CLEAN ENERGY COUNCIL

7 May 2020

Mr John Pierce AO
Chairman
Australian Energy Market Commission
PO Box A2449
Sydney NSW 1235

Lodged via AEMC website: www.aemc.gov.au

Dear Mr Pierce,

INVESTIGATION INTO SYSTEM STRENGTH FRAMEWORKS IN THE NEM (EPR0076): DISCUSSION PAPER

The Clean Energy Council (CEC) is the peak body for the clean energy industry in Australia. We represent and work with hundreds of leading businesses operating in renewable energy and energy storage along with more than 6,500 solar and battery installers. We are committed to accelerating the transformation of Australia's energy system to one that is smarter and cleaner.

The CEC welcomes the opportunity to provide comments on the Australian Energy Market Commission's (AEMC's) discussion paper on its investigation into system strength frameworks in the National Electricity Market (NEM). We strongly support the AEMC's investigation. The review is timely given the emergence of significant system strength matters across all NEM jurisdictions and that the system strength requirements as part of the generator connection process are leading to substantial uncertainties, costs and delays to new projects. As a result, although the current minimum system strength and 'do no harm' frameworks have only been in place since 1 July 2018, they are not producing efficient outcomes, therefore are not producing the best outcomes for customers and so require revision.

What is system strength?

System strength is an important characteristic of a power system that is necessary for secure operation, but it is a complex concept. Although the National Electricity Rules (NER) give a definition of system strength service, the CEC agrees with the assessment that system strength has become a catch-all term for interrelated factors that together contribute to power system stability. The current NER use of three-phase fault level as a proxy does not necessarily provide a complete description of the system strength service. However, the catch-all approach to system strength lacks clarity and is proving challenging for industry, particularly where actions are being taken or required as a result of

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system strength but with limited detailed explanation and therefore understanding of the underlying system strength issue.

As a result, the CEC agrees that the AEMC should examine and seek consensus within industry as to the definition of system strength. It may be appropriate that the definition takes the form of a description of the concept. Should this be the case, it may need to be accompanied by a system strength metric. The metric could be reflected as the system strength service, or perhaps more appropriately system strength capability. The need for a metric, however, may be dependent on the system strength framework pursued. A centrally coordinated approach may not require a metric as the NER could define the obligation for the transmission network service provider (TNSP) to ensure that the power system is stable and the Australian Energy Market Operator's (AEMO's) existing Power System Model Guidelines would continue to cover the power system needs as a whole.

Key issues with the minimum system strength framework

Under the minimum system strength framework, fault level shortfalls have been declared in South Australia, Tasmania, Victoria and Queensland. From the clean energy industry's perspective, the principal issue with this framework is that it is too reactive and not sufficiently forward-looking.

While the NER requires AEMO to provide forecasts of shortfalls over a planning horizon of at least five years, in reality AEMO's ability to do this is limited and its declarations of a shortfall tend to occur once system strength issues have already emerged and following the curtailment of significant amounts of generation. This is most recently apparent in both the Victorian shortfall declaration at the Red Cliffs node made in December 2019, three months after AEMO had announced 50 per cent constraints to five operational solar farms in September 2019, and in the North Queensland shortfall declaration at the Ross node made in April 2019 after AEMO had already announced limits to three operational wind and solar farms the month prior.

This approach is also problematic for generators as addressing a system strength shortfall is a protracted process. Following the declaration of a shortfall, it can take some time for the relevant TNSP to provide services to address the shortfall, which means that the generator curtailments can occur for prolonged periods of time. In the case of South Australia, AEMO declared a system strength related NSCAS gap (which ElectraNet elected to treat at that time as a notice of a system strength shortfall under the incoming new system strength framework) on 13 October 2017 (with an inertia shortfall declared on 24 December 2018) but ElectraNet's synchronous condenser solution will only be installed in mid to late 2020 and commissioned by early 2021. This is not through any reluctance or tardiness on ElectraNet's part in addressing the shortfall, but rather the time required to investigate shortfall remediation options, receive necessary regulatory approvals from the Australian Energy Regulator (AER) and technical approvals from AEMO and then procure and commission the synchronous condensers.

Since 2017 when the South Australia constraint was introduced, wind farms have experienced reductions in generation of up to almost ten per cent at times. For a 100 MW wind farm, this translates to an annual revenue reduction in excess of $1 million. Given it will be over three years from when the constraint was introduced to when the synchronous condensers will be commissioned, this is a profound revenue reduction to South Australian renewable energy generators.

The current process to address a shortfall is an incomplete solution given its incremental nature. The approach whereby AEMO has responsibility for forecasting system strength issues for the five-year time horizon and then TNSPs are responsible for addressing the issue means that TNSPs cannot undertake a proactively planned and strategic approach to addressing system strength. This gives rise to a potential for ongoing repeated shortfall declarations and remediations as the generation fleet changes rapidly with new asynchronous generation connections and ageing synchronous generation retirements. This means TNSPs cannot seek cost efficiencies through taking advantage of scale efficiencies from a forward-looking and planned approach that could also co-optimise to address other issues such as inertia.

Relatedly, the current process is also an incomplete solution given the inability for the framework to account for future uncommitted new generation. As uncommitted generation cannot be reflected in the minimum fault levels framework, this further limits the ability for TNSPs to plan and seek scale-efficient system strength solutions.

Key issues with the 'do no harm' framework

The 'do no harm' requirement is one of the most problematic elements of the connection process for new generators. This requirement injects significant uncertainty into the connection process, manifesting itself in an excessively lengthy and detailed connection process where proponents are frequently required to implement costly remediation options.

Modelling requirements

A system strength impact assessment is required under the 'do no harm' framework when a new generator is negotiating its connection with the relevant NSP. The assessment requires that a Preliminary Impact Assessment (PIA) is undertaken for all connecting generators and depending on the results of this assessment, a Full Impact Assessment (FIA) may subsequently be required. CEC members have indicated that most connecting generators are currently being required to undertake a FIA irrespective of the PIA outcomes. This is leading to significant delays to projects, even for those that believed they were locating in stronger parts of the network and therefore were not expecting to have to conduct a FIA.

The modelling as part of the FIA is complex, time-consuming and onerous for connection applicants as it requires detailed information exchange between the NSP, AEMO and connecting applicant at various stages of the process. The iterative nature of the modelling process is compounded by the significant number of generators connecting to the system simultaneously and therefore the number of scenarios that need to be modelled, which requires that the modelling must be frequently re-run as system conditions change during the connection process. This is proving difficult for applicants as they have little visibility of the model and they are working with incomplete information on system conditions and therefore it is difficult to reach agreement with the NSP and AEMO on scenarios for testing. In addition, applicants do not have access to AEMO's system-wide model used to observe interactions between generators and supporting network elements.

Complicating this even further is that committed generators are being advised that they must consider the impact of any generators already integrated into the PSCAD wide area model based on when their PSCAD models were integrated into the model. This is the case even if those other generators received their 5.3.4A letters and were committed after. This practice does not seem efficient.

Some of the difficulties with the modelling requirement may be attributed to the fact that the system strength impact assessment is a relatively new requirement. Developing PSCAD modelling capability and expertise has taken some time. However, although capabilities and experience have grown, the CEC believes that the modelling requirement will remain an onerous and time-intensive task. This is not helped by the fact that there is a relatively limited pool of consultants nationally that have the capability to operate this platform.

The costs for connection applicants to engage consultants and undertake multiple rounds of modelling as part of the system strength impact assessment are not insignificant. CEC members have indicated that costs associated with this assessment can be as high as $1 million. In a recent study of CEC members, we found that around one-third of projects take more than a year to receive an offer to connect after submitting a connection application, which is well in excess of the two to ten month indicative timeframe provided in AEMO's connections process diagram.[1] This can be attributed to the difficulties associated with the system strength impact assessment, in tandem with generator performance standards negotiations.

Modelling outcomes

Given the time-intensive nature of the process, connecting applicants are increasingly receiving FIA results late in the connection process and sometimes once construction has begun. These results often require some system strength remediation work, sometimes at some distance away from the project. The lateness of the results often leaves applicants struggling to define optimal remediation solutions, under significant time pressures, in order to complete their project, particularly given the above modelling requirements results in a fairly opaque FIA process for connecting generators. Applicants have little visibility of the modelling underpinning the FIA results and limited detail is provided in the FIA report. This provides applicants limited opportunity to scrutinise the FIA outcomes and means they cannot adequately forecast system strength related costs upfront.

While the AEMC's managing power system fault levels rule change envisaged that connecting applicants would be able to remediate system strength through a range of options (e.g. contracting with existing synchronous generators), due to timing constraints and opaque FIA results, a quick and capital-intensive solution is often the only option that can be implemented. This is typically a very costly synchronous condenser. For example, a 50-70MVA synchronous condenser may be sufficient to offset adverse system strength impacts from a 200MW project. A synchronous condenser of this size could cost as much as $20 million to $25 million depending on the level of inertia required to ride through faults. This represents approximately 15 per cent of the overall project cost.

It is worth noting that access to modelling data and improving the modelling process in itself will not completely overcome the challenges being experienced by connecting generators. Some CEC members report that they are being asked to remedy all perceived problems associated with the modelling although they consider these problems relate to broader network issues rather than their own individual connection. This is clearly not the intent of the 'do no harm' framework. It is not the responsibility of the next connecting generator under assessment to resolve any recently identified issues found in the model.

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[1] Available at: https://aemo.com.au/-/media/files/electricity/nem/network_connections/nsp-connction-process-diagram-v20.pdf?la=en&hash=EFA71EEEC722058C7B225C22593A1649.

System outcomes

The ‘do no harm’ requirement is resulting in multiple synchronous condensers being built by multiple connecting generators. This uncoordinated approach is leading to a degree of overbuild, which is clearly not an efficient market outcome from both an investment and operational perspective. The proliferation of a larger number of smaller synchronous condensers means that as a whole, the system has not been able to take advantage of cost efficiencies associated with a scale-efficient solution such as a single larger synchronous condenser.

Generators building individual synchronous condensers is also leading to operational complexity as there is no certainty when each generator will operate its synchronous condenser. This also further complicates modelling as it requires that interactions between synchronous condensers are evaluated to ensure potential adverse interactions are managed.

Developing a new framework for system strength

The above issues demonstrate how the current system strength frameworks are leading to increased uncertainties, costs and delays across the power system and therefore inefficiencies that result in adverse consumer outcomes in the long-run. Accordingly, the CEC strongly believes that a centrally coordinated approach to system strength best overcomes the issues with the current frameworks and is more apt for the current transition underway where numerous, more dispersed and relatively smaller generators will connect to the electricity system concurrently as compared with the larger single generator connections the NEM has experienced historically.

Risks should be placed with those best placed to manage them and it is our view that AEMO and TNSPs are this party as they have better overall visibility of the long-term security needs of the power system. Consequently, the ‘do no harm’ requirement would be removed under such an approach. Not only would such an approach lead to more efficient system strength planning and management, but it would remove a significant amount of uncertainty for generator investments by potentially reducing connection times and improving the predictability of the connection process and associated connection cost. The ability for TNSPs to undertake scale-efficient long-term system strength solutions should also lead to lower costs to consumers.

TransGrid’s efficient management of system strength on the power system rule change request suggests a centrally coordinated model. The CEC believes there is strong merit in this model and encourages the AEMC to assess this rule change request expeditiously.

Plan

A key benefit of a centrally coordinated approach is that it could enable greater proactivity to deliver the necessary levels of system strength in advance of issues arising. Under such a model, system strength across the power system could be forecasted over the longer term as part of AEMO’s Integrated System Plan (ISP) and set based on the ISP’s optimal development path. Importantly, such an approach would allow for the inclusion of projected (uncommitted) new generator connections across the NEM.

Procure

The CEC supports responsibility for system strength procurement being assigned to TNSPs. TNSPs could proactively tender for and procure system strength. In doing so, they could procure the least-cost solution through either contracting with existing system strength service providers or building regulated network assets. Such an approach could also allow for better co-optimisation of system strength with other services, such as inertia and voltage control.

We consider regulatory oversight by the AER is essential to ensure economic discipline in the TNSP's system strength procurement.

While the TNSP's procurement should be competitive and regulatory oversight is appropriate, we encourage the AEMC to consider how this process can be streamlined to ensure it is timely in order that system strength solutions can be implemented well ahead of issues emerging.

Price

Given the AER's regulatory oversight of the system strength procurement, it is appropriate that the costs of the system strength provision procured by a TNSP are regulated.

Pay

The costs of the system strength provision procured by a TNSP could be recovered through generators and/or consumers and the AEMC should evaluate the appropriate cost sharing arrangement between these two parties, noting it will likely need to be flexible across the NEM. If costs are to be recovered from generators, either in part or in full, there is a preference that this is through the connection fee rather than through an ongoing fee similar to a transmission use of system charge. A clear upfront connection fee would assist with cost transparency and predictability for new investments.

The current 'do no harm' requirement provides location signals to new connections as the system strength remediation should be lower or nil for generators that connect to strong parts of the network and vice versa for generators that connect to weak parts of the network. It is important that a revised system strength framework continue to provide locational signals in relation to system strength to new connections. Allowing for different generator connection fees for different fault level nodes should facilitate this.

Other considerations for this investigation

Generator incentives

The CEC recommends the AEMC explore how a centrally coordinated system strength framework could incentivise generators to support system strength through their plant design and the quality of their connection. Options could include rewarding new generators that have optimised for system strength through a reduced connection fee or establishing a system strength procurement process and related contracts framework that provides an incentive for generators that may want to invest in measures to provide the system strength service.

This approach should be explored in preference to a mandatory generator provision obligation or generator system strength access standard. The CEC is concerned that any form of mandatory requirement on generators would lead to issues similar to those already being experienced with the current ‘do no harm’ requirement. In addition, generators would wear all the costs of system strength provision despite not being a causer or beneficiary in all cases, particularly for generators that connect to strong parts of the network.

Transitional arrangements

In potentially moving to a revised system strength framework, the AEMC should carefully consider the need for transitional arrangements. Currently, a number of renewable energy projects are installing equipment such as synchronous condensers to remediate their system strength impact. The AEMC should consider how these projects can be rewarded or compensated under a revised framework. Options could include a contracting requirement with the TNSP or a mechanism to transfer ownership and operation of this equipment to the TNSP. These projects should not incur a system strength related connection fee.

System strength and generator performance standards

While the AEMC’s system strength investigation does not intend revisiting the generator performance standards, the link between system strength and these standards cannot be ignored.

Retuning the control systems of existing generators is a legitimate option to remediate system strength issues that would avoid the significant time and cost impacts associated with commissioning a synchronous condenser. However, it is rarely if at all done. Not only is there no incentive for an existing generator to retune its equipment to minimise the time and cost impacts for a connecting generator, but existing generators are hesitant to retune their control systems as it may require that all their performance standards are reopened and they undertake a 5.3.9 process. The AEMC should consider how control system retuning can be undertaken without requiring an onerous process to be followed by an existing generator (i.e. without reopening all its performance standards or requiring a 5.3.9 process). Under a centrally coordinated approach, it may be appropriate that the TNSP would be responsible for determining the specific settings of a generator’s control equipment and therefore could be responsible for any post-commissioning requirements to model and retune generator equipment.

In addition, the generator performance standards framework requires that connecting applicants meet the automatic access standard unless they are able to demonstrate why the automatic access standard cannot be achieved. As a result, connecting generators in a weak network are currently being required to meet the automatic access standard and hence this puts the network at the margins of power system stability. This impacts the opportunity to retune in order to connect subsequent generators as the ability for an existing generator to retune is limited by its requirement to continue to meet the automatic access standard and the ‘do no harm’ obligations of the new generator (which do not allow for re-turning of existing generators). The performance standards to which this most evidently is the case are 5.2.5.5 – generating system response to disturbances following contingency events and 5.2.5.13 – voltage and reactive power control. As a result, the AEMC should reconsider the automatic access standard negotiation framework and whether amendments need to be made to allow movement away from the automatic standard in order to better facilitate subsequent generator connections.

Recent system strength issues

In recent years, significant issues have emerged in the West Murray Zone and North Queensland where existing generators have been constrained due to system strength issues. The most frustrating element for the affected generators in both these areas is that many have been compliant with the system strength and generator performance standards requirements at the time of their connection. These system strength issues have come to light due to more sophisticated modelling as part of AEMO's system wide PSCAD model and improved capabilities at the TNSPs.

In the West Murray Zone and likely also for North Queensland, remediation has been or will be required for individual generators rather than on a network level. For example, the constraint in the West Murray Zone has recently been provisionally lifted after new firmware with enhanced control capability was developed and revised inverter settings were coordinated across the five affected operational solar farms. This has been at significant expense to the five affected generators. One affected solar farm has estimated a total cost of $4 million ($3 million in lost revenue and $1 million in external costs associated with the retuning of inverter settings) as a result of the constraint and associated remediation work in the West Murray Zone.

It is worth noting that the resolution of this issue for the five affected generators revolved around tuning and control system changes related to one inverter original equipment manufacturer (OEM). In the future, multiple OEMs are likely to be involved in order to resolve similar issues, hence a more efficient process is required which focuses on the overall power system needs first and then performance obligations and performance standards of individual generators.

For developments that are not yet operational and therefore will now be connected according to AEMO's sequence, there are also significant associated costs. One project in the West Murray Zone has indicated that until the end of April 2020, it had incurred a cost of $49 million related to system strength from lost revenue and the purchase of a synchronous condenser. If delays persist for the generators in the sequence, there is the potential that power purchase agreements will need to be renegotiated.

The AEMC should assess these cases to ensure that the future system strength framework can avoid similar situations where existing plants have to remediate for emergent system strength issues following their connection and commissioning and developments with connection agreements have their connection delayed and may have to undertake further system strength remediation. A centrally coordinated approach to system strength lends itself to this provided that there is a removal of barriers to re-tuning and revising performance standards for the greater benefit of the power system and consumers.

South Australian Office of the Technical Regulator requirements

The Office of the Technical Regulator (OTR) has a requirement for either real inertia (real physical inertia provided by a synchronous system) or fast frequency response for all new generators.[2] This is resulting in connecting generators installing synchronous condensers throughout South Australia,

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[2] Available at: https://www.sa.gov.au/__data/assets/pdf_file/0003/311448/Generator-development-approval-procedure-V1.1.pdf.

which is leading to the same inefficient outcomes currently being experienced throughout the NEM as a result of the 'do no harm' requirement. The CEC recommends the AEMC work with the OTR to ensure consistent technical requirements in relation to system strength and inertia across all jurisdictions. Removing the OTR requirement and allowing for a centrally coordinated approach through AEMO and TNSPs for system strength and inertia would likely still meet the technical intent of the OTR's requirement.

Conclusion

The uncertainties, delays and costs associated with system strength issues during the connection process and compounded by recent curtailments of operating generators and further connection delays in the West Murray Zone and North Queensland are culminating in an overall chilling effect on new generation investment. After a record breaking two years of investment in large-scale projects in 2017 and 2018, the paces of projects reaching financial close slowed dramatically in 2019. In 2018, 44 projects totalling 5,570 MW were financially closed in the NEM. By contrast in 2019, 25 projects totalling 1,925 MW were financially closed in the NEM. While this investment slowdown is for a number of reasons, it can be partly attributed to grid connection uncertainties as the CEOs of CEC member companies have ranked concerns and challenges related to grid connection as the biggest business challenge facing renewable projects in Australia at present.

The uncertainties associated with connections and system strength will manifest in either increased risk premiums being built into projects moving forward (by both debt and equity) and/or reduced investments in new generation. These uncertainties are a key reason for the recent departure of developers and EPC contractors from the Australian renewable energy development market.[3] We need to promote a strong and stable investment environment to ensure new generation can come on board in a timely manner to replace ageing thermal generation as it retires. The CEC believes a centrally coordinated approach to system strength is vital to restore investor confidence and facilitate an efficient energy sector transition.

Thank you for the opportunity to comment on this consultation. The CEC looks forward to working closely with the AEMC throughout this important investigation. If you would like to discuss any of the issues raised in this submission, please contact me as outlined below.

Yours sincerely,

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[3] For examples see Giles Parkinson, "Major contractor quits Australia solar market after huge losses on projects" *Reneweconomy*, 1 May 2020. Available at: https://reneweconomy.com.au/major-contractor-quits-australia-solar-market-after-huge-losses-on-projects-82078/.