Your Ref: ERC0263

5 November 2021

Ben Hiron
Australian Energy Market Commission
GPO Box 2603
Sydney NSW 2000
Submitted online to: www.aemc.gov.au

Dear Ben

Submission: Primary frequency response incentive arrangements

CS Energy welcomes the opportunity to provide a submission to the Australian Energy Market Commission's (**AEMC's**) *Draft rule determination – Primary frequency response incentive arrangements* (**Draft Determination**). CS Energy is strongly supportive of ensuring processes such as incentivising the provision of Primary Frequency Response (**PFR**) that are critical to the effective and efficient management of secure and reliable energy now and into the future are agile and fit for purpose.

About CS Energy

CS Energy is a Queensland energy company that generates and sells electricity in the National Electricity Market (**NEM**). CS Energy owns and operates the Kogan Creek and Callide B coal-fired power stations and has a 50% share in the Callide C station (which it also operates). CS Energy sells electricity into the NEM from these power stations, as well as electricity generated by other power stations that CS Energy holds the trading rights to.

CS Energy also operates a retail business, offering retail contracts to large commercial and industrial users in Queensland, and is part of the South-East Queensland retail market through our joint venture with Alinta Energy.

CS Energy is 100 percent owned by the Queensland government.

Key recommendations

The NEM is changing and will continue to do so as it transitions to a market with more variable renewable energy (**VRE**) and an overall lower carbon footprint. The ability to effectively and efficiently manage power system security and reliability against this evolving landscape is paramount, and CS Energy supports the need to develop flexible and adaptive market and regulatory frameworks to ensure services such as PFR meet the requirements of the NEM particularly from both an AEMO and Market Participant perspective.

CS Energy concurs with statements by the Energy Security Board (**ESB**), AEMC and the Australian Energy Market Operator (**AEMO**) highlighting the importance and integral role of frequency control in an alternating current power system such as the NEM. In particular, the value of PFR has been elucidated in AEMO's technical reports[1] and the GHD advice[2] that have contributed to the Draft Determination.

The declared importance and value of PFR, in CS Energy's view, should be mirrored in the frameworks that procure and incentivise its provision. This is not reflected in the Draft Determination and CS Energy requests that the AEMC undertake further work and consultation prior to any finalisation of Rule changes. In particular, CS Energy's concerns include:

- There are many challenges with the proposed approach that remain unresolved as highlighted in the recent Technical Working Group (**TWG**) that convened following the release of the Draft Determination. The issues and concepts raised require further discussion and insight, with appropriate time and consultation to digest and debate.

  Furthermore, given the approach in the Draft Determination had not been previously discussed in either the public consultation to date or the TWG, CS Energy is concerned that the consultation process has effectively been truncated. This risks inefficient outcomes for all and is unlikely to be an enduring solution;

- It is too early to make definitive assumptions on the impact of mandated PFR on participants and the power system. For example, the cost of the rollout of the mandated settings on existing assets is still indeterminate. Wear and tear on a unit cannot be measured over a period of months but will only be understood during overhauls where the long-term impact can be assessed. Furthermore, the impact will be different for each technology and each asset and this needs to be properly understood over time. It is premature to conclude that the current mandated requirement will not impact the availability of PFR in the future;

- The efficacy of the current PFR arrangements on system frequency needs further assessment. Its implementation has seen diminishing returns as more generators adjusted to the required PFR governor settings. The need for all generators to have a deadband of ±15mHz has thus not been justified.

  AEMO has also noted the emergence of a ± 50mHZ oscillation, the root cause of which has not been determined nor has any remedial action;

- The absence of a new Normal Operating Primary Frequency Band (**NOPFB**) that balances the trade-off between the engineering need and economic efficiency. This standard should be developed prior to finalising any procurement mechanism; and

- The lack of due consideration of alternative approaches for the provision and incentivisation of PFR. The mandated regulatory requirement appears to be a given yet there has been no exploration of what deadband settings are appropriate. An assessment of varying deadbands on frequency control should also have be conducted to determine the feasibility of a spectrum of deadbands where participants could decide to be an early or late lifter with PFR subject to their circumstances without adversely impacting on frequency control. This would provide a spectrum of capabilities like service provision in the Frequency Control Ancillary Services (**FCAS**) markets.

---

[1] AEMO, *Technical White Paper - Enduring Primary Frequency Control Arrangements in the NEM*, August 2021
[2] GHD, *Enduring Primary Frequency Response – Report to the AEMC*, September 2021

Furthermore, the current timelines do not provide the opportunity to consider the findings of the Double-Sided Causer Pays (**DSCP**) mechanism conceptualised by Intelligent Energy Systems (**IES**)[3] with the support of the Australian Renewable Energy Agency (**ARENA**) and the Australian Energy Council (**AEC**).

CS Energy is also concerned with the approach proposed in the Draft Determination that allocates the development of key details of the framework to AEMO via its procedures. As the system operator, AEMO applies an operational lens in developing mechanisms and is not best placed to assess the market outcomes. A level of transparency and governance in the development of frameworks for any procurement mechanism must be specified in the National Electricity Rules (**Rules**) to avoid ambiguity or inadvertent outcomes.

CS Energy strongly encourages the AEMC to delay finalisation of any Rules changes related to PFR so that the necessary detailed work and consultation can be performed. The current sunset clause should also remain. Not only will this provide the opportunity to resolve many of the issues raised to date but should also allow for proper consideration of approaches alternative to the current “one size fits all” ±15mHz deadband which is unlikely to incentivise availability of PFR capability into the future. CS Energy is supportive of the development and implementation of enduring arrangements that support the efficient control of power system frequency through the incentivisation of plant behaviour. The focus of this Rule change must remain on incentive mechanisms to deliver the desired outcomes at least cost to consumers.

Responses to the Draft Determination

CS Energy’s responses to the Draft Determination are set out in the Attachment.

If you would like to discuss this submission, please contact Henry Gorniak (Market and Power System Specialist) on 0418 380 432 or hgorniak@csenergy.com.au.

Yours sincerely

Alison Demaria
Head of Policy and Regulation (Acting)

[3] https://www.iesys.com/Projects/dscp

ATTACHMENT A

As the generation mix changes, frequency control is expected to play a more integral role in maintaining the safe, secure and reliable supply of energy to consumers. Frequency control services traverse a spectrum of characteristics that play complementary roles in the NEM, with AEMO categorising these broadly as inertial response, primary, secondary and tertiary frequency control.

PFR is defined by AEMO as per '*active power controls act in a proportional manner to respond quickly to measured changes in local frequency and arrest deviations'*.[4] Its contribution to the resilience of the NEM as the generation mix changes is widely acknowledged and the need to explicitly value PFR is the basis for the Draft Determination.

In CS Energy's view the Draft Determination does not provide frameworks that adequately value and incentivise the provision of PFR both now and into the future and will not deliver an efficient and effective outcome for consumers. CS Energy suggests the AEMC:

- Extend the timeframe for finalising the rule change request to allow for further consultation and consideration of frameworks;
- Challenge the assumptions that have been drawn from the implementation of mandatory PFR to date, and utilise the sunset period to explore alternatives;
- Progress the development of a standard for NOPFB from which frameworks for PFR provision can be aligned; and
- Explore other approaches to ensure that PFR is appropriately incentivised in both the short-term and investment timeframes.

Without this consideration, the AEMC will unlikely be able to ensure that the appropriate enduring arrangements are developed and implemented to support the control of power system frequency and incentivise plant.

AEMC's proposed approach

CS Energy has actively participated in the AEMC consultation process including membership on the TWG and was surprised by the direction in the Draft Determination. The proposed PFR framework has not been raised in previous consultations and stakeholders have thus not been provided with adequate opportunity to understand and contribute to its development. This contrasts to the usual AEMC consultation process which draws upon the TWGs in the iterative design process as demonstrated by the recent system strength Rule consultation.

The Draft Determination raises several concerns as well as relegating the details of the design of any market incentives to AEMO. This is untenable for a draft Rule determination and the AEMC should undertake further consultation to, at a minimum, address the issues and concepts raised in the TWG on 15 October 2021. As the system operator, AEMO is not best placed to determine market incentives and impacts. The structure of any incentivisation

[4] AEMO, Power System Requirements, p.17

framework needs to be embedded in the Rules to provide the appropriate level of transparency, incentivisation and governance for all parties.

CS Energy would like to see either a further Directions Paper or Second Draft Determination to address these concerns including, but not limited to:

(a) Outcomes of the implementation of mandatory PFR

Level of PFR provision

CS Energy disagrees with the advice obtained by the AEMC that the rollout of mandatory narrow-band PFR has been successful and that directly measurable costs of the new obligation on conventional plant appear low. On the contrary, the "same size fits all" approach appears to be heavy-handed with all the improvement in system frequency occurring prior to the completion of the first tranche of governor switching. Figure 1 shows the daily system frequency and standard deviation as measured at Callide B Unit 2 from mid-July 2020 to mid-October 2021, the trend of which clearly showing the improvement in the first month and diminishing returns thereafter.

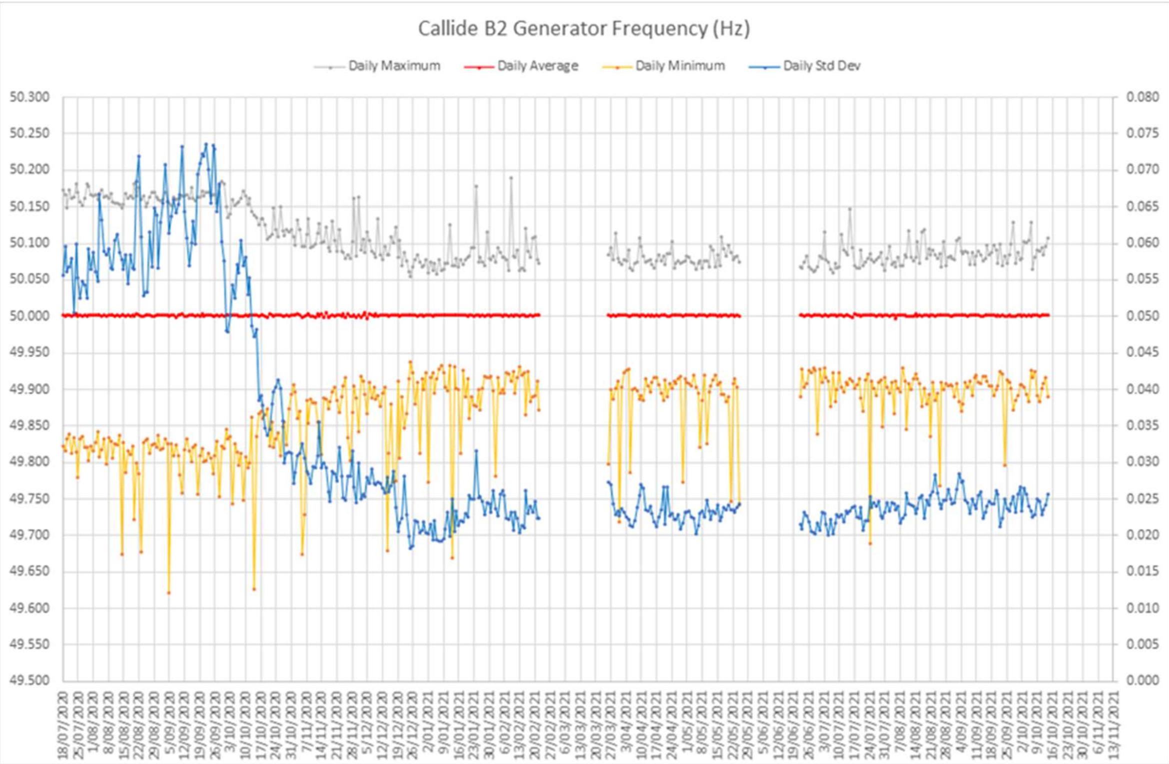

Figure 1 System frequency measured at Callide B2

This suggests that PFR need not be mandatory for the entire capable fleet or at least does not need to be as stringent as a ±15mHz deadband. It also suggests that much of the PFR governor response is wasted by counter-action between governors with different response lags and characteristics.

Cost of mandatory PFR

It is premature to determine the cost to generators of providing PFR, with costs associated with wear and tear to become apparent over time. While the cost may likely be low for steam turbine driven generators, this is unlikely to be true for hydro plant with large guide vane ring assemblies, or for high efficiency gas turbines where the PFR causes an increase in Equivalent Operating Hours (**EOH**) and thus more frequent expensive overhauls, or for renewable generators which are forced to spill free energy. The claim that there is little cost on generators thus is discriminatory to those technologies that are expected to be a growing part of the future generation mix.

Observation of periodic oscillations

AEMO has advised that since the commencement of mandatory PFR implementation, a very slow, 18 to 22 second period (0.045 to 0.055 Hz) oscillation has been observed.[5] Furthermore, all NEM regions are speeding up and slowing down simultaneously reflecting a common mode oscillation. With the continuing rollout of PFR and the Draft Determination's proposed removal of the sunset clause, it is imperative that AEMO determine the root cause of these oscillations and the potential impact to the system and its connected assets.

CS Energy is of the opinion the oscillation could be due to the interaction of governors with different response time constants and characteristics, and that it is a proportional type oscillation with the period related to the level of system inertia relative to the amount of PFR. It is unlikely to be an integral type oscillation due to Automatic Governor Control (**AGC**) regulation FCAS because the time constants used in the AGC's Frequency Indicator would be longer than the period of this oscillation. This is detailed in AEMO's technical advice[6] which showed that the oscillation persisted when the AGC was not operational during the loss of SCADA and regulation FCAS for 70 minutes on 24 January 2021. The level of PFR required will be a function of the level of system inertia, therefore, AEMO may need flexibility to limit droop proportional gains under the PFR rule to efficiently adapt to future changes in system inertia.

Given the diminishing returns exhibited in Figure 1, CS Energy is concerned that further tranches of mandated PFR have (and will continue to) served only to further contribute to the 18 to 22 second common mode frequency oscillation. This will likely exacerbate the wear and tear on governors, and more high cycle thermal stress fatigue accelerates EOH accumulation on some units. Furthermore, in incentive mechanisms such as a DSCP system, the wasted governor interaction would result in unnecessary higher costs.

(b) <u>Economic efficient level of PFR</u>

Given the observations from the implementation of mandatory PFR to date, there are both technical and economic reasons to reconsider whether the current mandatory narrow deadband represents the most efficient approach to PFR provision. A mandatory ± 5% response without the need to maintain headroom or footroom could be specified, with discretion allowed for a range of deadband settings to achieve the desired response within a NOPFB that would provide system security as determined by the Reliability Panel.

The efficient level of PFR to be procured is best defined through the development of a system standard. The Draft Determination sets a risky precedent in developing a procurement solution before an efficient volume of supply has been defined in a metric. The AEMC has indicated that the Reliability Panel will be undertaking a review of the Frequency Operating Standard (**FOS**) next year. This needs to occur prior to the finalisation of any mechanism for PFR.

[5] AEMC, *Technical Working Group May 2021*, Slide 22
[6] AEMO, *Technical White Paper – PFR requirements*, Section A1.3.3

The Draft Determination notes that AEMO has recommended a new NOPFB that would specify a frequency band around 50 Hz and the percentage of time that frequency should be within this band during normal operations.[7] CS Energy is supportive of a NOPFB, but its specifications need to be determined by the Reliability Panel and take into account both the engineering requirements and the economic trade-offs. The standard must have a clear and accountable basis and cannot be determined in isolation.

Operational standards reflect the overall system requirements while providing flexibility in how and what services are procured in order to meet the standard. Contingency FCAS markets are a key example, with three (soon to be four) raise and lower markets that provide complementary frequency control services to meet the standard. Within each market, AEMO specifies the broad technical characteristics required and a range of providers with a spectrum of capabilities are sourced. This facilitates the standard being met in the most economically efficient manner and provides forward signals to the market about the value of these capabilities.

The absence of a PFR standard thwarts the exploration of other approaches to procuring the service, some of which may represent a more effective and efficient arrangement. These are discussed below.

(c) Incentivising the provision of PFR

Determining incentive arrangements for system services needs to be multi-pronged:

- Disincentives, whether existing or potential, need to be identified and considered;
- Clear incentives need to be established that explicitly encompass the value of the service and how this value may change over time; and
- Appropriate transparency and governance in incentive frameworks.

Identification and removal of disincentives

Additional to the cost and oscillatory impacts outlined above, the Rules and associated compliance regulations actively disincentivise the provision of PFR. As outlined in the Draft Determination, the interpretation and enforcement of the Rules with respect to compliance with dispatch instructions[8] was a catalyst for the removal of narrow deadbands by participants.

Disincentives still exist in the related procedures for the provision and measurement of PFR. For example:

- AEMO's dispatch conformance alert system is yet to align with the PFR rule changes made under the '*Removing disincentives to providing PFR*' rule change process that are intended to clearly legitimise being off target to help correct frequency. Traders continue to receive "Off Target" alerts despite PFR contributing to a significant portion of the "MW Error" in AEMO's dispatch compliance system due to:

[7] AEMC, *Draft Determination Primary Frequency Response Incentive Arrangements*, p.71
[8] Australian Energy Regulator, *Compliance Bulletin No. 1 Compliance with dispatch instructions, offers and bids*

- The discrepancy between the “Total Cleared” in AEMO’s AGC system and the actual AGC setpoints seen by generators when PFR provides a head start to load ramping; and
- PFR itself still being included in the “MW Error”, which is simply “Total Cleared” minus “Actual MW”.

This then potentially impacts subsequent decisions and outcomes. This is shown in Figure 2.

Figure 2 PFR influence on AEMO 5 Minute Dispatch MW Error.

- Participants do not receive a linear AGC setpoint ramp. This appears to be principally due to resetting the “Total Cleared MW” to “Actual MW” at the start of each Dispatch Interval (**DI**). The resultant flat spots in AGC ramps at DI boundaries if “Actual MW” is lagging behind an AGC setpoint ramp before the start of the DI, and the inconsistent ramp rate between DIs is directly responsible for degrading the ramping response of generators.

The AGC setpoint ramping should not be reset to “Actual MW” every DI, rather it should just continue from the AGC setpoint at the end of the previous DI with no pause. In this way, it would be decoupled from any PFR influence. Unlike AGC setpoint changes, PFR is not rate limited and should not be allowed to alter the base AGC setpoint ramping. If the reason for resetting “Total Cleared MW” to “Actual MW” at the start of each DI is because the energy market dispatch engine does not account for the influence of frequency deviations on system load, then AEMO needs to model the frequency influence on load and generation and factor into the dispatch an estimate of the change in generation needed to correct frequency;

Figure 3 highlights the impact of this observation on Kogan Creek Power Station (**KCPS**) when the frequency or steam pressure influence is holding the ramping back at the start of the DI, the change in the AGC setpoint is less than five times the Rate of Change (ROC) setting, producing a flat spot in the unit’s AGC load setpoint ramping (dark blue in the figure).

KCPS’s AGC setpoint ramps faster than the ROC setting when the frequency or steam pressure influence gives it a head start on ramping, which then produces a linear ramp through the five-minute DI boundary. However, it also produces a MW Error in AEMO’s dispatch system because the unit’s rate limited AGC setpoint cannot reach the Total Cleared energy target that was initially issued in dispatch.

- The non-linearities in AEMO’s AGC setpoint ramping distort the legitimacy of any causer-pays framework. Causer pays performance factors are judged by comparing actual MWs against a linear trajectory between dispatch targets, whereas they should be judged against the AGC set points as received by the generator and that are sent back to AEMO with the actual MWs; and

- As outlined in its submission to the Market Ancillary Services Specification (**MASS**) consultation, CS Energy is concerned that ambiguity in the definitions of “Contingency Event Time” and “Initial Value” introduced to accommodate the PFR contribution will potentially expose participants to rulings of non-conformance with contingency FCAS bids.

Figure 3 AGC setpoints including the observed 'flat spots' at Kogan Creek Power Station

Incentive mechanisms for PFR provision

CS Energy does not consider that other options have been appropriately explored prior to the Draft Determination nor has there been adequate justification for continuing the mandated ±15mHz deadband.

Prior to the 2014 AER ruling on compliance with dispatch, PFR was provided by a range of generators via a range of different deadband and droop settings. CS Energy does not understand the rationale for all generators to have the same tight deadband. CS Energy also notes that AEMO indicated the potential to explore several variations in deadband settings.[9] In CS Energy's view, the implementation of mandatory PFR should be utilised as a trial to test the feasibility of a spectrum of deadbands that facilitate the ability of participants to determine whether to be an early or late lifter of PFR subject to their circumstances without adversely impacting system frequency.

Such a trial could still be conducted and should be done in parallel with the development of the NOPFB. Arguably, sensitivity studies on varying deadband and droop settings in the development of the NOPFB specifications would facilitate enduring arrangements.

CS Energy is supportive of incentivising behaviour that reduces the overall costs of frequency control to consumers. The Draft Determination does not provide these incentives focusing instead on the cost of PFR provision and not its value. CS Energy appreciates that mandated settings provide AEMO with a level of operational confidence. In the short-term, a mandated approach alone may deliver the frequency control required but it will not facilitate the availability of this capability in the future. This was highlighted in GHD's advice to the AEMC.

The focus needs to be on the incentives and mechanisms that will deliver the desired outcomes into the future. Uniform deadband and droop settings will not provide the required incentives. CS Energy would like the AEMC to explore different deadband and droop settings that would still provide the desired frequency control but would also establish the premise for an effective incentive scheme. This is a compromise position on the mandatory aspect of the PFR rule, in lieu of a relaxation to a mandatory 5% droop outside wide range settings of ± 0.5 Hz which is a standard European "limit frequency" feature of Siemen's governors (such as Kogan Creek Power Station).

CS Energy is also disappointed that the current timeframes of the Draft Determination do not provide the opportunity to consider the findings of the DSCP mechanism being explored by IES with the support of ARENA and the AEC.

A DSCP market for PFR with a flat price for 'MW.Minutes' of response would allow economics to dictate who participates at a narrow deadband to capture a larger portion of the market, and who would find it more economic to minimise their contribution with a wider deadband. As far as system security is concerned, all PFR contributes equally to arresting the frequency deviation, so it is only the amount of response within ± 0.5 Hz that needs to be mandatory.

The FCAS regulation raise/lower price could be utilised in preference to an energy price for PFR as the energy price does not have a raise/lower price component. By inference, PFR potentially has a higher weighting than regulation FCAS and a scaling factor could be utilised to reflect this higher value.

[9] AEMO, *Implementation of Mandatory Primary Frequency Response Rule – Status Update*, 5 October 2021

The DSCP could apply to all PFR and need not be limited to within the NOFB or even within ± 0.5Hz. That is, it would be an additional payment to contingency FCAS providers when they are required to respond. Given that a significant portion (possibly the majority) of response to large system disturbances has always come from participants who are not in the contingency FCAS market[10], their contribution should be valued instead of being further penalised by uneconomic continuous narrow deadband PFR.

Transparency and governance

Enduring arrangements that incentivise capability such as PFR in both the operational and investment timeframes rely on an appropriate level of transparency in regulatory frameworks. The Rules must specify the proposed PFR framework while the details of its implementation can be developed via AEMO's operational procedures. As the system operator, AEMO is not best placed to determine the appropriate market arrangements.

Other comments specific to the Draft Determination

If narrow band PFR remains mandated, then CS Energy does not support a PFR FCAS market if it is layered on the impending FFR and existing FCAS markets. It is also hard to envision a market for a mandated service. However, without some form of PFR market mechanism, headroom and footroom will not be considered explicitly during dispatch. Instead there will be a reliance on headroom and footroom being created in FCAS dispatch outcomes. Under certain operating conditions there is the risk that delivery of PFR on a sustained basis over time may erode the enabled amount of FCAS potentially leading to a subsequent shortfall in response to a contingency event. This negates the role of PFR in strengthening the resilience of the system.

The recovery of the unused regulation FCAS based on energy is prejudicial to those participants that have performed in correcting or maintaining the frequency at 50 Hz. It is unacceptable and perverse to create a disincentive by penalising participants that have performed in a positive and corrective manner to be allocated costs to cover unused regulation FCAS.

As the Draft Determination stands, it is difficult to see the proposed arrangements providing an enduring framework, and risks undermining the resilience of the NEM in the longer-term.

[10] AEMO, *Renewable Integration Study*, Appendix B