Mr Charles Popple
Chair, Reliability Panel
Attention Ben Hiron
c/- Australian Energy Market Commission
PO Box A2449
SYDNEY SOUTH NSW 1235

(Lodged electronically via AEMC/RP website) **9 June 2022**

Review of the Frequency Operating Standard (Ref. REL0084)
Issues Paper 28 April 2022

Delta Electricity operates the Vales Point power station situated 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 respond to the questions raised in the issues paper.

Delta Electricity has been an active participant in performance monitoring, consultation and market reforms regarding frequency control in recent years. In 2017, Delta Electricity and other generators alerted AEMO to deterioration in frequency performance. In these interactions, the reluctance and caution apparent in the operator taking steps to use and adjust existing controls, whilst partly understandable, suggested inadequacy in the existing standard in the viewpoint of the operator, or a lack of confidence in the standard that the previous operator, NEMMCO, had advocated for in 2001. The hesitation to adjust was reportedly due to expectations that adjustments would either not work and/or would lead to increased costs to the market if it resulted in the dispatch of more FCAS. Adjustments such as increasing volumes procured for effective Regulation FCAS dispatch, which when eventually implemented in 2019 did demonstrably tighten frequency distribution, and reviews of load relief assumptions, that had apparently not been reviewed in fifteen years of market operation, ought to be more regularly examined and adjusted by the operator where data presents a necessity to do so.

The hesitancy and the eventual request for mandatory controls by the operator highlights a possible weak link in the rules between the intent of the frequency operating standard and actions, subject to current Rules, to effect overall adequate control of the system frequency. If existing Rules are appropriate, the wording of the standard could be altered to highlight the importance of the Standards and ensure that all necessary actions, as determined from adequate monitoring, reporting and documented control adjustments, are deployed to maintain the standard.

The review of the standard might need to consider recommending or making a change in the rules. Adjustments available to the operator under the current rules ought to have been pursued in full and, following full deployment, factually demonstrated by way of trended conditions over several reporting quarters, as being ineffectual in meeting the standard before any Rule change was proposed. This should particularly be the case for rule changes which mandated controls. Despite operator and third party theoretical viewpoints that mandatory controls do not cost supplying participants, in reality they do. On most existing plants, frequency control is interconnected with energy storage prepared for FCAS services and that storage is now utilised more readily by Mandatory PFR than the present FOS requires, with real fuel costs albeit in smaller amounts but in greater total volumes than previously. It is of course true that wider variations in frequency as was occurring prior to Mandatory PFR is costly in other ways.

Since 2017, market participants have collaboratively developed rule changes and controls that have tightened the overall frequency distribution range. From a quick observation of recorded performance information from a single NEM location, the inefficiency of mandated controls ought now be obvious to all and the evidence included in re-evaluations taking place for this review. The assigned PFCB range may have been considered necessary in estimations prior to implementation but is demonstrably questionable from the following local observations:

1. October 2020 to January 2021 improvement from mandatory narrow band PFR from only 40% implementation in first tranche generators (0% in 2nd and 3rd tranches) is very apparent;

2. No observable improvement in the frequency distribution has taken place since that time (January 2021 to May 2022);

3. The evidence from a count of events occurring outside the present NOFB is that Mandatory PFR is delivering overall frequency distribution tighter than that of 2011/12 (and probably earlier) when previously frequency control was considered adequate; and

4. There remains a regular and rapid variation in frequency, 50mHz amplitude at a 28s period, not checked by regulation FCAS or mandatory PFR, which has been observed in locally recorded and consistently evaluated frequency traces as far back as 2007 but is not considered to have existed prior to the commencement of the NEM.

Delta Electricity considers these observations represent critical points that the Reliability Panel should examine closely in determining a revised standard and particularly in reference to any new considerations regarding a quality of the frequency. Should the Reliability Panel support reasoning for the PFCB as defined presently in AEMOs PFRR, adequate evaluation and demonstration in the final determination, considering viewpoints of all NEM participants as to that necessity, is recommended.

Purpose of the Standard

The Standard should define and seek to balance objectives of technical excellence with economic value of the control. Whether or not the standard drives AEMO unilateral determinations of quantities necessary in FCAS markets, assumptions it makes for load relief and PFR, and the reactions of all NEM systems to AEMOs dispatch instructions and expectations, and whether it achieves a tight 15mHz distribution or a loose 150mHz distribution should be reexamined on the basis of the purpose of the band and the consequence of wider bands (or ineffective deployment of controlling adjustment). The expected impacts on both the market and electrical equipment from the extremes of frequency should be clearly re-examined and documented in the final determination to underpin why the standard is determined to be what it is. It is not readily apparent that the looser quality existing prior to September 2020, although clearly observed and accepted by most participants as causing operational issues, warrants the frequency deadbands currently deployed in AEMOs existing primary frequency response requirements (PFRR) 15mHz primary frequency control band.

The observable 50mHz p-p variation that continues to exist despite the primary frequency control band (PFCB) of mandatory PFR, suggests other forms of control adjustment and controlling band(s) may be required. For example, is it possible that the sustained variations of 50mHz amplitude are the result of interactions between new and old technology? If this is the case, when coupled with the projected decline in inertia and system strength, such variations could soon pose more dominating larger amplitude impacts. If unchecked, large rapid oscillatory frequency variations could cause damage and long duration downtime to the remaining synchronous fleet of machines. AEMO are already obligated by rules to adequately control system frequency and could (or should) be more active with overall coordination efforts to reduce the present 50mHz variations. It is hoped that this review of the standard can develop new performance criteria to address this and other possible emerging conditions.

In reviewing the standard, the AEMC Reliability Panel is challenged to find the optimum values for the existing bands of the standard, incorporate any new bands such as the PFCB, as may be proposed by the operator, and, importantly, will consider the interacting economic and engineering impacts to find the right balance in determining the boundary values applied to each band. Overly tight bands cause more “mileage” for controllers subsequently impacting wear and tear not immediately economically apparent to the market. Looser bands cause less “mileage” but the changes occur over a wider range of frequency and cause larger individual corrections. At the end of the day in the monitoring of

performance, a check of a reliable high speed recorded trace of frequency demonstrates easily to anyone whether that balance is being achieved and, therefore directly demonstrates the effectiveness of overall control. For example, a current examination of 4s data will demonstrate that although the AEMOs IPFRR PFCB is +-15mHz, in any one day, the 4s samples of frequency are outside this range more than 50% of the time meaning controllers are active and controlling frequency continuously with resultant wear and tear impacts.

Regarding the consideration of RoCoF for the standard, it is not easy to have such a standard imposed upon existing plant not adequately specified to operate for a particular standard and a wide setting assigned without knowledge as to the impacts upon existing plant might encourage the wrong outcomes should it be eventually realised that an assigned band was too wide to avoid damaging equipment. It is probably best to be set by examining the conditions during particular events and comparing the worst case conditions to the general trend of RoCoF in non-contingent conditions. In providing some guidance of the general trend, a chart of conditions is provided in Attachment 2 which arguably demonstrates a slow increase RoCoF in normal operation has been occurring over the last decade and a half.

Balance the Engineering and Economic Reasoning

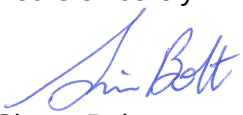
The original NEM had a +-50mHz NOFB, which NEMMCO successfully proposed to widen to +-150mHz in 2001. The reliability panel is encouraged to revisit the previous 2001 determination, recreate engineering reasonings and rational behind why the standard was widened then, review and adopt key engineering parameters of importance to the proposed standard to be determined and also strengthen the meaning of the standard, and the interrelated operator unilateral decisions that impact on overall control, to ensure the standard is the respected reference that it should be, from which, no reasoning as to why the standard is not being met should be apparent other than an operator has miscalculated the quantities required to effect control, procured insufficient services and/or providers have not adequately provided mandated or procured services.

It is also true though that the National Electricity Objective would not be achieved by skyrocketing overall FCAS prices and costs, inadequate frequency control from a widening dysfunction due to falling inertia, system strength or inadequate adherence to frequency control dispatch. Therefore, it is probable that the AEMO conceived PFCB has a place but perhaps not at 15mHz which probably represents a value too close to the probably error in the present breadth of NEM systems of frequency control.

The following pages provide a table of comments to the Reliability Panel's specific questions included in the issues paper.

If the AEMC wishes to discuss this submission please contact Simon Bolt on (02) 4352 6315 or simon.bolt@de.com.au.

Yours sincerely



Simon Bolt
Marketing/Technical Compliance

Attachments

1. RELIABILITY PANEL'S TOPICS OF INTEREST – Delta Electricity responses
2. Charts of relevance as maintained by Delta Electricity using Vales Point recorders

ATTACHMENT 1 – RELIABILITY PANEL'S TOPICS OF INTEREST – Delta Electricity responses

	Reliability Panel Question	**Delta Electricity Comments**
QUESTION 1: **DEFINING THE REQUIREMENT FOR FREQUENCY PERFORMANCE DURING NORMAL OPERATION**		
•	What considerations should be taken into account when defining the target for frequency performance during normal operation?	During normal operations, accurate high-speed traces of frequency are themselves representative of frequency control performance; i.e. performance of frequency and the operator's overall control. Frequency can be appear steady over the long term (5 minute to 5 minute) but contain regular variations in the shorter term (20s to 20s) and also in the very short term 2s to 2s. The standard may require definitive tuning actions for each timeframe. The wider time performance seems to have been controlled for many years by FCAS regulation and improved in recent years by less than 40% system dispatch of mandatory PFR. Nothing seems to be addressing the shorter and very short-term variations which may reflect inadequacy of controls or AEMO's AGC to Unit tuning effort. (see chart of high speed data in the attachment 2 comparing 2006 and 2022 over a 20-30s period)
•	What are stakeholders' views on the potential options for refining the target for frequency performance during normal operation?	In a market environment, efficiency is best achieved if only the right amount of control is deployed and deployment of control inside the margins of error in measurement of speed or frequency is dysfunctional and could be more damaging that it is effective in controlling. In the longer term, the transitioning technologies need clear signals to meet to ensure that all generation and all electrical loads are protected from the extremes of frequency that might damage them. Refining the targets to ensure outcomes that avoid damaging equipment and/or avoid increasing

	Reliability Panel Question	Delta Electricity Comments
		unserved energy periods are appropriate. Assigning targets that do much more than this would be an inefficient assignment.
•	Are there any regionally specific issues that should be taken into consideration when setting requirements in the FOS for normal operation?	Continuous readiness by the operator, when required by a contingent or multiple contingency event, to rapidly adjust and assign regional FCAS dispatch seems to be a required outcome from previous experiences.
•	What stakeholders' views on the costs and benefits to generators associated with power system frequency being held more closely to 50 Hz during normal operation?	The constant adjustments made by PFR reactions has a cost on all systems. To conventional and modern rotating intermittent plants it is increased mileage of controlling equipment with predictable increased wear and tear defects and routine maintenance needs. To static plants (like inverters and batteries) it will be ageing equipment faster than would be the case if left to a wider variation. Whilst it is true, in theory, that a tightly held 50Hz level would minimise overall frequency reactions and therefore lower costs, in practice post mandatory PFR implementation is not delivering frequency tightly held to the PFCB, a smaller quantity of PFR would do as well as mandated PFR and it may not be possible to get tight 50Hz adherence without other controls and/or tuning adjustments, in which case the mandatory PFR control is demonstrably inefficient and causing increased cost if the PFCB is not set wider than the shorter term variations mandatory PFR is not effectively controlling.
•	What are stakeholders' views on the system wide costs and benefits of specifying that system frequency should be held more closely to 50 Hz, as proposed by AEMO?	In terms of overall system control, the width of the system frequency band will have proportionally squared impact on the overall accuracy of calculations and adjustments in system wide equations as the equations will be based on system frequency affecting impedance calculations that may

	Reliability Panel Question	Delta Electricity Comments
		assume being 50Hz +- x%. The larger x becomes, the more inaccurate the equations become increasing the likelihood of unexpected reactions and larger impact from contingency events. However, at wider frequency widths much wider than the PFCB and even the NOFB, real costs would eventually appear in the form of statistical increase in breakdowns of equipment of all participants and users of electricity. The concept of a PFCB seemed as applied in AEMOs PFRR seemed to focus on finding ways to effect Frequency Control avoiding FCAS procurement costs for services that support the existing NOFB. However, in practice at present, Mandatory PFR utilises the same mechanisms and preserved reserves that are stored in readiness to deliver 6s FCAS to support the NOFB and therefore utilises 6s FCAS reserves at a PFCB deadband even though the reserve energy is not required under the PFRR. This utilisation is inappropriate, because it is not what procured 6s FCAS reserves are for and the controllers can't easily distinguish between PFR or FCAS purposes.
QUESTION 2: **THE PRIMARY FREQUENCY CONTROL BAND**		
•	What considerations should the Panel have in relation to the setting of the PFCB?	A/ The engineering reasoning for the deadband based on factual evidence of frequency conditions and impacts: 1. Observable improvement from mandatory narrow band PFR was achieved from only 40% implementation in first tranche generators; 2. No observable improvement in the frequency distribution above 40% 1st Tranche implementation;

	Reliability Panel Question	Delta Electricity Comments
		3. Numbers of events sending frequency outside the present NOFB is fewer than 2011/12 (and probably earlier); and 4. A regular 50mHz amplitude at a 28s period variation continues. What reasoning supports the PFCB being inside a variation it is not controlling or reducing? 5. What are the documented variation limits for most electrical equipment to continue to operate safely? (Charts in the Attachment 2 support details mentioned in items 1 to 4) B/ The purpose of it in the overall fleet of all control mechanisms (FCAS Regulation, AEMO FCAS dispatch quantity estimations, AEMO load relief assumptions, AEMO AGC operation and choice of 4s control, AEMO Time error correction) and the possible use for it as a wider band safety net reaction set at +-500mHz that will arrest Units and loads prior to UFLS or OFGS.
•	What are stakeholders' views on the setting of the PFCB?	The AEMO PFRR PFCB seems to have been an assignment based on control theory and a resultant belief that as tight a possible deadband on all machines will provide a continuous small recovery assistance. The following points highlight some issues with this assignment and the viewpoint: 1. mechanical governors, which reportedly have zero deadband, actually have, due to mechanical hysteresis, variable deadband ranging from 0

	Reliability Panel Question	Delta Electricity Comments
		to 100mHz. Assigning PFCB tighter than 100mHz is uncoordinated if governor reactions and secondary reactions in the Unit controller are not engaged in a similar fashion. Prior to the NEM 50mHz was the previous NSW deadband on the equivalent frequency bias controllers probably because this was the most effective coordination for the NSW system and NSW frequency was steadier (i.e no 50mHz variations) than the current system albeit at a wider overall normal operating frequency band of 49.9 to 50.1Hz. 2. Mandatory PFR at the PFCB assigned by AEMO has not addressed a 50mHz variations that exist. 3. The operator and the standard remain quiet on how participants measure frequency so that it is consistently and transparently observed. Generally during steady conditions in a strong system, frequency should be similar and comparable in all parts of the system. Without an assigned commonality of the measurement, it is unlikely that participants can discuss conditions with precision and it is unlikely that control systems will coordinate if they are not reacting to comparable and consistent source information. 4. 1,2 and 3 suggest to Delta Electricity that a NEM coordination effort might be required that includes for progressive widening of AEMOs PFCB to find the most optimal point that minimizes the observed variations not addressed the AEMO IPFRR and the PFCB it defined. Such an approach is not unlike how frequency bias deadbands were set prior to the NEM.

	Reliability Panel Question	Delta Electricity Comments
•	Are there any regionally specific issues that should be taken into consideration when setting for the PFCB?	All controls of nearby generators should be sensitively tuned by coordinated AEMO approach under the premise of Rule 4.4.1a) to find the most appropriate settings that delivers best overall performance rather than be a mandated minimum that could actually be causing performance issues. If the PFCB was set to provide Mandatory PFR at a wide band and controllers were required to be designed and implemented to react decoupled from an energy dispatch target, Generation would perhaps assist better at curtailing events such as 28 January 2020's sustained (50minutes) high frequency condition that was caused by an incorrect demand feed to the AEMO dispatch engine. In that event, the sustained nature of the high frequency and automatic dispatch reactions to off targets consistently produced AGC dispatch targets above FCAS adjusted actual output at a time when frequency was at a sustained 50.3Hz despite the delivery of all FCAS services. The ramp up directives from the AGC are problematic in such circumstances and a Mandatory wide-band PFR reaction, if considered, should also consider the need to override erroneous AGC dispatch allowing the overall reaction to arrest frequency faster than 50minutes. Such a design would also assist regional recovery when regional interconnectors are interrupted.
•	What are stakeholders' views on the potential implementation costs associated with changing the PFCB?	There would be minimal issues assuming a wider band was considered for existing controller designs. However, if being considered, a much wider band could, if decoupled from Unit setpoints in all participants, also achieve more effective frequency control when sustained conditions occur. (The 28 January 2020 1730 to 1835

	Reliability Panel Question	Delta Electricity Comments
		high frequency event in NSW is a case worth reviewing by the Panel in considering other areas of inadequacy in frequency control.)
•	What are stakeholders' views on the costs and potential savings of the PFCB being set at a narrow, moderate or wide setting, as described above?	Wide band could act as a more effective pre-protection controller backing up FCAS delivery and preceeding load or generator shedding. (see above comments) A moderate band may provide a better tuning result for overall coordination between primary and secondary controls. Narrow band reportedly reduces the larger reactions required because of the greater number of smaller reactions. However, the smaller reactions occur continuously and, without analysis and testing of the coordination between plants, worsens overall coordination and ages controlling equipment for no real benefit. A narrow band seems theoretically favoured but if practically implemented inside the error of some measurement systems, is dysfunctional and could lead to damage from continuous and uncoordinated reactions and counter-reactions between unit controllers.
QUESTION 3: **DEFINING A SYSTEM STANDARD FOR ROCOF**		
•	What should be taken into account in setting system limits for RoCoF?	Historical levels during extreme events and the general trend of system. See attached for some records from 2007 to 2022 for the general trend. Plant capability of existing equipment not previously specified for RoCoF is another consideration. Larger RoCoFs may be possible when all large conventional systems have retired or are reduced to the minority but this will need careful monitoring.

<table>
<tr><th></th><th>Reliability Panel Question</th><th>Delta Electricity Comments</th></tr>
<tr><td>•</td><td>If the Panel chose to set a RoCoF standard, what format should it take?</td><td>The calculation of RoCoF (and the specifications on the frequency value it is sourced from) should be examined first and the format for RoCoF determined by considering the best available RoCoF producible from the raw inputs. The time frames over which RoCoF is to be determined is essential to identify e.g. +- 4mHz/s change in any 4s sample, or should we evaluate variations over faster period and average also over the 5 minute interval?</td></tr>
<tr><td>•</td><td>If the Panel chose to set a RoCoF standard, what factors should be taken into consideration?</td><td>Grandfathering equipment that may not be able to meet the standard. The impact on the NEM from the assigned standard in terms of ancillary service dispatch.</td></tr>
<tr><td>•</td><td>Would the establishment of the RoCoF standard burden stakeholders with significant adherence costs?</td><td>Potentially if the result of the standard led to an AEMO requirement to establish RoCoF capability standards on existing plant which may require the development or revision of capability documents and testing to prove resilience of plant to a proposed standard.</td></tr>
<tr><td colspan="3">QUESTION 4: THE FREQUENCY BANDS FOR CREDIBLE CONTINGENCY EVENTS</td></tr>
<tr><td>•</td><td>What are stakeholders’ views on the appropriateness of the existing settings in the FOS for the recovery of the power system following credible contingency events?</td><td>A check of the recorded data is worthwhile to review to form a viewpoint. Delta Electricity maintains some data as shown below:
<table>
<tr><th>Year</th><th>Number of Events (>0.15Hz deviations as detected at Vales Point)</th><th>Events >0.2Hz (typically contingent events)</th><th>Time outside NOFB (including all events) (%)</th><th>Events >0.2Hz returning to NOFB < 5min (% of events)</th></tr>
<tr><td>11/12</td><td>71</td><td>19</td><td>0.033 %</td><td>63%</td></tr>
<tr><td>12/13</td><td>91</td><td>34</td><td>0.032 %</td><td>79%</td></tr>
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<tr><th></th><th>Reliability Panel Question</th><th>Delta Electricity Comments</th></tr>
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<tr><td>13/14</td><td>84</td><td>18</td><td>0.020 %</td><td>94%</td></tr>
<tr><td>14/15</td><td>309</td><td>34</td><td>0.078 %</td><td>71%</td></tr>
<tr><td>15/16</td><td>872</td><td>61</td><td>0.237 %</td><td>77%</td></tr>
<tr><td>16/17</td><td>3600</td><td>118</td><td>0.849%</td><td>60%</td></tr>
<tr><td>17/18</td><td>10512</td><td>203</td><td>0.557%</td><td>62%</td></tr>
<tr><td>18/19</td><td>15800</td><td>263</td><td>0.766%</td><td>76%</td></tr>
<tr><td>19/20</td><td>10386</td><td>179</td><td>0.474%</td><td>78%</td></tr>
<tr><td>20/21</td><td>1831</td><td>46</td><td>0.089%</td><td>74%</td></tr>
<tr><td>21/22</td><td>15
(at 31Mar22)</td><td>4</td><td>0.0022%</td><td>100%</td></tr>
</table>
The data above which includes contingency event time in comparisons to the 99percentile NOFB, suggests that the time outside the NOFB is now well inside the standard but was close to breaching the standard in 16/17 and in certain months of 18/19 and 19/20 did breach the standard. Recovery time post contingency events was always challenged prior to Mandatory PFR but recovery times are now typically less than 30s suggesting a possible aspect that could be considered in any relaxation of the PFCB in targeting whatever band might maintain the present FOS NOFB expectations and still meet the Contingency event recovery expectations without overly operating inside either.</td></tr>
<tr><td>•</td><td>What are the implications for the FOS as a consequence of the revised contingency framework established under the Enhancing operational resilience in relation to indistinct events rule?</td><td>No comment.</td></tr>
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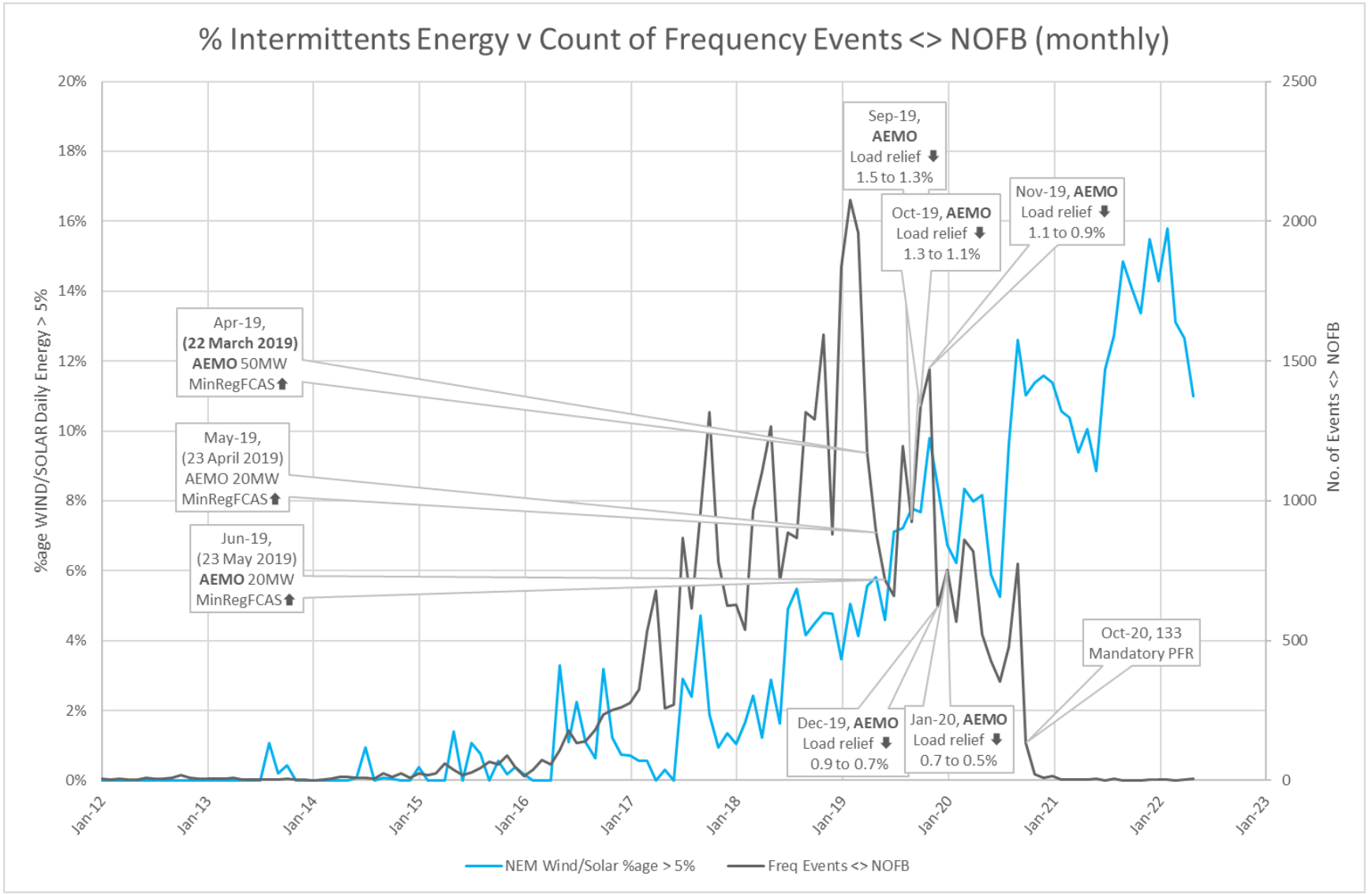
	Reliability Panel Question	Delta Electricity Comments
•	What opportunities exist to amend the FOS to help address the increasing operational risks identified by AEMO through the Engineering framework?	No comment.
•	Are there any regionally specific issues that should be taken into account when considering the requirements in the FOS that relate to credible contingency events?	The more difficult conditions experienced have occurred after interconnector interruptions separating regions from FCAS services provided for in another region. Regional FCAS safety nets or guidance in the standard about the speed of revised FCAS considerations after interconnector interruption and regional separation events might provide the right signal to AEMO on changes in procurement decisions.
•	What are stakeholders' views on the appropriateness of the operational frequency tolerance band for supply scarcity (48.0 – 52.0 Hz) and any cost impacts for the connection of new generators?	The conditions have not been experienced in recent mainland history but that shouldn't be used to argue for narrower capability in new generators. However, the bulk of the existing fleet of large NSW turbines at Coal fired power stations already have limited life (20minutes total life) for operation in range 51.5 to 52Hz so it is also fortunate that conditions have not occurred in that range.
QUESTION 5: **THE FREQUENCY BANDS FOR NON-CREDIBLE CONTINGENCY EVENTS**		
•	What are stakeholders' views on the appropriateness of the existing requirements in the FOS for the management of protected events?	See below.
•	What are stakeholders' views on the appropriateness of the existing requirements in the FOS for the management of non-	A multiple contingency event (or protected event) that permits 51.5Hz for 2 minutes (or more due to only reasonable endeavours) seriously risks a long term unserved energy condition in NSW (and possibly NEM-wide). Low

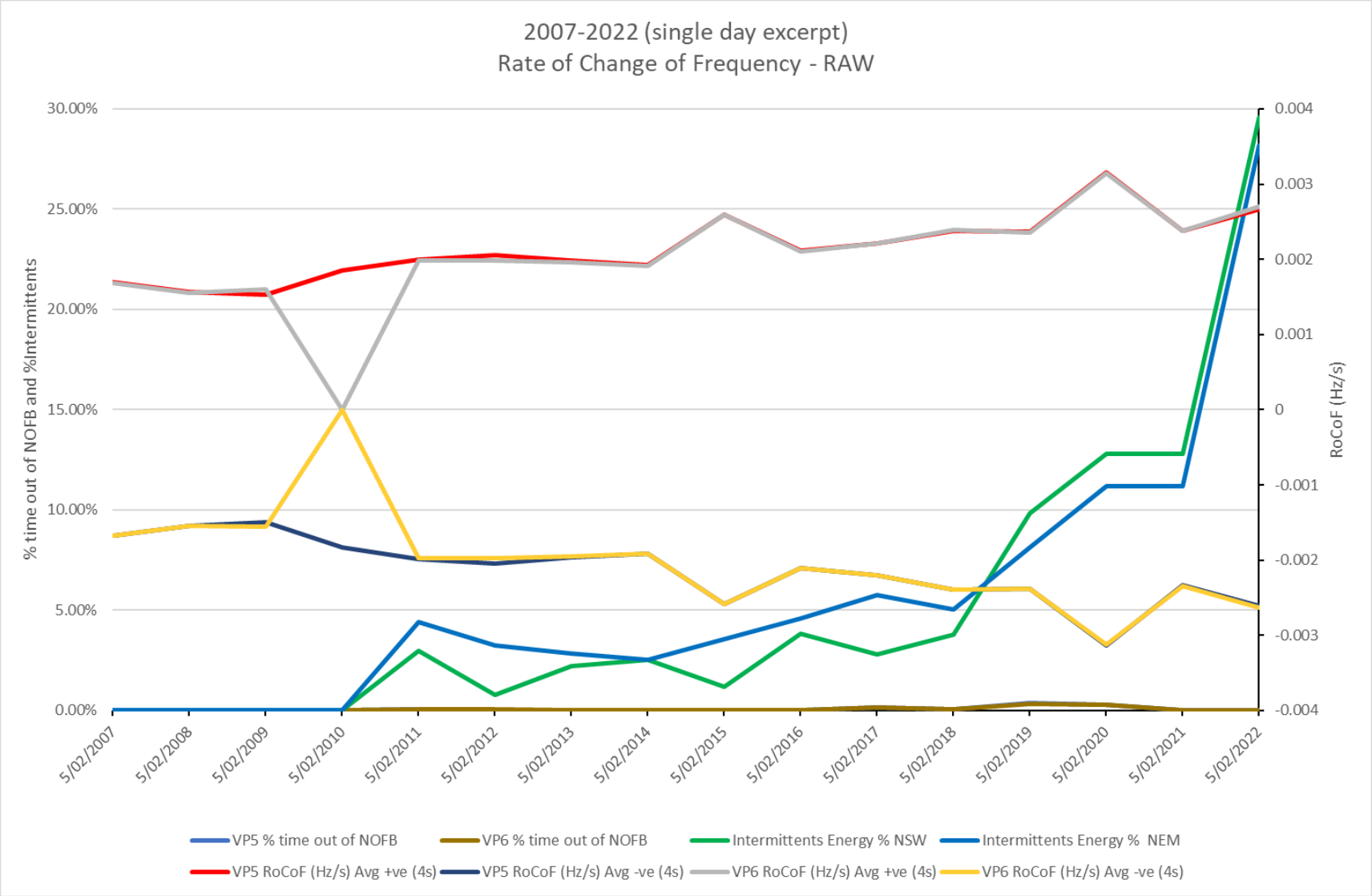
	Reliability Panel Question	Delta Electricity Comments
	credible contingency events, that are not declared as protected events?	pressure cylinders in steam turbines have long blades that experience severe harmonic bending moments when operated between 51.5 and 52Hz. (NSW turbine manufacturers suggest only 20minutes of life exists for such conditions). It is suggested the upper range be considered to be lowered from 52 to 51.5Hz permitting such turbines to be tripped above 51.5Hz.
•	Is there a need for the FOS to further clarify the expectations of the operation of the power system following a non-contingency event?	Reasonable endeavours can apply to reactions from operators to adjust to the conditions but should not apply to general decisions made governing overall dispatch that can help manage the risk of such conditions occurring. Such decisions are expected to be made well in advance of day-to-day conditions and required clear targets in the FOS inclusive of any conservative engineering buffer to ensure the limits are meaningful for use in system operation. It should be normal to see the operation of the system reach the extremities of the limits of the standard and abnormal for some arbitrary level well inside those limits to be unilaterally considered normal by the operator.
•	Are there any regionally specific issues that should be taken into account when considering the treatment of non-credible contingencies in the FOS?	The more difficult conditions experienced have occurred after interconnector interruptions separating regions from FCAS services provided for in another region. Regional FCAS safety nets or guidance in the standard about the speed of revised FCAS considerations after interconnector interruption and regional separation events might provide the right signal to AEMO on changes in procurement decisions.
QUESTION 6: **MAXIMUM CONTINGENCY SIZE IN TASMANIA**		

	Reliability Panel Question	Delta Electricity Comments
•	What are stakeholders' views on the appropriateness of the current limit in the FOS for the largest allowable generation event in Tasmania?	No comment.
•	What are stakeholders' views on whether the limit on the maximum allowable generation event should be extended to cover other credible contingency events, including load and network events?	No comment.
QUESTION 7: **MAXIMUM CONTINGENCY SIZE IN THE MAINLAND NEM**		
•	Do stakeholders consider it beneficial to introduce a fixed generation limit in the mainland NEM? If so, how should the limit be set?	A limit that discourages construction of large generators is not considered to be beneficial. If limits were set they need to include considerations for interconnector interruption and apparent rooftop solar interruption (en masse) amongst the total size of any one event. As a large interruption can induce the inverter dropouts in the DER fleet, the preparation for such reactions in the calculations of any limit (and in fact in the FCAS procurement) is essential to ensure no tendency exists to reduce a limit (and ensure large enough quantity of reserves are being prepared).
•	Would the introduction of a limit incur significant costs on AEMO to maintain system security?	No comment.
•	Would the introduction affect the investment or operational decisions of stakeholders?	If the limit leads to a size restriction on new plants then it would affect the investment and/or operational decisions.

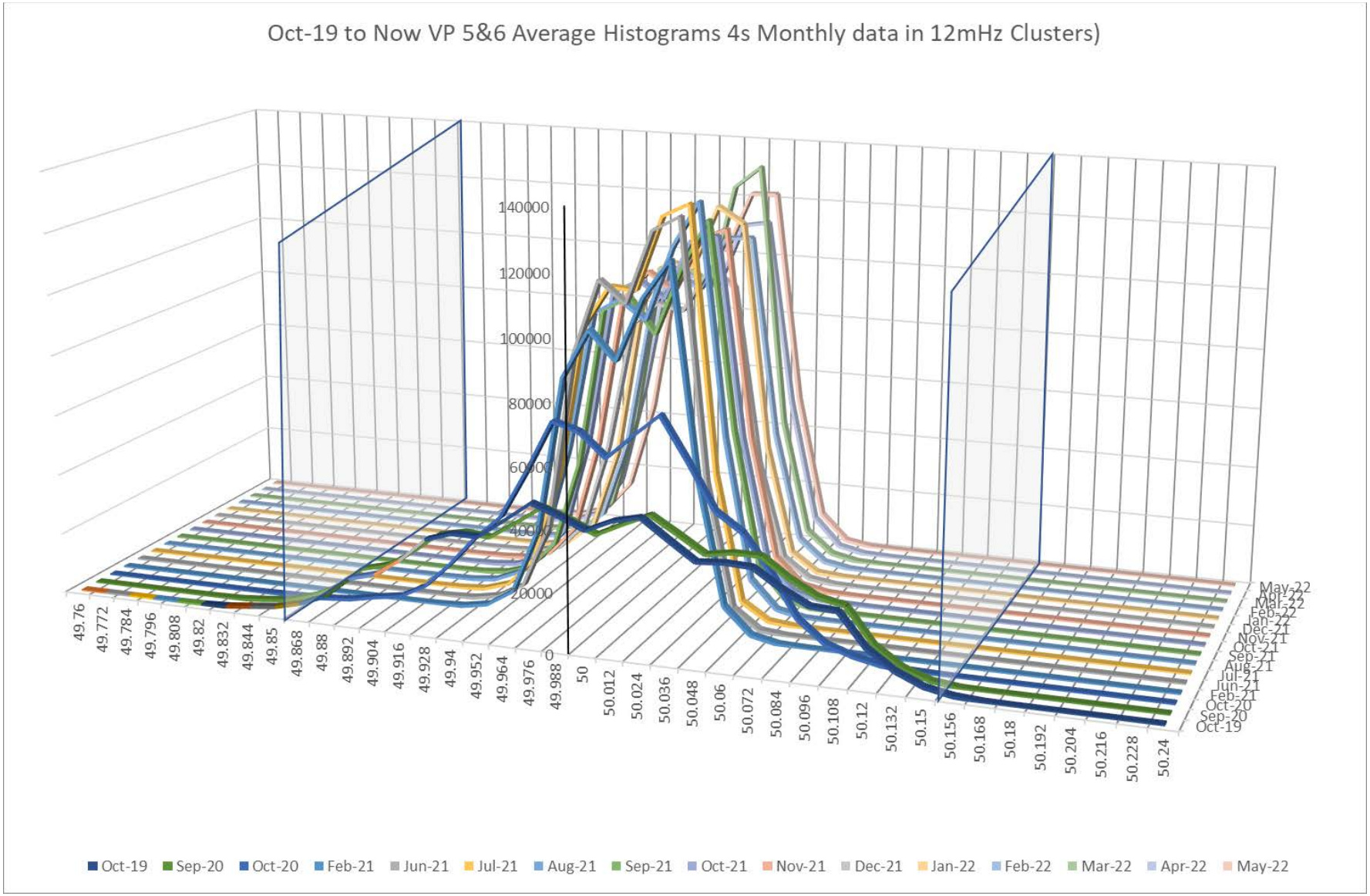
	Reliability Panel Question	Delta Electricity Comments
QUESTION 8: **ACCUMULATED TIME ERROR IN THE NEM AND TASMANIA**		
•	What consequences or costs may arise from the relaxation or removal of the accumulated time error requirement from the FOS for the mainland NEM and for Tasmania?	If FCAS regulation dispatch quantities are presently considering the time-error correction requirements, it is possible that relaxation might lower the quantities of FCAS regulation in dispatch and this is not expected to have a positive impact on NOFB frequency experience. Regulation FACS and mandatory PFR (along with 6s FCAS reserves) are what has provided the recent narrowing improvement in the frequency distribution.
•	What cost do stakeholders incur, if any, of maintaining compliance with the current accumulated time error requirement?	No comment.
•	Are there any other comments or concerns that stakeholders wish to raise with the Panel in relation to accumulated time error?	No comment.

Attachment 2





RoCoF measured from daily 4s frequency data showing the slow upward trend over 15 years (only single day comparisons)


Oct-19 to Now VP 5&6 Average Histograms 4s Monthly data in 12mHz Clusters)
140000
120000
100000
80000
60000
40000
20000
0
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49.772
49.784
49.796
49.808
49.82
49.832
49.844
49.85
49.868
49.88
49.892
49.904
49.916
49.928
49.94
49.952
49.964
49.976
49.988
50
50.012
50.024
50.036
50.048
50.06
50.072
50.084
50.096
50.108
50.12
50.132
50.15
50.156
50.168
50.18
50.192
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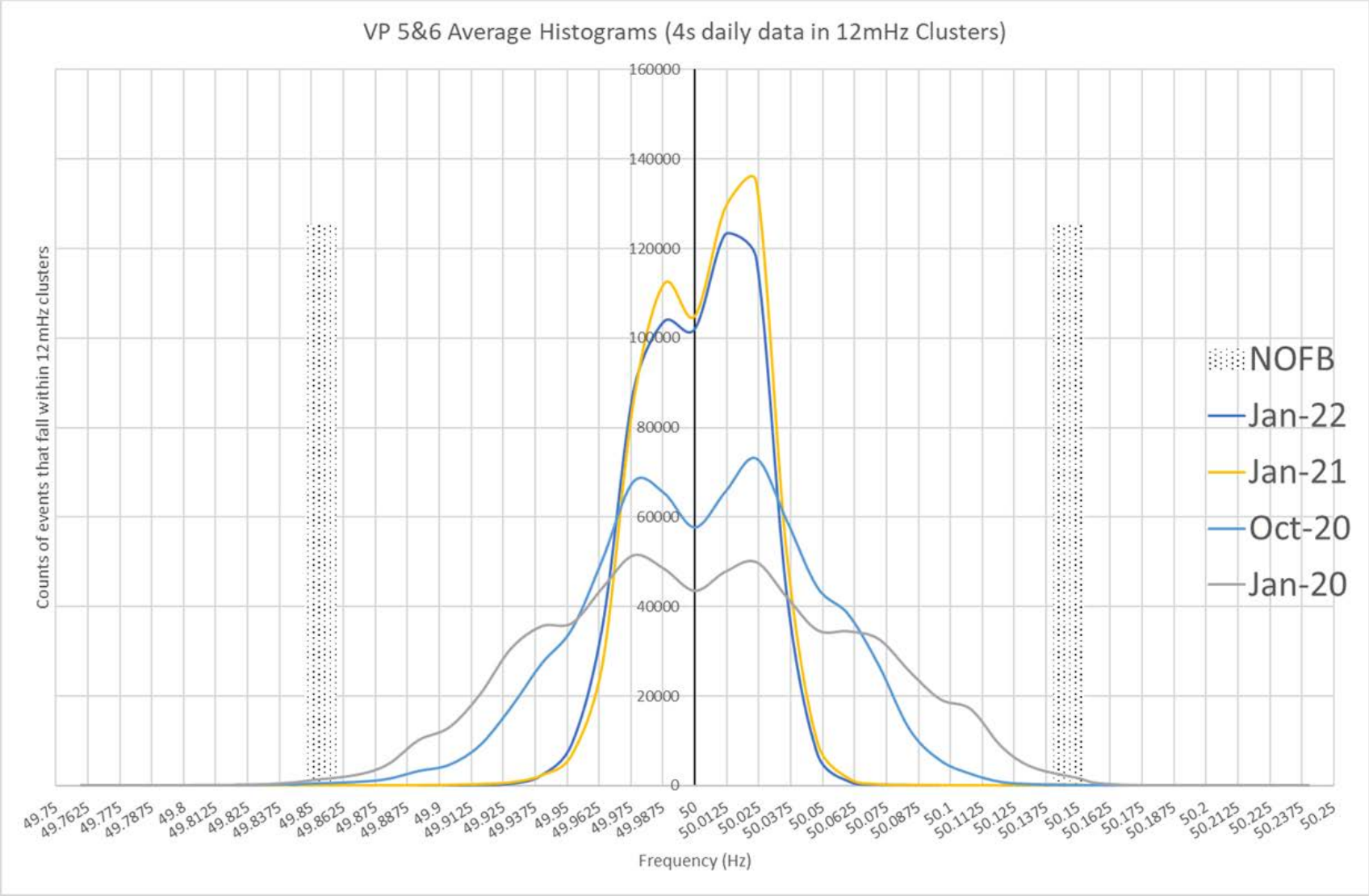
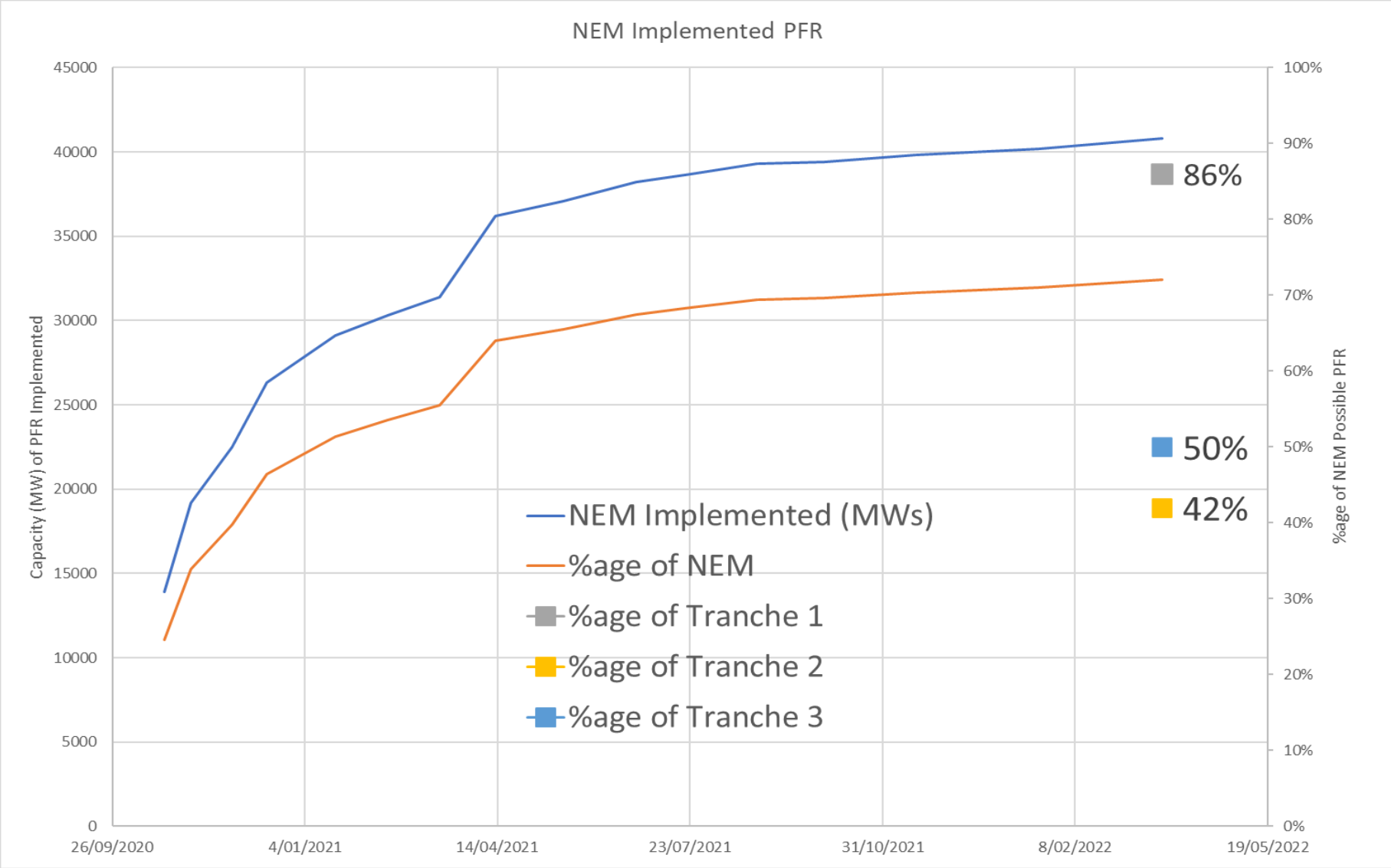
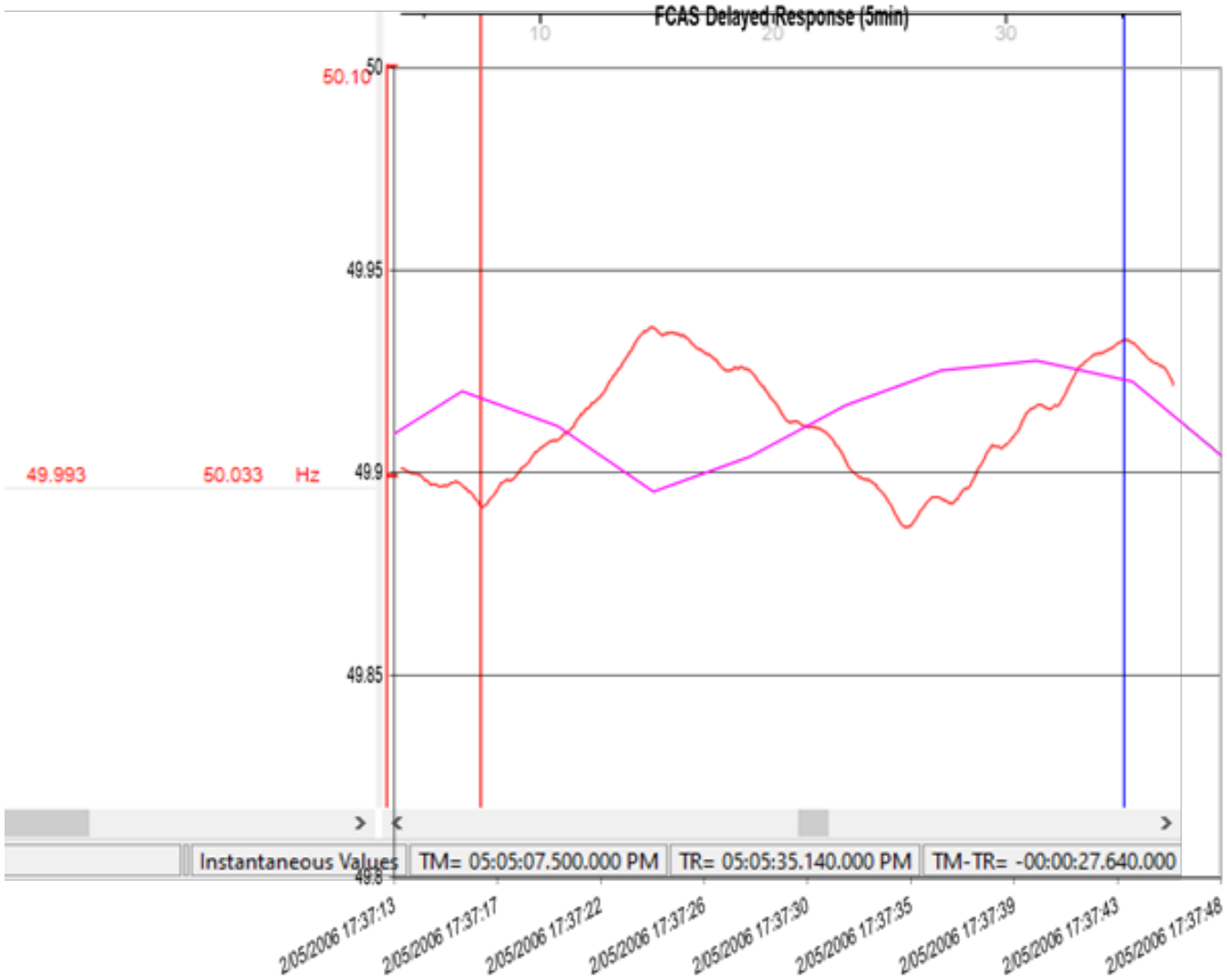
Feb-21
Jun-21
Jul-21
Aug-21
Sep-21
Oct-21
Nov-21
Dec-21
Jan-22
Feb-22
Mar-22
Apr-22
May-22

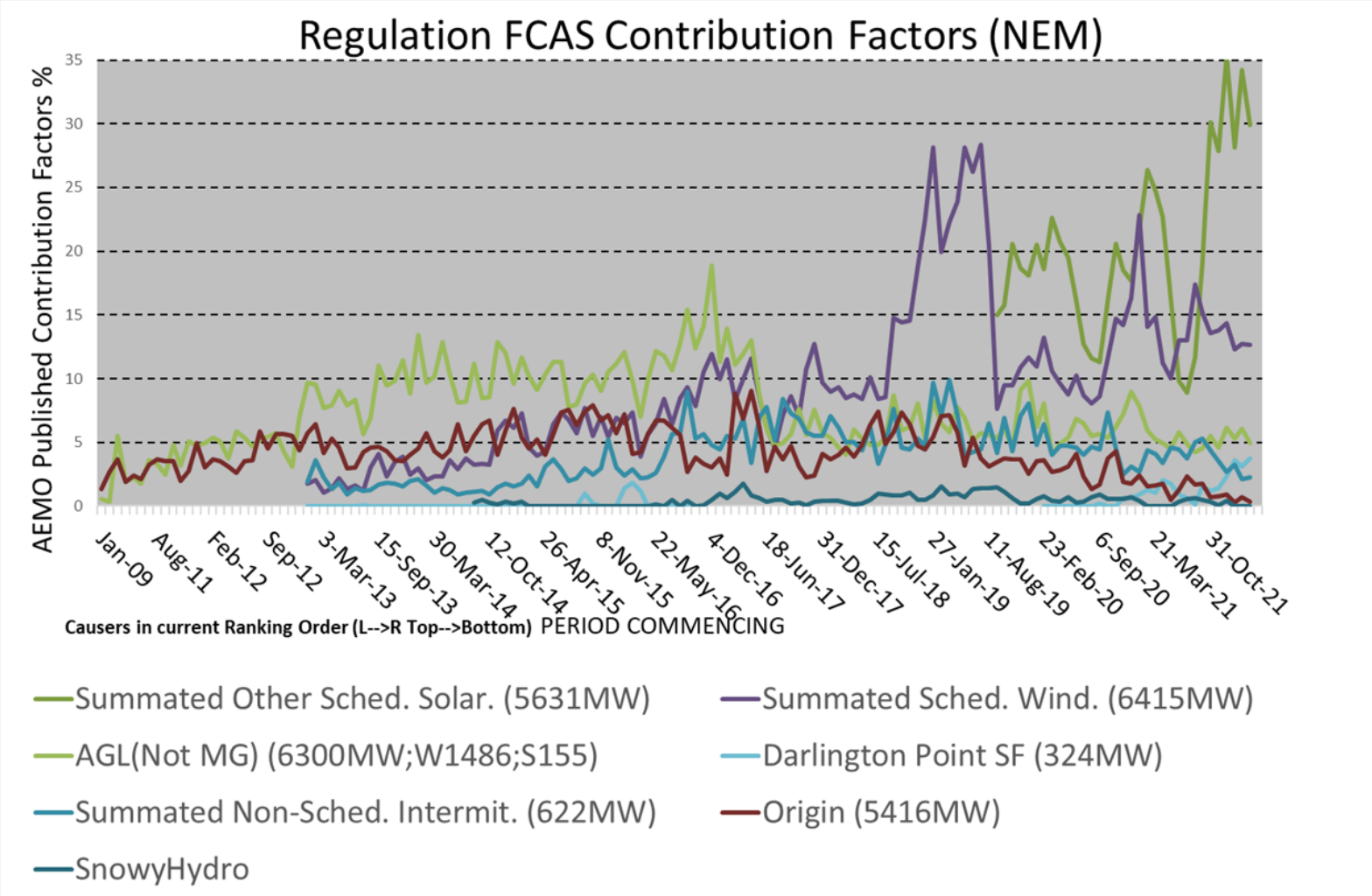


Between January 2021 and January 2022 where is the improvement in the distribution from added Mandatory PFR?


NEM Implemented PFR
Capacity (MW) of PFR Implemented
%age of NEM Possible PFR
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
26/09/2020
4/01/2021
14/04/2021
23/07/2021
31/10/2021
8/02/2022
19/05/2022
86%
50%
42%
NEM Implemented (MWs)
%age of NEM
%age of Tranche 1
%age of Tranche 2
%age of Tranche 3



Unchecked ~50mHz p-p variations observed in 2006 (pink) and in 2022 (red) – Should the standard define conditions that seek to control this?



Note: Prior to Aug 2019 Wind and Solar were summated in what is since labelled the Summated Sched. Wind

Should FCAS contribution per Installed MW, as measured in AEMOs Contribution factor arithmetic be a target that attracts attention in the standard?