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(Lodged electronically via pfr@aemo.com.au) **16 January 2023**

**PRIMARY FREQUENCY RESPONSE REQUIREMENTS REVIEW**
**RESPONSE TO THE ISSUES PAPER**
**Date of Notice: 6/12/2022**

Delta Electricity operates the Vales Point Power Station located at the southern end of Lake Macquarie in NSW. The power station consists of two 660MW conventional coal-fired steam turbo-generators. Delta Electricity appreciates the opportunity to comment on the proposed revisions to the Primary Frequency Response Requirements (PFRR).

Delta Electricity is concerned that rigid deployment of the primary frequency control band and the available support at times from generators, sometimes without adequate headroom or footroom, are combining and having impact on the even distribution of frequency. Daily charts of the distribution shows signs of overregulating to the PFCB yielding a far from bell-shaped distribution around the expected 50Hz nominal and distortions that suggest raise services are quite different in effect and dominance to that of lower services on certain days. The tightness of the band and the lack of routine system-wide examination of the coordination between various controllers on machines (mechanical-hydraulic governors and DCS supported frequency control) and AEMO's AGC regulation FCAS and dispatch targeting, are considered to be contributing factors as to why there remains a general erraticism in frequency that was not present in the 20$^{th}$ century or the early years of the market in the early 21$^{st}$ century.

Delta Electricity is also concerned that frequency erraticism in the present NEM means that frequency steadiness may not be controllable fast enough by any available PFR as currently designed. Continued unchecked, it is possible the maintenance of tight PFCBs and the erraticism will effect longer term damage on machines increasing unplanned downtime and outage works to correct but, without effective elimination or better dampening control of the erraticism, may also produce repeating failures in speed governing equipment.

If AEMO wishes to discuss any details of this submission, please contact Simon Bolt on (02) 4352 6315 or simon.bolt@de.com.au.

Yours sincerely,

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**The Present Frequency Condition**

A single generating unit is not designed nor reasonably expected to recover frequency of the entire system back to 50Hz on its own. All machines, in coordination with the reactions of all other machines and load as steered by a smart central dispatch from AEMOs NEMDE and AGC, can do this. Each mechanical-hydraulic governor reacts to speed changes before the unit load controller returns the Unit to dispatch setpoint. Unit FCAS controllers of a machine are designed to proportionally correct unit setpoint to provide the sustained response until frequency returns inside expected deadbands.

A mechanical-hydraulic governor reaction with supporting stored energy is a natural PFR delivery system i.e., the reaction provides a response in output proportional to the detected **speed change** (not an absolute frequency value) according to the 'droop' percentage ratio. These controllers have no deadband but from examination of recorded 4s sampled frequency data, "deadbands" result from the mechanical-hydraulic reaction which are statistically wider than the assigned PFCB and are not adjustable. A PFCB set inside this resultant deadband and deploying correcting absolute frequency controllers installed in the Unit DCS is probably uncoordinated with the mechanical-hydraulic reaction and therefore contributing to erraticism.

DCS controllers, that aim to sustain the Unit correction to any detected frequency deviation from 50Hz, attempt to compliment the initial mechanical governor reaction. Assigned deadbands in these controllers are adjustable and should be specifically determined by investigation and consultation between the Generator and the system operator so that responses coordinate well with the local mechanical-hydraulic governor, with other nearby synchronous units and also with any AEMO deployed frequency control. Continuous overcorrection is to be avoided in order to avoid unnecessary wear and tear that raises the potential for premature failure in the mechanical-hydraulic mechanisms which are expensive to maintain in terms of both parts and the length of Unit downtime to repair. In the specific case of ageing units such as Vales Point, overcorrection could also accelerate the potential end of life of the two units.

Uncontrolled erraticism in frequency will be ageing all machines more than a steadier frequency condition would. Rigid assignment of a tight PFCB to all machines is considered to be contributing to this erraticism and therefore accelerating the potential for failure as the various machines age further and retire. It is considered likely that tuning efforts, centrally coordinated by AEMO, inclusive of deploying subtle changes to assigned deadbands of the controllers of the frequency controllers on each Unit, where possible, could achieve a steadier frequency outcome as may attention to detail about the overall PFR quantity required at any given time or, perhaps more importantly, coordinated efforts in general to reduce uncoordinated reactions.

Mandatory PFR has not reduced the erraticism as can be observed in the 50mHz variations over a 20-30s period and there are occasional signs the amplitude of the variations is increasing. It is considered that lack of coordination of the overall frequency control delivery could be responsible.

**Variety in control**

As mentioned, controllers between power stations may need better coordination with nearby units (or even units less nearby such as can be influenced in the applied settings of power system stabilisers included in the automatic voltage regulators of each unit).

The mechanical-hydraulic governors react to changes in turbine speed and the reaction is automatically associated with the delivery of the response.

DCS Frequency controllers, on the other hand, rely on frequency detection, processing time, target correction and target delivery and the frequency detection system of such controllers is quite separate in location and design to the speed detector/controller of the mechanical systems. Are all these elements at any Unit coordinated well enough and should AEMO be providing a lead role in coordinating efforts to improve the overall control of frequency under Rule 4.4.1(a)?

Are close units with different governing technologies (e.g. mechanical-hydraulic and electro-hydraulic) adequately coordinated?

Possibly related to aspects of frequency coordination, the AEMO AGC appears to ramp the energy target delivery to units that also control energy ramping locally. Is the duplication of such ramping controls, which could also be contributing to frequency erraticism, necessary?

Any disconnection between the intent and expectations of frequency control and the actual delivery of that control, highlights more possibilities for why frequency erraticism remains an observed problem.

**AGC contributions to the erraticism**

AEMO may be also aware, as is indicated by decisions taken in January 2021 to reverse some AGC changes that improved frequency distribution early in the PFR implementation, that the AGC dispatch delivery contributes to the erraticism being experienced.

Prior to the removal of the AGC changes, the frequency distribution was superior to that which has continued since, despite a doubling of MW capacity with MNBPFR installed.

It is considered that AEMO assigning technical resources to investigate these concerns and seek tuning outcomes, including a greater variety in the applied deadbands in locations in the NEM, could improve steadiness and therefore also complement efforts in the market place to incentivise performance via the PFR incentives being designed in the Frequency Performance Payments procedural changes to the Regulation FCAS Contributions Factor Procedure.

**Rise in frequency events without identifiable Contingent cause**

There are certainly far fewer frequency excursions beyond the NOFB as a result of the narrowing of the outer extremities of normal frequency distribution but there is now a growing proportion of events that appear to be associated with rapid changes in load and large numbers of aggregated generating sources despite the MNBPFR. Are these events occurring during the time when there is a lack of headroom or footroom for PFR? Such events should be routinely included for in the quarterly reporting on frequency conditions.

ATTACHMENT – CONSULTATION PAPER QUESTIONS

# Primary Frequency Response Requirements Review – January 2023

## Consultation Paper Questions

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## 3.4 Issues for Consultation

### 3.4.1. Issue 1 – transitional issues

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| 1. | Is there any other way AEMO could address the issues that are currently impeding full implementation of the Mandatory PFR rule? If so, how should the PFRR be amended to achieve this? |

Response:

The full implementation of Mandatory PFR is arguably a demonstrable overreach beyond effective PFR needed within the capabilities. Far less quantities of MWs on PFCB control settings demonstrably performed the same narrowing that increasing Mandatory PFR quantities is delivering and erraticism continues to exist that Mandatory PFR is not controlling as is reportedly understood and accepted by AEMO.

A large missing element in the PFRR description is that related to the AEMO AGC to Unit dispatch interface. Elements on this could be included for to discuss:

- AGC dispatch and targeting to units that can affect PFR,
- Expected frequency distribution,
- Improved understanding of the overall coordination issues such as:
  - how natural PFR from mechanical-hydraulic governors works (reacts to speed change and not absolute frequency),
  - how units may interact with other units
  - how the AVR stabiliser settings may be important contributors

- how PFR, FCAS regulation and 5minute energy target decisions are expected by AEMO to interact
- softening the wording of the defined PFCB to make it the default minimum deadband but also included for in a new section discussing AEMO to unit tuning and the possible need to vary the deadband as part of toolbox of actions to reduce the overall erraticism.

However, modifying the PFRR probably won't fix frequency erraticism. Re-evaluating the situation and seeking a different Rule change to expand on the meaning of Rule 4.4.1(a) and including tuning efforts in the Rules might.

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| 2. | Are there any other issues AEMO should consider in the context of the process that Connection Applicants must follow to assess PFR capability and settings? |

Response:

The self-assessment and variation process seemed to work and requires no changes but closer adherence to Rules, the words the PFRR uses in support of the Rules and adjustment in the expectations from the Rules AEMO has, is recommended. Batteries are not required to provide PFR when they are charging and the proposed wording of the PFRR, whilst it can be reasoned to be supporting expectations AEMO prefers to be drawn from the Rules, should not go beyond what the Rules permit even if a 'free' response from a charging battery is wanted by AEMO. If AEMO considers the delivery to be mandatorily required, the Rule needs changing. If it is not, it shouldn't need suggesting in the PFRR which are considered should only support the Rules or at least distinguish between that which is supporting the Rules and that which is an AEMO preference not necessarily supported by the present Rules.

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| 3. | Are there aspects of the key PFRR technical requirements that could benefit from further refinement? |

Response:

Section 3.2 remains problematic in the assigned rigidity of the same deadband application on every NEM Unit. It is likely some flexibility in deadband settings between Units is needed for better overall coordination. The PFRR Rules do not mandate that all Units carry the same deadband. The wording of section 3.2.2 remains not necessarily in accordance with the expectations of the Rule 4.4.2A(b)(1)(i) which defines that the PFRR "must include maximum allowable deadbands which must not be narrower than the *primary frequency control band*". It is suggested that in finalising the PFRR, AEMO consider some options for future tuning that might seek to vary from words that require every unit to be set "equal to the PFCB" as presently proposed. An alternative in support of better overall tuning of frequency control the NEM, could be conceived where, with agreement from affected GS and where easy to adjust, AEMO assigns a variety of slightly wider deadbands to distinct areas of the NEM.

Clarity of the expectations of PFRR technical requirements could also be improved by way of example technology attachments to the PFRR that present various best PFRR application examples from various technology sets deployed in the NEM including detailed breakdowns of how multiple controllers may be used to provide the total PFR response from a single unit.

### 3.4.2. Issue 2 – exemptions and variations

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| 4. | Are there any other matters that should be included as standing exemptions or variations? If yes, why? What are the expected impacts of including them, and of excluding them? |

Response:

The existing set could be enhanced by adding wording that connects point (a), (b), (d) and (e) to actions either automatic from installed controller reactions or manual by Unit operator actions.

Does point (j) need amending? Reading it completely in combination with the wording in the opening sentence can be interpreted to mean that a unit is never required to provide PFR ….. Should it be saying "beyond the limit…" rather than "to the limit …" or should the sentence include words to read something like "to observe the limit…" meaning the a GPS might contain permissives whereby PFR can be deselected so that specific GPS performance as approved can be met?

In general regarding possible variations, unit responses from units such as at Vales Point are more often reduced in overall PFR reaction rather than completely removed. The PFRR could perhaps explore by way of technology examples how aspects of the PFRR may be temporarily reduced, rather than completely withdrawn, by automatic or manual control reactions to secure a Unit and prevent interruption. Is it therefore correctly worded to say an "Affected GS will not be required to provide PFR" in such circumstances? Maybe better wording is to describe some limitations as representing PFR that has a reduced continuity of response or an early withdrawal of response due to certain conditions.

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| 5. | Are the proposed amended timeframes for addressing applications for exemption or variation appropriate? If not, what should they be? |

Response:

Considering the present frequency condition, the timeframes could be longer. Further MNBPFR implemented since 40% of first tranche implementation seems to have no noticeable improving effect suggesting urgency for further implementations does not exist. However, if the exemptions or variations are considered by AEMO, in consultation with the affected GS, to potentially pose significant causation on erraticism of frequency as being experienced in the local area of the affected GS, the length for considerations and response are perhaps too long and should be maintained as in the interim PFRR.

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| 6. | Is it appropriate that substantive changes to an Affected GS that is subject to variation or exemption result in a need to revisit the need for exemption or application? If not, why not? |

Response:

Any reneging of an existing exemption or variation is subject to the wording of the Rules and the interim PFRR. For future exemptions and variations, the proposed PFRR section 6.8 could apply once acceptable. The need to revisit probably depends on what is being altered and so a review of the PFRR capability of each unit may already be contained by inference via the Rule 5.3.9 and relevant AEMO processes for alterations. The PFRR may need only reference these other Rules and

instruments if at all needing a change on this point and, at the very least, a check and confirmation that the Rules on PFRR and other Rules permit AEMO to revisit any approved variation or exemption is recommended to be done prior to final determination of this aspect of the revision.

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| 7. | Are there any other issues AEMO should consider in the context of exemptions and variations? If yes, why? |

Response:

Some response is reduced rather than completely removed in some automatic unit responses. The PFRR could perhaps explore by way of technology examples how aspects of the PFRR may be temporarily reduced, rather than completely withdrawn, by automatic or manual control reactions to secure a Unit and prevent interruption.

### 3.4.3. Issue 3 – changes to Affected GS

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| 8. | Is it appropriate that AEMO should consider PFR settings to be dependent on the configuration of the Affected GS as at the date the PFR settings are approved? If not, why not? |

Response:

The PFRR Rules don't appear to support what AEMO is seeking as proposed in section 6.8. There are perhaps other Rules that could be referred to that may support revisiting the PFRR capability of a Unit. Without specific PFRR Rules that support the revisiting, AEMO should either seek to link section 6.8 to other Rules that potentially support it or otherwise omit it until a future Rule change can establish the requirement.

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| 9. | Are there any other issues AEMO should consider in the context of the longevity of PFR settings? If yes, why? |

Response:

The PFRR Rules don't appear to support what AEMO is seeking as proposed in section 6.8.

The urgency for participants to continually communicate with AEMO on changes to the PFFR capability is not present as mandatory PFR has produced narrowing of frequency.

The PFRR is only meant to define minimum expectations. Variations to plant response that remain above the minimum expected and above Generator Performance Standards may not need regular discussion between the participant and AEMO under the existing Rules. If additional Rules are required to support future frequency control efforts such as system tuning, then a new Rule change request appears to be needed.

### 3.4.4. Issue 4 – testing and demonstration of stability

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| 10. | Are there any other issues AEMO should consider in the context of tests and demonstration of plant stability? If yes, why? |

Response:

In the present condition, the 50mHz erraticism may on occasion impede effective determination of "stability". The PFRR stability expectations would be improved by including an AEMO viewpoint regarding the 50mHz variations which, as previously reported by AEMO, appeared to be accepting that the erraticism is uncontrollable. Providing comment on the erraticism condition in the PFRR, excusing reactions of Units to the erraticism where such reactions hinder a determination of stability, could be a worthwhile inclusion for AEMO to consider.

### 3.4.5. Issue 5 – demonstrating compliance with the PFRR

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| 11. | Are there any compliance issues AEMO should consider? If yes, why? |

Response:

A unit being considered compliant or non-compliant may become more difficult to demonstrate should erraticism being experienced over a 20-30s period become stronger (i.e. increased peak to peak amplitude). The PFRR would benefit from statements on the erraticism as being outside of the capability of PFR to control.

### 3.4.6. Issue 6 – clarification of relationship between PFR and MASS

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| 12. | Are there any other sections in the PFRR that should be cross-referred to the MASS? If yes, why? |

Response:

Linking to the MASS in appropriate ways that align with the Rules to clarify expectations of either the MASS or the PFR is supported but ambiguous descriptions that vary in interpretation from that made from the Rules wording, or the intent of the Rules as described in determinations that supported the relevant Rule, are to be avoided.

Clarifying whether dispatch instructions, where mentioned, is meant to be referring to energy and/or FCAS dispatch, is considered necessary at various places throughout the PFRR.

### 3.4.7. Issue 7 – other drafting and technical considerations

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| 13. | Are there any other sections AEMO should redraft? If yes, why? |

Response:

Section 2.2 is not complete in the sense that it only describes the obligation on stored energy which is, from some interpretations, only relevant to a raise response. Under the Rule as determined and explained by the AEMC in its determination, the expectation was that it applies equally to the headroom available on a unit to move in raising support rather than simply stored energy that may preserve energy to deliver rapid raise support. Some Units cannot provide a rapid PFR raise response unless there is storage provision maintained in the prime-moving energy to do so and the PFR Rule 4.4.2A(c) is meant to ensure participants are excused from needing to store energy (or headroom as the AEMC explained in the determination) to provide PFR. Similarly, but apparently outside the Rule as drafted, in the transitioning market, conventional steam fired units are regularly experiencing operations to low loads below levels where the Unit can sustain a lower PFR reaction

and some newer units won't move at all when operated at a low load limit. Excuse from a PFR lowering reaction due to a lack of "footroom", as is considered to be permitted via other Rules on expected performance standards, is not adequately explained in the interim PFRR or the proposed PFRR, except perhaps implied in the standing variations.

Every clause of the PFRR should refer to the relevant Rule it is generated from by including the Rule reference in brackets after the title of each section of the PFRR. The wording of the PFRR clauses should pay very close attention to the Rules and not provide details not supported by relevant Rules nor vary from the intentions of the Rules as documented in the determination reports that produced the Rule. Providing requirements or procedural steps that have no Rules basis but appear necessary in support of PFR delivery should be clearly separated from clauses designed from Rules directed requirements. Clauses without a clear Rules basis should only be included with reasoning that proves the necessity for them, and if the necessity is not provable, the requirement should be removed or reduced to being a suggestion by AEMO as to how participants may proceed in order to comply with definitive clauses that are based on the Rules.

### 3.4.8. Issue 8 – provision of PFR in conjunction with energy dispatch

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| 14. | Do you agree that there is no need for further changes to the PFRR arising from the clarification in NER 4.4.2(c1)? |

Response:

The section 4.3 should actually refer to the Rule to clarify the expectations.

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| 15. | Is there anything else AEMO should consider in the context of the application of PFR to BESS? If yes, why? |

Response:

PFR is not required on a BESS when charging as described by the Rules. The document defines what PFR "requirements" are which should not go beyond what the Rules mandate. The wording proposed for 4.3 is not helpful in describing that Units can optionally provide additional services to the that required by the Rules. The optional requirements can be asked for by AEMO but the options for participants to do so does not need to be written in the PFRR which should only describe what the Rules require.