S&C ELECTRIC COMPANY
Excellence Through Innovation

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Claire Richards
Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

Our Ref: JC 2018-060

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Dear Claire,

S&C Electric Company response to the Draft Report – Frequency Control Frameworks Review (EPR0059)

S&C Electric Company welcomes the opportunity to provide input into the Draft Report on the Frequency Control Frameworks Review.

We believe that a mandated requirement should be placed on generators to deliver frequency response, both inertia and primary response (two different things). The AEMC recognises (pages 81 and 88) the wide system benefits that a mandated response would bring to connected generators and customers. We also believe that the mandated requirement should be remunerated. All participants must have a proven capability and then must bid into a tender process. The Market Operator would the award tenders based on prices received from mandated and non-mandated providers to deliver frequency control at least-cost. Participants could then price in the cost of providing any service (although the Report indicates this is small), while also bidding in good faith.

S&C Electric Company has been supporting the operation of electricity utilities in Australia for over 60 years, while S&C Electric Company in the USA has been supporting the delivery of secure electricity systems for over 100 years. S&C Electric Company not only supports the "wires and poles" activities of the networks, but has delivered over 8 GW of wind, over 1 GW of solar and over 45 MW of electricity storage globally, including batteries in Australia and New Zealand. We have also deployed over 30 microgrids combining renewable generation, storage and conventional generation to deliver improved reliability to customers.

S&C Electric are particularly interested in facilitating the development of markets and standards that deliver secure, low carbon and low-cost networks and would be very happy to provide further support to the Australian energy Market Commission on the treatment and potential of emerging technologies and approaches.

Yours Sincerely

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General Comments

Forecasting of Variable Generation

Geographical diversity may smooth out variations in a 5-minute dispatch period, but equally there may be locations (geographically) were local network issues impact on stability or the ability of the forecast generation to deliver a dispatch target. This is particularly true in a poorly interconnected system.

Renewable generators run their own forecasts and are best placed to provide accurate information to AEMO for dispatch.

Market Service versus a Mandated Service

The FCAS market has not delivered frequency control in the NEM. It is difficult to see how "tweaking" the market will improve the experience of the past 4-5 years, which have been characterized by deteriorating frequency control, to the point where frequency is outside the Normal Operating Frequency Band for greater than the statutory 1 %.

In the draft report AEMC states that:

"If a mandatory requirement for primary frequency response were universally applied to a large proportion of the generation fleet, it is likely to lead to a strong improvement in frequency performance during normal operation. This option would also support system resilience by providing a wide geographical distribution of frequency response capability."

And

"… considers that a mandatory obligation to provide primary regulating response, option C [The mandatory provision of response only (not headroom)], is likely to deliver both improved frequency performance during normal operation and improved system resilience to multiple contingency events. A mandatory requirement for frequency response without headroom would likely send a clear signal to market participants to drive operational behaviour that will support both frequency regulation and system resilience."

So, if we want good frequency control in the NEM, this is the best option.

Additionally, a mandated service would encapsulate both inertia and primary response (two different technical responses to a frequency excursion) from synchronous generators. It would ensure that the issues related to poor frequency control (generator damage, difficulty synchronising etc.) would be minimised and if all connectees provided frequency support, then the "load" would be distributed, meaning all participants deliver some support, spreading the "burden" more broadly (where the networks allow).

There appears to be some disagreement on whether there is a *significant* cost associated with delivering frequency support via inertia and primary response. It is likely that the cost is small and so this should not be a barrier to participation. In any case, the model where the service must be deliverable and proven, but also bid into a tender process (the GB model), allows participants to price their response appropriately

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(but still in good faith) and AEMO would then select those bids from mandatory providers and non-mandatory providers that best delivers control and the lowest cost to the end-customer.

It is clear that there is an astonishing lack of knowledge about the (proven) capabilities of currently connected synchronous generators to deliver inertia and primary response and this should be resolved as soon as possible to allow AEMO and AEMC to understand the available synchronous support already on the system.

While there may be some synchronous plant on the system that is unable to deliver inertia and primary response, it is important to remember that in order to deliver energy into the market and be paid for that energy, the NEM must be stable. Synchronous generation still dominates the NEM (over 80 %) and that indicates there is a significant resource available to support frequency.

While there may be an issue with placing a mandatory requirement on existing synchronous generation, most of the connected large combustion plant and hydro-electric generation plant connected at a time when different rules applied, and frequency support was required. The Australian Energy Council notes that the NEM has an aging generation fleet (https://www.energycouncil.com.au/analysis/aging-generation-australias-coal-fired-fleet/. Average age for synchronous plant is 33 years old). New plant, such as the gas plant in South Australia, have been specifically built to provide system support, so presumably would be able to participate in mandatory services for inertia and primary response. In any case, requiring mandated providers to bid in their service, allows all synchronous generators price their provision appropriately.

It should be noted that ALL newly connecting generators, both non-synchronous and synchronous, in Europe and the UK are now required to provide frequency support (see: https://electricity.network-codes.eu/network_codes/rfg/).

The Principles

We agree all connecting parties should be treated fairly and equitably, this includes non-synchronous, as well as synchronous.

A mandated requirement to deliver inertia and a primary response, should be remunerated, so this allows plant to factor in the cost of providing those services.

We are surprised that AEMC believes that the fundamental need of any power system, including the NEM, for frequency control, is not an important principle of the Frequency Control Framework Review. No market will function, if frequency is out of control.

We agree that any frequency service should be known, predictable, verified (can be delivered and was delivered) and accessible. We further agree that a performance-based approach is adopted to procurement and payment (providers should be paid for what they actually deliver).

It is essential that energy dispatch is not prioritised over providing frequency support. Clarification is immediately needed on meeting dispatch requirements versus delivering frequency support, since this has been identified as causing participants to move away from a frequency response to better match

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energy dispatch instructions. Requiring a synchronous plant to move away from a frequency response will require work and may place stress on the equipment.

Deadband and Frequency Distribution

Setting an appropriate deadband is important. Currently, it appears as though the deadband setting coincides with the outer edges of the defined Normal Operating Frequency Band. Action to return frequency to normal should be undertaken well before reaching the outer limit of the Normal Operating Frequency Band. Ensuring deadbands are appropriately set to deliver frequency control within the Normal Operating Frequency Band is a better option than tightening/narrowing the normal operation frequency band (as in Texas). Tightening the Normal Operating Frequency Band may be needed in the future as variable generation becomes dominant, but this is not predicted to occur for several years.

AGC is not fast enough

The AGC will not deliver a signal rapidly enough to support a called for primary response. This response must be automatic and based on a response to a frequency excursion. The AGC certainly could not call an inertia service. Improving the AGC will not deliver either inertia or a primary response.

Inconsistencies in the NER

If there is any *perceived inconsistency* in the NER (page 61) that promotes the move away from governor response this should be corrected. The NER fundamentally underpins the operation of the NEM and therefore needs to be correct. Even if AEMC believes *legally* the NER is clear, the fact that legal arguments may be needed to defend a particular approach to frequency response and energy dispatch, indicates there is an issue and that legal clarity should be provided to give generators the reassurance they need to securely provide frequency support.

Frequency response from fast acting assets

Assets that can provide a fast response (<1 second) currently have to bid against assets already participating in the 6 second FCAS market. Incumbents do not have the investment costs associated with new rapidly acting assets (typically batteries) and are likely to be able to offer lower prices.

It should be noted that in GB the Enhanced Frequency Response service was valued lower than primary response and has resulted in a subsequent drop in value through the entire National Grid frequency service market:

“As described in the December 2017 Update From The Field, Clean Horizon believes that the 1 100 MW of battery storage projects in Great Britain will soon saturate the frequency regulation markets (EFR, FFR and future fast response products). This could lead to very competitive prices in these auctions as well as other markets (such as STOR 20 minutes, and balancing mechanism) to be addressed by storage systems as soon as the revenues expected on the frequency regulation markets cease to be profitable enough for the most expensive projects.” Clean Horizon, Update from the Field, April 2018.

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Speed alone, does not typically offer sufficient value to fast-responding assets. Markets that also value accuracy of response (e.g. Reg D signal in PJM, although PJM have now altered the specification of the Reg D signal to disadvantage batteries and favour dispatchability and capacity) offer the greatest incentive to batteries.

Inertia is not a Selective Service

If a synchronous generator is connected to the system and operating, then they will be providing inertia, whether they intend to or not. For this reason, inertia provision and primary response should be a mandatory services and the issues around deadband settings need to be resolved and a mandatory requirement to deliver frequency support, within specific deadband settings, is likely to be the best route to delivering frequency control at least cost. If there is still a shortfall in "inertia" then the requirement for an inertia market should then be reviewed, but it would be preferable to create a "frequency control service", which is technology neutral, rather than an "inertia" service, which is not.

Future System needs for Frequency

While AEMC and AEMO do need to be exploring the options for frequency support in a NEM with less synchronous generation and more variable generation, this should not be a high priority. Various reports (e.g. Finkel Report, CSIRO-ENA Roadmap) indicate that there are tens of years before the level of variable generation combined with the retirement of incumbent synchronous generation reach a point where new approaches are needed.

There may be regions in the NEM where the balance between variable and synchronous generation has reached a point that alternative frequency responses need to be explored and indeed there are a variety of trials already underway.

However, the combination of the future issue with the current pressing issue of inadequate frequency control in the NEM need to be separated from each other, since once needs immediate resolution and the other can be resolved with less haste. The development of new rules will need to occur with an eye on the future, but this should not delay the changes needed today.

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Response to Questions

1. AEMO's procedure for determining how regulating FCAS costs are recovered and from whom (the "causer pays procedure") does not transparently and accurately map the allocation of costs to actions that create the need for the regulation services.

(a) That AEMO investigate whether:

(i) the average period used for calculation of contribution factors could be aligned with the period over which the costs are incurred, preferably on a five minute basis

(ii) the ten business day notice period between publishing and applying contribution factors is appropriate or could be removed.

(b) That AEMO clarify how the causer pays procedure works and the specific variable that generator performance is measured against (i.e. frequency indicator or frequency) such that contribution factors can be calculated in real time by market participants.

> We strongly support the review of the "Causer Pays" mechanism to ensure that the determinations (calculations) are documented and transparent to better allow market entities to determine their liabilities and assess their risk. Moving to a closer to real-time approach would be preferable.

2. Frequency control performance under normal operating conditions has been deteriorating in recent times, largely as a result of generators reducing or removing their provision of a voluntary 'governor response'4 to minor frequency deviations.

That the providers of a primary regulating response should be remunerated for the costs of providing the service, in particular where the opportunity costs of maintaining the capacity to provide the service (e.g. maintaining headroom to be able to increase output) are likely to be high.

The implementation of one of the following two options is likely to build on the existing market frameworks and support improved frequency control during normal operation:

• provision of a primary regulating response through the existing regulating FCAS markets

• changes to the causer pays arrangements to facilitate the provision of incentive payments for primary frequency response during normal operation.

Further work is required to investigate and describe the potential arrangements for the implementation of these options, and the associated costs and benefits of these arrangements.

The current FCAS market has demonstrably failed. Frequency is not being contained with the Normal Operation Frequency Band and, further, the cost of the FCAS service has increased. It is not clear if the costs have increased because more MW are required or if the cost of each MW has increased. Clearly,

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customers are paying for a service that is not being delivered. It is difficult to see how the current market, even with the addition of a "primary response" will be any better than the current FCAS market approach.

> We continue to support a mandatory requirement for the provision of inertia and primary frequency response from connected generators. All connected generators must be able to prove their capability to deliver a response to AEMO, and then that response is required to be bid into a tender, allowing AEMO to select the providers that offer the most cost-effective support. Delivery of any response would be remunerated on the basis of the accepted tender. See comments in above.

3. There is currently a lack of transparency regarding the frequency performance of the power system and the performance of FCAS markets.

That a rule change request be submitted to amend the NER to require:

(a) AEMO to monitor, and publish reports on, frequency outcomes with respect to the requirements of the frequency operating standard

(b) AEMO to provide information to the AER on the performance of FCAS markets and for the AER to monitor, and report on, the performance of FCAS markets.

> As well as reporting the performance of *the market*, the performance of the providers of FCAS should be monitored and reported.

4. There is an absence of market participant categories in the NER that permit distributed energy resources capable of exporting electricity to the network to be aggregated to provide market ancillary services (e.g. FCAS).

That a rule change request be submitted to enable:

(a) Market Ancillary Service Providers to classify small generating units as ancillary service generating units for the purposes of offering market ancillary services

(b) Small Generation Aggregators to classify small generating units as ancillary service generating units for the purposes of offering market ancillary services.

These changes may also require changes to AEMO's market ancillary service specification (MASS).

> We support this rule change, but this is not as urgent as accessing the frequency control available from currently connected generation.

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5. The current MASS potentially presents a barrier to the provision of market ancillary services by distributed energy resources, and may be resulting in an under-utilisation of market ancillary services provided by newer technologies.

That:

(a) AEMO provide more information regarding particular service characteristics that may be able to be trialled under the MASS

(b) undertake trials of distributed energy resources providing FCAS that consider various technology types and different options for metering and verification, with a view to sharing the outcomes of the trials with relevant stakeholders

(c) conduct a broader review of the MASS and consider how the value of distributed energy resources can be appropriately recognised.

We support the review of the MASS and trials to facilitate the participation of new technologies.

We are not sure if 1 MW is a meaningful minimum size for participants. What is the minimum size that has a measurable impact on the NEM? Smaller capacities may offer an important service to the DNSPs.

6. The current application of the connection arrangements for distributed energy resources, and Australian Standard 4777, may be hindering the ability of distributed energy resources to provide system security services.

That Energy Networks Australia, in developing its national connection guidelines, provide guidance on:

• what capability is reasonable to require from distributed energy resources as a condition of connection in order to address the impact of that connection

• the expected application of AS 4777 to different connection types and sizes

• the technical justification for any mandated services

• the extent to which any mandated services would detract from the ability for distributed energy resources to offer system security services.

The Commission encourages stakeholders to provide input into the development of these guidelines.

The ability of any distributed energy resource to provide ancillary service to the NEM is dependent on the ability of the distribution network to transmit that support to the wider system without compromising the operation of the distribution network. It is also dependent on the distribution network operating reliably, which may not be the case in times of stress.

Also, DERs are typically connected to the network via an inverter, which when complying with AS 4777 or DNSP connection requirements, may mean that during a local outage or voltage

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excursion, the inverters will disconnect (required for safety reasons) taking these service providers offline. Therefore, voltage standards, management of reliability, including momentary outages will be critical to ensuring that DERs are actually available to provide an ancillary service.

In the future, distributed energy resources may directly provide a service to the DNSPs (or TNSPs), which will be highly location dependent, meaning that there may be competition for a single resource between the NSPs and AEMO. Developing protocols for how best to utilise DERs and determining who has priority in a given situation will be critical (e.g. Energy Networks Association (UK) Shared Services:

https://www.nationalgrid.com/sites/default/files/documents/6%20monthly%20report%20-%20December%202017.pdf).

7. Distributed energy resources providing system security services are likely to have an impact on local network conditions. Similarly, local network conditions will likely affect the ability for distributed energy resources to provide system security services.

That:

(a) AEMO, in conjunction with DNSPs, conduct trials of aggregated distributed energy resources providing FCAS to assess their ability to provide services under different network conditions, and how the provision of those services affect the local network and the power system more broadly

(b) DNSPs and aggregators share information about the types of network conditions that may constrain the operation of distributed energy resources providing system security services, and the types of services that may affect network conditions, with a view to determining how the value of distributed energy resources can be maximised for both parties.

We agree that is a major issue that needs for be addressed before services from DERs can be deemed to be reliable and cost-effective. See also comments for point 6.

8. The existing frameworks for frequency control may be inadequate to address the future needs of the power system as the demand and supply sides of the sector continue to evolve, but the time frames over which these changes are required, and what new services might be required in future, are uncertain.

That, in the medium term:

(a) AEMO conduct a broader review of the MASS to recognise the capability, and more accurately value the response profile, of new technologies that are capable of providing frequency control services

(b) the AEMC and AEMO refine the time frames and develop a work program for making any substantive changes to FCAS frameworks, informed by:

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(i) an assessment of any consequential impacts arising from the implementation of any revisions to frequency control arrangements in the normal operating frequency band

(ii) investigations undertaken by AEMO into:

— the emerging capabilities of fast frequency response technologies, including trials of various technology types, with a view to publishing the outcomes of the trials with relevant stakeholders, and to inform the development of future service specifications

— the evolving technical and operational requirements of the power system and the inter-relationships between different system services, including frequency response, inertia and system strength.

> While we agree that all of these issues are important and need to be progressed, they are not as critical as resolving the access to frequency control services from currently connected generators.