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John Pierce
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Australian Energy Market Commission
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Dear Mr Pierce

Inertia Ancillary Service Market

AEMO welcomes the opportunity to provide feedback on the consultation paper for the AEMC's assessment of the Inertia Ancillary Service Market rule change.

AEMO strongly supports market frameworks for valuing and unbundling the components of a secure, reliable and efficient system. This includes valuing the synchronous capabilities of existing and future generation, as well as procuring synchronous capability decoupled from energy generation in the form of other equipment such as synchronous condensers. As AEMO has noted in previous submissions to the System Security Market Frameworks Review, synchronous units provide a range of services including inertia, but also system strength and synchronising torque. AEMO is continuing to undertake studies to better understand the technical envelope of the NEM.

While the AEMC's approach would provide some of these benefits, AEMO is concerned that a marginal price on inertia will not be able to value the full range of services that units with synchronous capabilities can deliver to the grid. To ensure consumers are provided with secure and affordable energy, there is a need to clarify all of the different needs of the power system on a disaggregated basis and to identify and procure a co-ordinated portfolio of investments (combined with the efficient use of existing assets).

As an alternative framework, AEMO recommends the development of a centrally managed contract market for synchronous units or other services to ensure system security. We believe this would provide the flexibility for AEMO to consider the full range of power system needs, rather than only considering inertia in isolation. AEMO's proposal would help co-optimise services on both the investment and operational timescales, and the contract market could be transitioned to a real-time market or price signal in future if there was merit in such an arrangement.

We have provided further detail in our attached submission. If you would like to discuss our submission please contact Joel Gilmore, Principal Market Design, on 07 3347 3048.

Yours sincerely

Peter Geers
Executive General Manager, Markets

AEMO COVER LETTER + SUBMISSION_FINAL2 - SUBMISSION TO AEMC INERTIA ANCILLARY SERVICE MARKET RULE CHANGE

1. Context

AEMO, and other international power system operators, are examining a range of options for managing power system security given the changing generation mix. The solutions adopted will determine the future need for synchronous capability[1] to support power system security. Given the range of potential variables and solutions, it is not possible to define a single fixed minimum level of synchronous capability that is required to maintain system security.

New generation (and storage), network investment, demand management and operational constraints (including emergency control schemes and performance standards) each have a role to play in maintaining system security in the NEM. In order to form a view on the most efficient way to maintain system security, it is necessary to consider the full range of power system needs, including system security, reliability, as well as likely operational and pricing outcomes.

Further information is required to drive the efficient development of the power system. The current NEM regulatory and market frameworks do not sufficiently reward all of the essential system security services. Historically, AEMO has been able to obtain adequate levels of inertia, system strength, and frequency control as a by-product of synchronous generation. With the growth of non-synchronous generation, which is resulting in less synchronous generation being dispatched by market outcomes, this approach is no longer always sufficient to ensure that system security is maintained, which has been the subject of AEMC's recent rule changes.

2. Defining system needs

AEMO's previous submission highlighted the need to consider system security constraints in a holistic manner. The potential challenges if there are insufficient synchronous units online are varied and complex. This can include security problems with high rate of change of frequency (RoCoF) events and low fault levels (or system strength or short-circuit ratios), as well as other problems that are not neatly captured by these two high-level descriptions (such as rotor angle stability, voltage stability, and propagation of voltage dips across wider areas of the network).

The instantaneous injection or absorption of energy provided by the inertial response of synchronous units following a disturbance is one important element, but is not the complete picture. AEMO is working to further understand the limits of operation of a power system with very low levels of synchronous capability, and refine the definition of the various fundamental system needs. This includes unbundling needs so that they can be identified, valued properly, provided when needed, and have costs recovered efficiently. However, AEMO is also identifying the boundaries of problems that can be managed using the central dispatch process.

AEMO is concerned that the AEMC's proposed approach may not adequately capture these issues. AEMO agrees that there is a need for a framework to procure additional synchronous capability above the minimum levels determined by the recent Rule Changes. However, it is likely that a simple shadow price of inertia (driven by the marginal value of binding constraints) is not sufficient to address all the physical requirements of the grid. As noted in our previous submissions, it is important that appropriate due diligence is carried out to ensure that the services being procured will deliver the benefits expected by consumers.

[1] Synchronous capability would include services from any large synchronous machines on the power system, including synchronous condensers, and not just synchronous generators.

2.1. Implications for South Australia

The AEMC's proposal focuses on RoCoF constraints, such as those applying to South Australia. AEMO notes that the 3 Hz/s RoCoF constraints (S_V_NIL_ROCOF and V_S_NIL_ROCOF) initially bound for 145 hours between 1 January and 27 May 2017, but have not bound since this time.

This change in constraint binding is predominantly due to the changed requirements for minimum number of synchronous units to be online in SA. A potential system strength gap was first identified in December 2016 by AEMO, suggesting there may be insufficient fault level available to support stable operation of synchronous units, wind generation, and dynamic reactive support plant, and therefore maintain a secure operating state.[2] The initial requirement was refined in July 2017, following a series of in-depth power system simulation studies, to require more complex combinations of large synchronous units to be online[3]. AEMO notes that the constraints associated with this system strength requirement have bound for 355 hours between their introduction in early July 2017, and the end of September 2017.

Therefore, in the short-term, adding additional synchronous capability to the system is likely to deliver a market benefit by relieving security constraints and avoiding the need for intervening in the market. However, this market benefit would be achieved primarily by resolving the system strength constraint rather than the RoCoF constraint. Furthermore, system strength constraints would not necessarily be relieved by additional inertia in general, but by synchronous capability in specific locations to provide the required system strength. In this case, it would be challenging to derive a marginal price for bringing additional synchronous capability online, and it would be inappropriate to pay that price to all inertia providers regardless of their location.

AEMO is currently assessing the minimum fault level requirements for South Australia under the recent Rule Changes, and has identified a system strength gap. The outcome of these assessments based on system security will determine the size of any remaining synchronous capability "gap", its corresponding market benefits, and the type of response required to address it.

In the future, it may be that inertia constraints again become more significant, or that it may be that system strength continues to be a limiting constraint. It would therefore seem inefficient to develop a framework which could only address one of these issues, particularly given the availability of solutions that might address both issues at the same time. Nonetheless, given the significance of the present system strength gap in South Australia, AEMO believes the recently implemented System Strength rule change requiring AEMO to identify minimum requirements and network service providers to close out any gap is a prudent interim measure.

2.1.1. Requirements over time

Over time, synchronous condensers will likely be able to provide the services that substitute for the majority of the synchronous capability currently provided by minimum-must-run levels of South Australian generation. These units will be decoupled from energy delivery, and have

[2] AEMO. Market Notice 56089. Available at: https://www.aemo.com.au/Market-Notices?searchString=56089
[3] AEMO. South Australia System Strength Assessment. Available at: http://www.aemo.com.au/Media-Centre/South-Australia-System-Strength-Assessment.

relatively low short-run marginal costs. However, the development of such units would depend on the relative economics of installing synchronous condensers compared to operating synchronous generation and how different services would be valued.

There is significant flexibility in how these units are designed. For example, synchronous condensers built to meet a system strength requirement could have a broad range of inertia constants. Additional inertia could be added to such units at a relatively low marginal cost. If synchronous condensers are installed, it will therefore be important to have a comprehensive framework available which could ensure that the optimal solution can be delivered.

2.2. Other regions

In Tasmania, AEMO expects that there is sufficient synchronous capability (owned by Hydro Tasmania) to manage a broad range of future scenarios. However, any framework should allow AEMO to work with TNSPs to determine when it is efficient to activate synchronous units, and allow Hydro Tasmania to recover reasonable costs incurred.

In other regions, AEMO notes that there is the potential for additional synchronous units in the future to deliver value if similar constraints emerge. AEMO agrees that a price on inertia may act as a proxy for this benefit, and assist retaining existing synchronous units (on both operational and planning timescales) or to provide a marginal signal for new capacity to include synchronous characteristics. However, as presented above, AEMO is concerned that an approach that values inertia in isolation may prove costly for consumers in the longer-term without necessarily delivering the anticipated benefits.

3. Frameworks to deliver the needs

AEMO strongly supports market frameworks for valuing and unbundling the components of a secure system. However, the implementation of a real-time spot market or price signal requires the appropriate elements for an efficient market to exist. These elements are not apparent for such a regionally and technically specific service.

AEMO is also concerned that the proposed framework will not deliver the certainty required to support long-term investments, which could include new synchronous generation (with or without the ability to operate in a synchronous condenser mode), synchronous condensers, or extending the life of existing synchronous units. In the AEMC's framework, the price paid to inertia providers would drop to zero if the marginal value of additional inertia is zero; while economically rational, it risks either locking in constraints over time or significant market uncertainty.

Further, it may create an incentive for synchronous units to withdraw from the market to create an inertia shortfall and a price on inertia paid to other providers (including in the same portfolio). This could result in higher costs to consumers, and a less efficient power system.

Given this uncertainty, and the lack of long-term counterparties (discussed further in Section 4), it may be challenging for an investment case to be built for new synchronous units.

As an alternative framework, AEMO recommends the development of a centrally managed contract market for synchronous units or other services to ensure system security. This is consistent with AGL's original Rule Change request as well as AEMO's submission to the Directions Paper[4].

[4] http://www.aemc.gov.au/getattachment/8cf91488-9d08-4bca-9649-22d1ed3813a4/AEMO.aspx

AEMO's proposed approach would involve the following steps:

- **Planning stage**. AEMO would undertake analysis and consultation as part of the National Transmission Network Development Plan (NTNDP) process to identify gaps in the delivery of inertia, system strength and related services
- **Procurement stage**. AEMO would hold a competitive tender for contracts for the delivery of services. This would be open to existing and new synchronous units, TNSPs and providers of synchronous condensers
- **Dispatch and enablement**. Closer to real-time, AEMO would co-optimise the dispatch of the contracts in or close-to real-time, similar to how some Network Support Agreement services are currently managed by AEMO. This could include day-ahead allocation of resources. In this way, the short-run costs of enabling any further synchronous units would be balanced against the potential wholesale market savings.

A contract market allows AEMO to work with providers and the relevant TNSP to ensure that services are considered in a holistic manner, and can address the required problems. TNSPs and other providers could compete to deliver these services on an equal footing. A contract market helps manage the locational nature of the synchronous capability requirement, and assists with providing the investment certainty required to optimise projects on the investment timescale. Well-designed contracts could be negotiated to reduce distortions to the real-time market and incentives for gaming.

This approach aligns with AEMO's current obligations to assess inertia requirements on both the planning and operational timescales under the Managing the rate of change of power system frequency Rule, as well as the Managing power system fault levels Rule. It may also be possible to merge these frameworks over time, consistent with AEMO's submission to the Draft Determination[5], such that AEMO acts as a central procurer for services to deliver both system security and market benefit.

Such a framework would provide the flexibility for a variety of interrelated security services to be procured, as the market benefits of these services are better understood. For any such defined service, AEMO could identify the market benefit opportunity in its NTNDP process, and seek competitive tenders from service providers. If the framework is limited to alleviating RoCoF constraints then it is likely that future Rule changes would be required to establish such an overarching framework. AEMO believes that if this current Rule change is defined more broadly it could obviate the need for further Rule changes in this space.

A centrally managed contract market would also be well suited to trialling alternative technological solutions, such as Fast Frequency Response (FFR), instead of inertia. As noted in previous submissions[6] , AEMO believes that FFR services would be best trialled under a contract market arrangement to begin with until such time as a market based service can be properly specified.

A contract market could be transitioned to a real-time market or price signal in future if there was merit in such an arrangement.

4. Specific responses to the AEMC's consultation questions

[5] http://www.aemc.gov.au/getattachment/0714c215-2128-4f92-94d5-69a07f10c019/AEMO.aspx

[6] http://aemc.gov.au/getattachment/f6b3113c-04b4-4170-bf78-fa354c4a9c93/AEMO.aspx

AEMC question	AEMO response
Do you consider a market sourcing approach to be preferable to a TNSP incentive scheme for providing inertia? If so, do you consider the use of IRSR funds accruing as a result of RoCoF constraints to be an appropriate mechanism for funding inertia payments?	AEMO considers a competitive contract market to be the most appropriate mechanism. The IRSR funding mechanism is theoretically appropriate for a narrow range of constraints (specifically, constraints on the interconnector that are directly proportional to inertia, including RoCoF constraints), but would not represent the funds required to address more general intra-regional or system strength related constraints.
Do you consider any of these alternative methods of payment for inertia to be preferable to the proposed IRSR funding approach? Are there any alternative funding arrangements that are not discussed, which you would consider to be preferable?	If only RoCoF constraints are considered, the proposed funding arrangement would likely be sufficient. However, if more complex constraints are to be addressed, additional funding would be required. Furthermore, as presented below, AEMO sees risks to the effectiveness of SRAs, and so recommends that an independent source of funding be sought.
To what extent would the proposed IRSR funding approach diminish the effectiveness of SRAs as an inter-regional hedge? Do you agree that inertia hedges could be used to assist with inter-regional hedging and would this provide increased certainty to providers of inertia?	The IRSR funding option would increase the complexity and uncertainty around SRAs. AEMO expects that participants seeking effective hedges would need to hold both SRAs and appropriate contracts with inertia providers. Conversely, they may be reluctant to enter into contracts for inertia in the absence of holding SRAs, which would in turn determine their contracting decisions elsewhere in the market. In order to preserve SRAs as a viable interregional hedging mechanism, it would be necessary to coordinate the simultaneous sale of both SRAs and contracts with inertia providers. This would ensure that the same entity holds both SRAs and inertia credits, if desired. However, given the relatively short timeframe of rolling IRSR procurement, this approach may not provide long-term investment certainty to new synchronous sources.
To what extent do you see there to be a need to address inter-regional RoCoF constraints versus intra-regional RoCoF constraints or other types of constraints?	AEMO notes that there are a broad range of system services historically provided by synchronous generation incidentally to energy production which may need to be valued explicitly in the future. This includes both inter-regional constraints (such as the RoCoF constraints identified by the AEMC) and intra-regional constraints (such as the system strength constraints that currently exist in South Australia and Tasmania). These intra-regional constraints can have both system security and market benefit implications. For example, if addressing the recent system strength rule change in South Australia delivers only sufficient synchronous capability to meet the system security requirement, further synchronous units may be able to relax the 1200 MW wind generation constraint and deliver a market benefit. A centrally managed contract market retains flexibility to procure services in a specific sub-region if required.
What do you see as the main concerns with TNSP participation in a market sourcing approach? How can these issues be resolved?	A contract market resolves this issue by allowing TNSPs to offer services competitively into this market. It also helps to ensure that any synchronous units paid for under a contract market is in addition to the inertia delivered by the minimum inertia and system strength frameworks.

AEMC question	AEMO response
To what extent do you see it as desirable to co-optimise inertia with energy and FCAS through the NEM dispatch process?	In principle, there is value in co-optimising in real-time, e.g., committing additional synchronous generation based on network constraints, and co-optimising inertia, Frequency Control Ancillary Services (FCAS) and potentially fast frequency response services in the future. However, it is unlikely that this can be achieved in the same real-time manner as we currently do for FCAS and energy. The physical relationships between inertia, energy targets and frequency response do not lend themselves to real-time marginal optimisation. A price signal may help, but is likely to be uncertain (and additional inertia risks crashing the price or, conversely, providers may withdraw from the market to force a price signal) In addition to co-optimisation in or close to real-time, there is the need to co-optimise services on an investment timescale and ensure there are sufficient incentives for delivering synchronous capability.
I Do you see a need to delay implementation of the proposed IRSR funding approach? If so, do you see value in adopting an alternative funding approach in the interim?	AEMO's concerns about the IRSR funding approach are outlined above. Implementation should at least be delayed beyond existing contract periods.