Your ref: REL0084

9 June 2022

Mr Charles Popple
Chair, Reliability Panel
Submitted online to: www.aemc.gov.au

Dear Mr Popple

Submission: Review of the Frequency Operating Standard

CS Energy welcomes the opportunity to provide a submission to the Reliability Panel's (**The Panel's**) *Issues Paper – Review of the Frequency Operating Standard* (**Issues Paper**).

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 ensure frameworks are appropriately reviewed and adapted to meet the requirements of the NEM and long-term consumer needs.

CS Energy accepts the observed and measured degradation of frequency performance during normal operations as detailed in the Issues Paper but considers the proposed ±0.015 Hz deadband to be extremely onerous and unprecedented in the history of the NEM. It is

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disappointing that the analysis for Primary Frequency Response (**PFR**) has not progressed beyond prosecuting the need (to which there is no argument) to instead determine what constitutes "good frequency control", setting appropriate metrics and evaluating the diminishing returns that have been apparent in the implementation of mandatory PFR.

The technical analysis to date has been biased and has focused on a predetermined outcome, that is, an extremely tight deadband that has not been justified operationally or economically. Alternative deadbands that have been considered are not genuine options and thus CS Energy implores the Panel to seek independent, external advice from technical and economic consultants to explore all potential outcomes.

Efficient and effective frameworks are best developed via a holistic approach that diligently examines both the underlying operational needs as well as the economic outcomes and trade-offs of any decisions. It is the Panel's role to develop these economically efficient metrics, balancing the trade-off between security and cost, and to review the performance of these metrics and how to embed them within the standards' framework.

The 2022 review of the Frequency Operating Standard (**FOS**) would benefit from the Panel:

- Engaging an independent expert to provide the technical analysis from an engineering perspective that reflects good operating practice. This assessment would be utilised to determine what constitutes good frequency control within the Normal Operating Frequency Band (**NOFB**) as well as explore a range of different and feasible options for the FOS, including deadbands wider than ± 0.015 Hz;

- Undertaking a robust economic assessment of any changes to the FOS both now and into the future acknowledging that it is too soon to quantify many of the costs of implementing mandatory PFR. This should include a range of scenarios demonstrating the economic and engineering trade-off while not compromising power system security;

- Extending the sunset clause for mandatory PFR by two to three years allowing for the performance of wider deadbands to be examined, and for all participants to have a better estimation of the impact on their units. A review of the FOS can be aligned with the end of this sunset period to assess the frequency performance; and

- Re-evaluating the timing of processes to allow the sequencing of work that will properly inform frequency control rather than the disparate processes currently underway.

CS Energy has provided further comment in Attachment A. If you would like to discuss this submission, please contact me on 0407 548 627 or ademaria@csenergy.com.au.

Yours sincerely

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ATTACHMENT A

The FOS is *the* integral component of power system frequency control, specifying the bands within which system frequency should be managed for an effective and efficient power system. Here frequency is the parameter and frequency control the service to deliver the FOS. The Panel's role is thus also integral as clause 8.8.1(a)(2) of the National Electricity Rules (**NER**) charges it with responsibility for determining power system security standards including the FOS.

CS Energy's expectations of the 2022 review of the FOS include an:

- Independent and holistic process;
- Independent and impartial technical analysis; and
- Independent and impartial economic analysis.

Independent and holistic process

This review of the FOS as expressed in the Issues Paper appears to be largely driven by the desire to institute a primary frequency control band within the NOFB. To this end, the FOS review appears to be reactive and narrow rather than a proactive assessment of what constitutes effective and efficient frequency management of the power system now and also over the longer term.

CS Energy agrees that effective PFR is critical for robust and resilient power system frequency outcomes but does not consider the Issues Paper to lay the foundations for establishing effective and efficient frequency control within the NOFB. For example:

- Sequence of, and integration with, other work – The Issues Paper, as it reads, risks the tail wagging the dog, with the FOS effectively being informed by an operational solution. The Panel would ideally ensure an independent review of the FOS and what constitutes good frequency control prior to the market operator considering individual solutions as to how frequency can be managed to the Standard.

  The Panel has indicated that this review will dovetail with the other pieces of work currently underway related to frequency control. This is not sufficient as it is a piecemeal approach; the Panel's work should set the agenda for all frequency control work. Instead, stakeholders have been forced to consider disparate processes that are being undertaken in parallel. This denies stakeholders the ability to holistically consider these reforms and identify any potential interactions that may have adverse impacts as discussed further below. It will also make the Panel's task of assessing the trade-offs between the benefits and costs more challenging given the conflicting/misaligned consultations;

- Lack of consultation on key decisions – aspects of the Issues Paper have been presented largely as a *fait accompli*, with the Panel consulting on the introduction of the Primary Frequency Control Band (**PFCB**). This form of the Standard is the Australian Energy Market Operator's (**AEMO's**) preferred option based on its *Technical White Paper*[1]. The Panel should be undertaking an independent assessment of the most appropriate form of the FOS, with stakeholders given the opportunity to comment.

[1] AEMO, *Enduring primary frequency response requirements for the NEM – Technical White Paper*, August 2021

Instead, the Issues Paper states its role is to '*trade-off between the security benefits of a more stringent FOS against the costs*'[2] the decision seemingly having been made.

Furthermore, CS Energy is concerned with the reasoning provided for dismissing some of the options, namely that the benchmark would require retuning over time. Given the energy system is in transition, potential retuning of operational metrics and standards is anticipated to be required as the system changes regardless so it shouldn't be shied away from here if deemed a legitimate option or operational requirement; and

- Limited focus of the Issues Paper – in addition to the narrow focus on what is suitable frequency control in the short-term, the Issues Paper is very operationally centric, with discussion often restricted to the potential impacts and benefits to AEMO. The Panel would ideally be cognisant of the broader impacts to the market and consumers across all aspects of the review. For example, Section 5.4.2 outlines how the FOS review will interact with other regulations from AEMO's perspective but does not consider other potential interactions. This is discussed further below.

Independent technical analysis

Technical analysis should inform the Panel's assessment of what constitutes "good operating practice" frequency control, and how this may change with time as the power system evolves. This also helps understand the potential risks and trade-offs when analysing the economics of amending the FOS.

CS Energy agrees with the degradation of frequency performance within the NFOB and the need to address it but is disappointed that the analysis continues to focus on prosecuting the need for PFR rather than exploring what constitutes good frequency management, that is, how tightly bound should system frequency be to 50 Hz.[3]

The analysis in the Issues Paper as presented to date is very binary with the wide distribution around 50 Hz exhibited in the period 2015-2020 deemed "bad" and the narrow distribution following Mandatory Primary Frequency Response (**MPFR**) "good". There has been no exploration of the suite of options in between, rather it is clear that AEMO's preferred approach is an extremely narrow deadband. This effective one size fits all approach not only ignores its cost but also that different technologies have unique characteristics regarding frequency control. It is unclear why this diversity in frequency control capability has been ignored. This is further evidenced by two key actions by AEMO:

- Defining PFR as a parameter not a service – The recent use of language indicating that PFR is a parameter and not a service contradicts AEMO's other reports[4]. Employing the same logic, secondary and tertiary frequency control would not be services either. All three categories are delivered by a control system with defined parameters;[5] and

- "Analysis" of PFCB deadbands - AEMO analysed three potential ranges for the deadband: narrow, moderate and wide. CS Energy notes that the moderate and wide deadbands reflect the NOFB and the contingency excursion band respectively, neither of which are the frequency domain over which PFR is required and expected to be solely active. CS Energy notes that wideband frequency response (outside ± 0.50 Hz is effectively wideband PFR, the safety net) should be armed at all times but only triggered

[2] Reliability Panel, *Review of the Frequency Operating Standard Consultation Paper,* p.20
[3] Note during the period 2015-2020 the FOS was effectively not breached during the period but changing performance was observed with frequency distributed towards the edges of the NOFB rather than remain around 50.0Hz under steady state operating conditions.
[4] See for example the Engineering Framework and related reports.
[5] See for example, AEMO, *Interim Primary Frequency Response Requirements*. 1 April 2020

under non-credible/multiple contingency events. While CS Energy has previously championed the benefits provided by wide deadband frequency response to system resilience to non-credible events, this is within the context of a suite of appropriate frequency control measures. At these frequency ranges "explored" by AEMO, narrow deadband alone would not be sufficient to manage frequency. The holistic approach is missing. It is thus unsurprising that out of the three deadbands only the narrow option provides acceptable frequency management.

CS Energy would expect any analysis considering deadbands to apply due diligence in exploring options *within* the NOFB, not frequency ranges where they are guaranteed to fail.

The Panel must seek independent technical analysis on the changing operational need for frequency control.

The details provided in AEMO's Technical White Paper lack the expected detail and analysis. AEMO's binary analysis has shown that the current ± 0.015 Hz deadband provides 'good' frequency control that, in itself, needs to be defined, but there has been no analysis on whether other settings would also provide 'good frequency control'. The Issues Paper acknowledges that '*AEMO has no metric for measuring and assessing in advance the adequacy of PFR levels under normal operating conditions*'[6] and this needs to be a core component of the technical analysis that informs the FOS. Aggregate responsiveness is not an appropriate answer.

The Panel must obtain technical analysis that at a minimum:

- Explores the diminishing returns observed during the implementation of mandatory PFR. This was also highlighted on 2 February 2021 when a large generator (550 MW) was disconnected in NSW at 2318 hours resulting in a frequency excursion from effectively 50 Hz to a minimum frequency of 49.79 Hz (within the normal frequency excursion band) with the containment, stabilisation and restoration being provided primarily by the first tranche of PFR providers and possibly by Frequency Control Ancillary Services (**FCAS**) contingency switch controller providers that have a default setting of ± 0.2 Hz, 49.80 Hz in lieu of an advised setting by AEMO.[7]

  This also raises the legitimate question as to why contingency services are set in the normal frequency excursion band that is a subset of the NOFB, and thus whether this band still has value;

- Considers appropriate metrics for measuring and assessing PFR levels under normal operating conditions, and thus clear performance criteria for system frequency;

- If a PFCB is considered the best approach, assess options that are genuine. For example:

  - Very narrow deadband – between 0 and ± 0.015 Hz;

  - Narrow deadband – between 0 and ± 0.05 Hz;

  - Moderate deadband – between 0 and ± 0.08 Hz; and

[6] Reliability Panel, *Op Cit*, p.33
[7] This is a requirement of the MASS as shown on its section 6, Table 5.

- Wide deadband – between 0 and ± 0.1 Hz.

In particular, the ± 0.05 Hz deadband was the governor setting pre-2015 and it would be useful to understand the rationale for this setting.

Wider deadband settings also more appropriately allocate risk across market participants and AEMO;

- Backcasting analysis with the different deadbands to determine how the power system would have performed under these wider bands for identified events. How resilient was the system? The determination of a NEM power system resilience factor is important and should be overlayed with the FOS and actual frequency performance to provide a meaningful insight to all stakeholders. Was there enough safety margin and what is an appropriate safety margin, etc.;

- Consider all potential interactions to leverage opportunities and maximise value while also avoiding unintended consequences. This includes but is not limited to:

    - Interaction with dispatch compliance – Given the Australian Energy Regulator decision was the root cause of the initial decline in PFR, the Panel needs to ensure interactions and consequences are properly identified and considered, and that there is no potential ambiguity;

    - Whether a distribution of deadband settings with early and late lifters provides a more efficient frequency distribution. This reflects inherent differences in technology capability and may have the additional benefit of reducing the 50 mHz oscillation which is likely caused by the current ± 0.015 Hz setting being just wide enough to cover the rotor angle oscillations between generators; and

- The level of reserves required for the provision of PFR (particularly at narrow deadbands) and how this may interact with the delivery of other frequency control services and potential Rules compliance issues.

CS Energy considers the current PFCB of ± 0.015 Hz to be extremely onerous and neither economically or operationally justified[8] and expects the Panel to review this setting without prejudice. '*Although updating the PFCB would be a non-trivial change*'[9], it should not be the default setting, and if the Panel's independent technical and economic analysis of the FOS indicates that it is not the most efficient outcome for consumers, then it should be updated.

Independent economic analysis

The broader, independent technical analysis should be completed in parallel with a rigorous economic assessment of the cost of amending the FOS. CS Energy anticipates there will be a natural trade-off between cost and how tightly frequency is bound around 50 Hz. This cost will be borne both now and in delivering the FOS in the future.

The economic assessment also needs to consider the validity of mandatory PFR particularly the challenge of no headroom or footroom or obligation to hold it and the costs that imposes based on outcomes. AEMO has stated that to do so would complicate the process, however delivery of the enabled FCAS contingency services is arguably compromised under a deteriorating system frequency excursion not linked to a contingency or power system event

[8] References to international best practice are not appropriately contextualised. For example, US systems require tight frequency control because they are interconnected with several other balancing authorities.
[9] Reliability Panel, *Op Cit*, p.31

where mandatory PFR extends to the enabled FCAS contingency services. This also potentially flags a Rules compliance issue for the provision of enabled FCAS. AEMO should be transparent in its position that the PFR headroom/footroom will be delivered through NEMDE constraining off/on FCAS providers for the provision of both FCAS contingency and regulation services.

Any assessment of costs needs to recognise that it is too soon to accurately identify and articulate the costs associated with power system frequency being held more closely to 50 Hz during normal operation. CS Energy is still determining this cost, although it is expected to not be insignificant. During the next major overhaul for each of the units in its portfolio, CS Energy will be able to assess the governor mileage and other relevant parameters to determine an indication of impact and subsequent cost implications.

Comments specific to the four consultation areas

Prior to recommendations, CS Energy provides comments to the specific questions posed in the Issues Paper.

Settings in the FOS for normal operation

As previously stated, CS Energy is supportive of the role PFR plays in normal operations but considers the current PFCB as extremely onerous and unsubstantiated. Options to better align the settings in the FOS with expectations for effective and efficient control of power system frequency need to be explored fully which has not been done to date. This assessment must be both technical and economic.

It is important that the settings in the FOS reflect a top-down approach rather than being biased by the bottom-up preferences of the system operator. CS Energy reiterates its comments in the independent technical analysis section above in particular:

- The need to determine an appropriate operational metric for PFR which reflects what is meant by ‘good frequency control’, and measures how this changes as the power system evolves;

- The need to examine alternative deadbands within the NOFB;

- It is too early to determine the impact of the current settings on assets, let alone claim a reduction in maintenance costs for units. Each unit’s response has been unique, and it is anticipated that the long-term impact of narrow PFR will vary across the CS Energy portfolio. Some parts of the plant, such as the hydraulic governors and boilers, are definitely “working harder”, which may lead to more frequent overhauls and, ultimately a material increase in costs; and

- Ensuring dispatch and compliance interactions are not ambiguous.

The Panel also asks whether regionally specific issues should be taken into consideration. CS Energy makes no comment on how settings may need to be different for Tasmania relative to the mainland NEM. However, it is noted that regional requirements for regulation FCAS was a key recommendation stemming from the 25 August 2018 event report. Given AEMO has not progressed this action, CS Energy assumes that regionally specific concerns regarding primary frequency control are not a priority.

As outlined in a previous submission, CS Energy suggests a “Lack of PFR” 1, 2, and 3 trigger thresholds, similar to the Lack of Reserves (**LOR**) for capacity reserves, could be

developed to provide the required level of visibility to the market operator and participants both under normal interconnected operation, potential separation event and electrical islanding operation. It is questionable that lack of confidence could arise for PFR availability when it does not occur for energy or FCAS provided the appropriate market signals are generated enabling participants to respond.[10]

System Standard for RoCoF

CS Energy has previously advocated for a RoCoF standard alongside a broader suite of metrics in the Rules for system security and encourages the Panel to advance this work. A system standard for RoCoF would:

- Provide AEMO with a clear metric on which actions to increase the level of inertia on the power system are based, and introduces consistency in performance;

- Set the basis for the procurement of Fast Frequency Response (**FFR**) allowing for consistent and transparent optimisation of FFR volumes with system conditions including inertia levels. The MASS consultation for FFR currently underway acknowledges the need for FFR volumes to be "inertia aware"[11] and a standard will facilitate this in a way that is most beneficial to consumers; and

- Assist in providing the market with transparency on both FFR and inertia needs. At present, the market information is often limited to generic statements about system security. How can the market be responsive and flexible to changing conditions if it has no visibility? If the market is to keep pace with the energy transition, information is vital and a system standard for RoCoF will deliver benefits to the future power system by increasing the level of transparency.

The operational conditions for which a RoCoF standard should be set ought to mirror those of frequency: a standard to apply following credible contingency events and one following non-credible contingency events. Importantly, a different standard should apply for system intact, potential separation events and electrical islanding operation.

There should not be a standard for protected events for the same rationale as to why protected events are not currently specified in the FOS but rather the FOS is applied to the protected event. It is anticipated that AEMO will consider RoCoF limits when defining the operational conditions of a protected event.

A RoCoF standard would have a centralised cost associated with the actions employed to meet the limit. However, if the standard is appropriately set, then CS Energy anticipates that many of these operational actions may become increasingly likely regardless as the system transitions, but the market wouldn't benefit from the transparency and consistency of these actions in the absence of a standard.

Furthermore, a system standard for RoCoF is different to generator standards and it is expected that new plant would be required to have a level of technical capability anyway, and thus the standard should not unnecessarily overly burden stakeholders.

Of course, consideration of a RoCoF standard is subject to the appropriate technical and economic analysis performed by the Panel, including consideration of the measurement timeframe and interaction with other mechanisms.

[10] CS Energy submission to *Directions Paper on Frequency Control Rule Changes*, February 2021
[11] AEMO, *Market Ancillary Services Specification Consultation*, May 2022, p.21

Settings for contingency events

CS Energy does not consider there to be clear justification for changing the settings for system recovery following contingency events. Operationally, what is relevant is the not the cause of a contingency event but its likelihood and potential impact as encapsulated in the FOS. The *Enhancing operational resilience to indistinct events* rule facilitates the changing operational nature of contingency events, allowing AEMO to consider a broader suite of potential events and update its reclassification criteria as appropriate.

If the Panel was going to review the maximum contingency size, then it would also need to consider the potential implications of doing so. For example, the disconnection of Distributed Energy Resources (**DER**) may at times constitute the largest contingency size. It may not be feasible or economically efficient for AEMO to procure sufficient contingency FCAS to manage events of this size, raising questions of whether limits on DER installation need to be considered.

CS Energy is also confused by the discussion on extending the generation event limit to cover other credible contingency events which focuses on what have always been classified as non-credible contingency events and can be managed via existing processes. For example:

- Has the current network event in the FOS been explored sufficiently and reviewed as to what it does represent and if it addresses some of current concerns or perceived shortcomings?

- ID040 and ID155 will be captured by the indistinct events provisions and AEMO's ability to cater for these events in its reclassification criteria;

- ID418 concerns an increased contingency risk associated with the loss of flow paths connecting significant REZs to the main transmission system. The planning process for REZs includes consideration of special protection schemes to manage such risks. Furthermore, if this event is explicitly considered in the FOS, then will all networks connected via a double circuit single tower transmission network be considered an equitable risk? and

- ID081 suggests the emergence of new risks associated with the unexpected disconnection of new large loads. Again, CS Energy questions how this is different to the existing experience with major industrial loads such as the smelters and the provisions in place to manage these risks.

Given the costs associated with changing the settings for contingency events, CS Energy suggests that the Panel first conducts a gap assessment of the existing mechanisms for managing such events. CS Energy notes that AEMO's assessment only considers the source of new risks and does not perform an evaluation of the existing frameworks within which they could potentially be managed. This includes special protection schemes, the protected events framework, reclassification schemes and the emergency frequency control schemes.

Furthermore, the consideration of dynamic optimisation of risk in energy dispatch as outlined in the Issues Paper's Box 3 seems to be a longer-term measure that AEMO could explore to flexibly adapt to the changing power system.

Time error correction

The Panel has raised a number of legitimate questions and topics without providing the required insights. This topic was arguably not closed out in the 2019 review.

There is sufficient evidence that time error correction is required but CS Energy has no comment on what the standard should be and how it should be managed.

Recommendations for the 2022 FOS Review

While there is broad consensus on the need for effective PFR, the onerous PFCB has not been justified either operationally or economically. Further to an independent technical and economic analysis of the options, CS Energy thus implores the Panel to:

- Extend the sunset clause for the current mandatory PFR response by two to three years, allowing for the necessary work to examine alternative deadband sizes;

- During this period, an appropriate operational metric for PFR can be developed which clearly defines acceptable frequency control;

- Participants will be able to better understand the operational cost of PFR on units;

- Explore wider deadband settings within the NFOB and their efficacy. CS Energy strongly supports a stepped approach in determining the appropriate PFR deadband with the ±0.015Hz deadband specified as an *absolute* minimum level and not the default level; and

- Review the FOS in two to three years to ascertain the costs and benefits of a wider deadband setting on frequency management, and its performance.

This process needs to be cognisant of the operational and investment timeframes.