectives on key issues within the discussion paper informed by our recent experience in addressing fault level and inertia shortfalls in South Australia.

We support further investigation into the expansion of system strength frameworks to allow Australia's power system to continue its transition from reliance on large synchronous generation to the rapid connection of large numbers of non-synchronous and inverter-based generation. It is important that the regulatory frameworks that support this transition promote system security in a manner that more effectively and efficiently addresses system strength and other system security issues in the National Electricity Market (NEM).

Our detailed response is contained in the Attachment and is structured to align with the chapter themes in the AEMC's discussion paper and stakeholder submission template. The key points are summarised below:

- Existing frameworks for managing system strength and related system security issues address immediate issues in a largely reactive manner but lack coordinated planning with a longer-term view and the ability to capture efficiencies by developing solutions that alleviate multiple system security issues. Piecemeal solutions distributed throughout the network that remediate adverse impacts for individual customer connections also create potential operational challenges by adding complexity and cannot be relied upon when relevant generators are not operating.

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- ElectraNet has been at the forefront of managing system security challenges as the energy mix transitions toward greater reliance on non-synchronous generation, including the challenges with significant uptake of rooftop solar PV installations, with the Australian Energy Regulator (AER) approving our contingent project to install synchronous condensers to address a declared system strength gap and inertia shortfall in South Australia and the Australian Energy Market Operator (AEMO) providing technical approval of the solution.

- Notwithstanding the projected contribution of these synchronous condensers toward alleviating system strength and inertia issues once commissioned, the management of system security issues on the South Australian network remains complex as the rapid connection of non-synchronous generation including rooftop solar PV continues. Assessing these connections under the “do no harm” framework and with a regional system strength constraint applied by AEMO that limits non-synchronous generation in order to maintain system security is particularly challenging, and is being hampered further by limited access to accurate modelling information.

- To effectively and efficiently address the challenges and limitations inherent in the existing frameworks described above in the long-term interests of consumers, system security services, including system strength, should be considered broadly by adopting a coordinated long-term planning approach.

- With this approach in mind, we support a centrally planned and coordinated model for the expansion of relevant regulatory frameworks, consistent with “Model 1” in the AEMC’s discussion paper but defined broadly so as to capture interactions with other system security services, noting that most solutions inherently addresses more than one aspect of system security.

- Key features of this model would include centrally coordinated planning built upon the Integrated System Plan (ISP) and existing transmission planning frameworks, with network businesses procuring the volumes of system strength services necessary to allow implementation of the optimal development path of the ISP on a least regrets basis, noting that the cost of these services would represent a relatively small portion of total required generation and transmission investment in the NEM.

We look forward to further engagement with the AEMC on these matters and would be happy to discuss any aspects of this response further.

Please direct any queries in relation to this submission to Simon Appleby in the first instance on (08) 8404 7324.

Yours sincerely

Rainer Korte
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ATTACHMENT

1. KEY ISSUES WITH THE CURRENT SYSTEM STRENGTH FRAMEWORKS

A. Limitations of existing regulatory frameworks

Existing regulatory frameworks are suited to addressing immediate system strength and inertia gaps in a reactive manner to provide a minimum service level but lack the coordinated planning that is necessary to manage the increasing number of system security issues that are manifesting from a rapidly evolving power system over the longer term and to provide an optimal level of these services.

Solutions are required to address a specific system security issue, such as system strength, and are frequently unable to capture coordination efficiencies offered by solutions that can alleviate multiple, sometimes related, system security issues, such as inertia and frequency control.

The implementation of these frameworks, particularly “do no harm” requirements, result in the distribution of uncoordinated, piecemeal solutions throughout the network in order to remediate the adverse impacts of individual customer connections. This approach presents a number of limitations and challenges including:

- the risk of inefficient long-term outcomes (including unit obsolescence) that do not consider economies of scale, particularly if a regulated solution is required in the same area later
- operational challenges by adding complexity and the potential for adverse interactions between facilities
- solutions such as synchronous condensers have a typical life of 30 years or more and asset sizing and design over that timeframe may not be given due consideration based on short term requirements, noting that the up-front incremental costs to scale up are minimal
- connection projects have a typical life span of 12-15 years and solutions installed to remediate the system strength impacts of these projects cannot be relied upon over a longer period
- asset utilisation may not be optimised given generators are not obligated to provide services when they are not operating, and
- complex and time-consuming modelling and additional capital expenditure requirements to remediate system strength impacts are an increasing barrier for new investment in renewable generation.

We consider these issues alone sufficiently demonstrate the need for reform.

In addition, our recent experience in addressing system strength and inertia shortfalls in South Australia has highlighted several other challenges when applying existing regulatory frameworks, requiring the development of specialised processes. These challenges and processes are outlined in sections B – E below.

B. Background on managing system strength in South Australia

The management of system strength continues to be an evolving issue with South Australia remaining at the forefront of this challenge. Following its declaration of a system strength gap at the Davenport 275 kV transmission connection point in South Australia in October 2017[1], AEMO subsequently published the required minimum three phase fault levels at relevant fault level nodes for South Australia in June 2018.[2] An inertia gap was subsequently declared by AEMO in December 2018.

We worked closely with AEMO to confirm the system strength (and inertia) requirements of the solution to address these shortfalls. As part of the comprehensive technical assessment required to develop a solution, we performed extensive Electro Magnetic Transient (EMT) studies using PSCAD™. Following the completion of due diligence studies, our proposed solution to install two synchronous condensers each at the Davenport and Robertstown 275 kV connection points received formal technical approval from AEMO in March 2019. We expect commissioning of these synchronous condensers will commence by end 2020.

AEMO currently manages minimum system strength requirements in South Australia by directing synchronous generation, when required, and applying a regional system strength constraint that limits the aggregate level of non-synchronous generation output in South Australia unless a minimum level of synchronous generation is dispatched.[3]

C. Effect of the non-synchronous generation system strength constraint in South Australia

The “do no harm” obligation introduced requirements for network businesses to undertake system strength impact assessments for new generator connections in accordance with AEMO’s System Strength Impact Assessment Guidelines.

In accordance with the Rules and the above Guidelines, we have submitted Full Impact Assessments (FIAs) to AEMO for several proposed generating system connections. These FIAs were performed subject to AEMO’s non-synchronous generation system strength constraint and were endorsed by AEMO following due diligence.

When performing FIAs for all proposed non-synchronous generating systems, the four synchronous condenser solution to the declared system strength gap as endorsed by AEMO is included in the base case as a committed solution.

Upon installation of the synchronous condensers to meet the declared minimum system strength requirement, the current operational limit on non-synchronous generation is expected to be relaxed in part which should reduce the exposure of non-synchronous generators within South Australia to this constraint but is not expected to remove the need for this limit entirely.

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1 AEMO, *Second update to the 2016 National Transmission Network Development Plan,* 13 October 2017, p.5. This followed AEMO’s declaration of a NSCAS gap for system strength in South Australia in its 2016 NTNDP published in December 2016.

2 AEMO, *System Strength Requirements Methodology – System Strength Requirements & Fault Level Shortfalls*, 29 June 2018.

3 AEMO, *Transfer Limit Advice – System Strength,* February 2020.

D. Assessing “do no harm” and the non-synchronous generation constraint

The “do no harm” obligation does not contemplate the operation of a pre-existing non-synchronous generation system strength constraint, as is the case in South Australia.

There is a need for the application of the obligation to be clarified considering existing network operating limits include this constraint.

We currently offer two options to non-synchronous generator proponents regarding our approach to conducting FIAs:

- ‘Option 1’ – Assess the system strength impact of the proposed generating system subject to the non-synchronous generation system strength constraint. If the FIA is passed, the new generating system will be included within that constraint and no further mitigation is required by the connecting generator.
- ‘Option 2’ – Assess the system strength impact of the proposed generating system outside the non-synchronous generation system strength constraint. If the FIA is passed, the new generator will be excluded from that constraint.

We consider that Option 1 above provides a suitable standard approach for accounting for existing system constraints when assessing generator connections within South Australia. Option 2 remains available to proponents that view the removal of their project from the constraint is of benefit.

Ongoing engagement with AEMO has resulted in the joint development of:

- a set of criteria whereby existing, committed and proposed non-synchronous generating systems have the option to undertake works that facilitate exclusion from the non-synchronous generation constraint[4], and
- an agreed approach for the removal of an existing non-synchronous generator from the non-synchronous generation system strength constraint. This approach was published in our 2019 Transmission Annual Planning Report (TAPR).[5]

E. Limited availability of modelling information

System strength assessment processes are complicated by the limited availability of modelling information to connection applicants regarding the network and nearby generating facilities.

Access to detailed models of generating systems is necessary to identify and resolve system strength impacts and generator performance issues for new generator connections.

We have identified the following issues regarding access to information:

4 Criteria based on connection point and system-wide performance characteristics, operational planning requirements and consideration of regulatory obligations as appropriate.

5 This approach was published in our *2019 Transmission Annual Planning Report* (p. 50).

- Due to confidentiality provisions and intellectual property protection requirements, connection applicants are unable to obtain PSCAD models of other generating facilities and rely on us to assess system strength impacts prior to lodging a connection application.

- We generally only have access to 'black-box' type models[6] of generating systems intending to connect to our network and frequently refer issues to relevant equipment suppliers, however, these suppliers are often only able to perform simplified system cases that do not allow wider system behaviour to be readily observed.

- Incomplete models can lead to adverse system strength impacts being incorrectly identified in the first instance and require studies to be repeated with revised models.

While acknowledging the rights of equipment manufacturers to protect their intellectual property, we consider the current assessment process lacks transparency for connection applicants and incomplete generator information adds complexity, delay and cost to assessments. Less onerous confidentiality rule requirements would improve the transparency and effectiveness of this assessment process.

We propose that confidentiality provisions be amended to enable the availability of PSCAD system models to connection applicants in accordance with AEMO's network data provision policy in the same way that PSS/E models are currently made available. Failing this, generic models could be benchmarked against and tuned to represent generating system "black-box" model performance and made available to connection applicants for initial assessment purposes.

2. EVOLVING SYSTEM STRENGTH FRAMEWORKS

A. Coordinated approach to maintaining system security

The provision of system strength is but one of several challenges in managing the security of a rapidly evolving power system. Services required to operate a secure power system include:

- inertia
- system strength
- frequency control
- power ramping
- reactive power and voltage control, and
- damping of oscillations.[7]

While there may only be a limited number of technical solutions for the provision of system strength, this is expected to change over time. Many of these existing solutions can, however, address multiple system security needs.

[6] These models often do not provide key information on equipment design. Additionally, performance attributes may be either concealed from view or unable to be altered for modelling purposes.

[7] This list is not exhaustive and interactions between system security services are varied and complex as described in Appendix A of the discussion paper.

To effectively and efficiently address system security issues and the long-term interests of consumers, interactions between these system security services should be considered by adopting a co-ordinated planning approach.

The AEMC's discussion paper acknowledges that the "do no harm" and minimum system strength frameworks were introduced in 2017 to address immediate system strength concerns and that the pace of the transition to non-synchronous generation sources means it is time to adjust and expand these frameworks. We consider that the approach to system strength should be considered broadly, rather than narrowly or in isolation, recognising that broader system security services and associated solutions are closely inter-related.

The discussion paper also recognises that existing regulatory frameworks provide no formal linkage between the system strength framework and other system security services, particularly inertia, complicating the coordination of different security services while failing to capture efficiencies associated with coordination.[8] Coordination currently relies on different short-term system security shortfalls being declared at the same time.

For example, following the emergence of separate fault level and inertia shortfalls in South Australia, ElectraNet received approval to install high-inertia synchronous condensers (fitted with flywheels) in order to efficiently address both shortfalls.[9]

The concurrent declarations were only coincidental and are unlikely to occur going forward. Further, the one solution must be assessed for compliance with two distinct system security frameworks and does not reflect a truly coordinated approach to addressing multiple security requirements.

B. Centralised coordinated model

While considering system security issues more broadly, we support a centrally planned and coordinated model for the expansion of system strength and other regulatory frameworks ("Model 1" in the AEMC's discussion paper).

In addition to being consistent with a coordinated approach, this model offers simplicity and allows existing planning processes to be leveraged. To effectively and efficiently address system security issues in the NEM, we recommend that this model include the following features:

- centrally coordinated planning built upon the optimal development path of the Integrated System Plan (ISP) and existing transmission planning frameworks to allow a longer-term outlook
- network businesses procure necessary volumes of system strength services to meet the long-term central plan
- the necessary volume of services should always be sufficient to allow implementation of the ISP, thereby removing constraints on the network, increasing hosting capacity, reducing generation investment risk and improving resilience on a least regrets basis without limiting requirements to a minimum or essential level of services on a reactive basis, and

8 See page 28 of the AEMC's discussion paper.

9 As described at pages 53-4 of the AEMC's discussion paper.

- where system strength services are insufficient to meet the prescribed level due to any unforeseen reasons, AEMO may declare a gap to ensure requirements are met as a last resort.

It is also worth noting that the current costs of managing system strength and wider system security needs, although increasing, still represent a relatively small portion of total generation and transmission investment costs in the NEM. Therefore, the procurement of system strength services necessary to implement the ISP on a least regrets basis is entirely consistent with the level of efficient investment associated with long-term system security needs.

The discussion paper recognises that “Model 4”, incorporating a generator performance obligation, can be utilised with any of the other three proposed models.

Model 4 would place an obligation on generators to be able to operate in a stable manner in low system strength environments in order to slow the decline of available system strength levels and allow non-synchronous generators to be more resilient to sudden or prolonged periods of low system strength.

We support the addition of this generator performance obligation to supplement the centrally coordinated approach described above.

3. SYSTEM STRENGTH FRAMEWORKS IN DISTRIBUTION NETWORKS

Actions taken by distribution network service providers (DNSPs) impact the management of system strength by transmission network service providers (TNSPs). As the TNSP, we are responsible for the long-term management of system strength in South Australia, which includes managing impacts originating from connections within the distribution system.

DNSPs are required to follow connection process requirements and consult with AEMO on system strength preliminary and full impact assessments. DNSPs typically consult with TNSPs when a connection to the distribution network is considered to have an impact on the transmission network. However, there remains a risk that a number of smaller connections, which individually are not expected to impact on system security, will collectively have a detrimental impact.

For these reasons, it is important that TNSPs are kept informed of system security issues that affect planning and operational requirements. We recommend that System Strength Service Providers are also consulted on system strength preliminary and full impact assessments conducted for connections to the distribution system.

The AEMC recognised the importance of effective joint planning between network businesses as part of the minimum system strength and inertia frameworks introduced in 2017.[10] Joint planning will continue to form an important element of an expanded system security framework.

[10] In accordance with clause 5.14 of the National Electricity Rules