REVIEW OF THE FREQUENCY OPERATING STANDARD

PUBLIC FORUM

15 DECEMBER 2022

RELIABILITY PANEL REPRESENTATIVES

CHARLES POPPLE (CHAIR), STEPHEN CLARK (TASNETWORKS) & CRAIG MEMERY (PIAC)

AEMC PROJECT TEAM

SEBASTIEN HENRY, BEN HIRON, VICTOR STOLLMANN, JULIUS SUSANTO & AMANDA SEETHOR

OTHER PRESENTERS

DAVID BONES (GHD), LUKE HYETT (GHD) & MARK STEDWELL (AEMO)

RELIABILITY PANEL AEMC

ACKNOWLEDGEMENT OF COUNTRY

We acknowledge that we are hosting this meeting from the lands traditionally owned by the Gadigal people of the Eora nation.

We also acknowledge the Traditional Custodians of the various lands on which you all work today and the Aboriginal and Torres Strait Islander people participating in this meeting.

We pay our respects to Elders past, present and emerging and celebrate the diversity of Aboriginal peoples and their ongoing cultures and connections to the lands and waters of Australia.

PURPOSE OF THIS FORUM

This public forum seeks to inform stakeholders about the Panel's draft determination for the 2022 frequency operating standard (FOS) review – published on 8 December 2022.

The agenda includes:

- Presentations by Panel members on the draft determination
- A presentation by GHD on the findings from its analysis and advice.
- A presentation by AEMO on its technical advice.
- Opportunities for stakeholders to ask questions and comment on the draft determination and the draft frequency operating standard.

AGENDA

Time	Agenda item	Presenter / Facilitator
9:30 am	Welcome and introductions	Charles Popple *(Chair of the Reliability Panel, AEMC Commissioner)*
9:40 am	Overview of the draft determination for the 2022 Frequency operating standard review	Stephen Clark *(Reliability Panel member, TasNetworks)*
10:00 am	Presentation on GHD advice	David Bones *(GHD)*
10:20 am	Q&A session	Victoria Mollard *(AEMC)*
10:35 am	Presentation on AEMO advice	Mark Stedwell *(AEMO)*
10:55 am	Implementation and future work	Craig Memery *(Reliability Panel member, PIAC)*
11:05 am	Q&A session	Victoria Mollard *(AEMC)*
11:25 am	Next steps	Charles Popple *(Chair of the Reliability Panel, AEMC Commissioner)*

FORMAT FOR THE WEBINAR

- You will have the option to make comments or ask questions via the Q&A function on your screen.
- When asking questions or presenting comments, please relate them to the purpose and scope of the meeting.
- In the Q&A area please first indicate whether you are asking a question or making a comment, then add your remarks, and then finally please include your name and organisation at the end.
- You are encouraged to use the "up-vote" feature for questions that you support – this will help us to prioritise your questions.
- We will attempt to answer all questions during the scheduled Q&A sessions - if we don't get to your question during the forum, we will follow up after the event.
- Comments can also be raised during the Q&A sessions. Where possible, and time permitting, participants may be invited to present their comments - if this happens, your mic will be taken off mute, and you will be asked to make your comment.

1

WELCOME & INTRODUCTORY REMARKS

REVIEW OF THE FREQUENCY OPERATING STANDARD

1.1 – WHO WE ARE

The Reliability Panel, which forms part of the AEMC's institutional arrangements, reviews and reports on the safety, security and reliability of the national electricity system.

The Panel is comprised of members who represent a range of participants in the national electricity market, including:

- Consumer groups
- Generators
- Network businesses
- Retailers
- Australian Energy Market Operator (AEMO)

1.2 – THE PANEL'S ASSESSMENT HAS FOLLOWED A RIGOROUS PROCESS

ISSUES PAPER

Issues paper outlining the issues for consideration published on **28 April 2022** to seek stakeholder feedback

AEMO ADVICE

As required under the NER, the Panel requested advice from AEMO on the issues for consideration, including:

- frequency performance during normal operation
- limits on operational RoCoF
- settings for contingency events
- limit on accumulated time error.

GHD ADVICE

GHD was selected by the AEMC to provide independent advice on:

- international and domestic approaches to manage RoCoF
- effects of PFCB settings on frequency performance during normal operation.

DRAFT FOS

The Panel's review is being conducted in accordance with the process set out in the NER, focused on the long-term interests of consumers.

The draft determination and FOS, published on **8 December 2022**, has been informed by the AEMO and GHD advice and stakeholder feedback.

2

OVERVIEW OF THE DRAFT DETERMINATION

REVIEW OF THE FREQUENCY OPERATING STANDARD

2.1 – CONTEXT FOR THE REVIEW OF THE FREQUENCY OPERATING STANDARD

Context for the review

This review of the Frequency operating standard (FOS) is part of a broader program of essential system services work that progresses the ESB's recommendations in the post-2025 work to "strengthen the grid" and support power system security.

The drivers for this review have been identified through related works undertaken by market bodies:

- The AEMC's *Mandatory primary frequency response* rule change
- The AEMC's *Primary frequency response incentive arrangements* rule change
- The AEMC's *Fast frequency response market ancillary service* rule change
- AEMO's 100% renewables *Engineering framework*

Process for the review

The Panel's draft determination is informed by advice from AEMO and GHD advisory.

AEMO – AUSTRALIAN ENERGY MARKET OPERATOR

AEMO provided technical advice as required by the Clause 8.8.1(a)(2) of the NER

GHD Advisory

Independent techno-economic advice and analysis provided by GHD advisory.

2.2 – OVERVIEW OF THE DRAFT FOS

The draft FOS includes additions and amendments to support power system security and would deliver reduced costs for consumers over the long-term.

The proposed amendments to the FOS include:

1 Updated settings for contingency events — including:

- limits in the FOS for the rate of change of frequency (RoCoF)
- the extension of the 144MW limit in Tasmania on the maximum allowable generation event to also include network and load events
- confirmation of the existing settings for the containment and stabilisation of frequency following contingency events

2 Settings for normal operation — including:

- confirmation of the allowable ranges for frequency during normal operation
- confirmation of the primary frequency control band (PFCB) in the FOS at the current settings
- confirmation that the target frequency in the NEM is 50Hz

3 Limits on accumulated time error – including:

- removal of the 15 second limit on accumulated time error for the mainland and Tasmania
- addition of an obligation on AEMO to monitor and report on the accumulation of time error

2.3 – THE DRAFT FOS – SETTINGS FOR RATE OF CHANGE OF FREQUENCY

In the context of reducing levels of system inertia, the Panel has introduced a standard for post-contingency RoCoF in the draft FOS. The standard is:

Following a **credible contingency event**, RoCoF must not exceed:
- Mainland: 0.5Hz measured over any 500ms (±1Hz/s)
- Tasmania: 0.75Hz over any 250ms (±3Hz/s)

For a **non-credible contingency event***, RoCoF must use *reasonable endeavours* to maintain RoCoF within:
- Mainland & Tasmania: 0.9Hz measured over any 300ms (±3Hz/s)

The Panel determined that introducing a RoCoF standard would have the following benefits:

1 Improved power system security

Promote secure operation of the system as system inertia declines

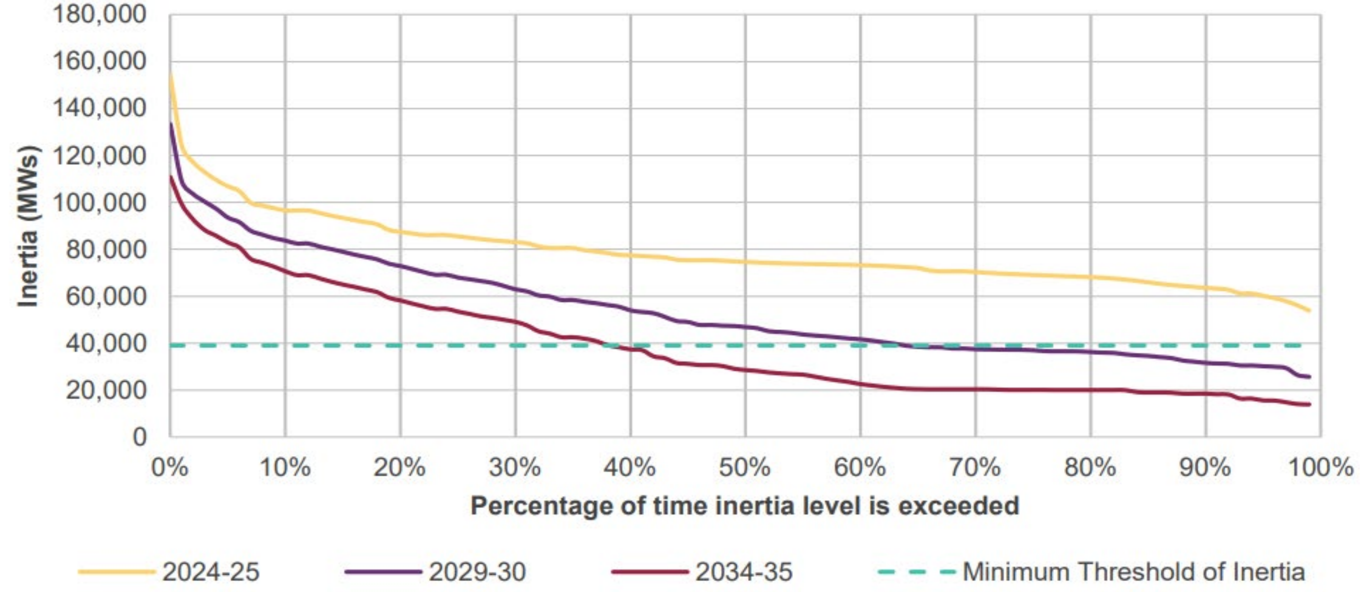
2 Improved power system resilience

Maintain the system within the capabilities of generation plant and EFCS

3 Promote efficient procurement of ancillary services

Support the valuation and procurement of RoCoF services (FFR, inertia, etc)

Inertia outlook for the mainland NEM (ISP 2022)



For a non-credible contingency event or multiple contingency event that is not a protected event. Limits for protected events considered as part of the declaration process.

2.4 – THE DRAFT FOS – SETTINGS FOR CONTINGENCY EVENTS

In light of the expressed interest in the connection of large commercial and industrial loads in Tasmania, the Panel has amended the draft FOS to extend the 144MW contingency size limit. The draft FOS:

Maintains the existing 144MW generation event limit in Tasmania and extends it to also apply to network and load events

The Panel determined **against** including a contingency size limit for the mainland NEM in the FOS

The updated settings for contingency events in the FOS are in the best long-term interests of consumers, because they:

1. **Improve power system security**
   Help manage the risks in operating the Tasmanian region (scarcity of FCAS, etc)
2. **Improve transparency, simplicity and predictability**
   Maintain a transparent indication of the hosting capacity of the Tasmanian grid
3. **A mainland contingency limit would be an inflexible approach**
   A mainland limit would be inflexible and may not reflect regional characteristics

There is an increasing interest in connection of large industrial and commercial loads such as hydrogen electrolysers and data centres

2.5 – THE DRAFT FOS – “SYSTEM RESTORATION” CONDITION

Following stakeholder comments surrounding the performance requirements under the automatic access standards, the Panel has renamed the “supply scarcity” operating condition in the draft FOS. The draft FOS:

Renames “supply scarcity” to “system restoration”

Maintains the current operational settings and related obligations on connecting generators

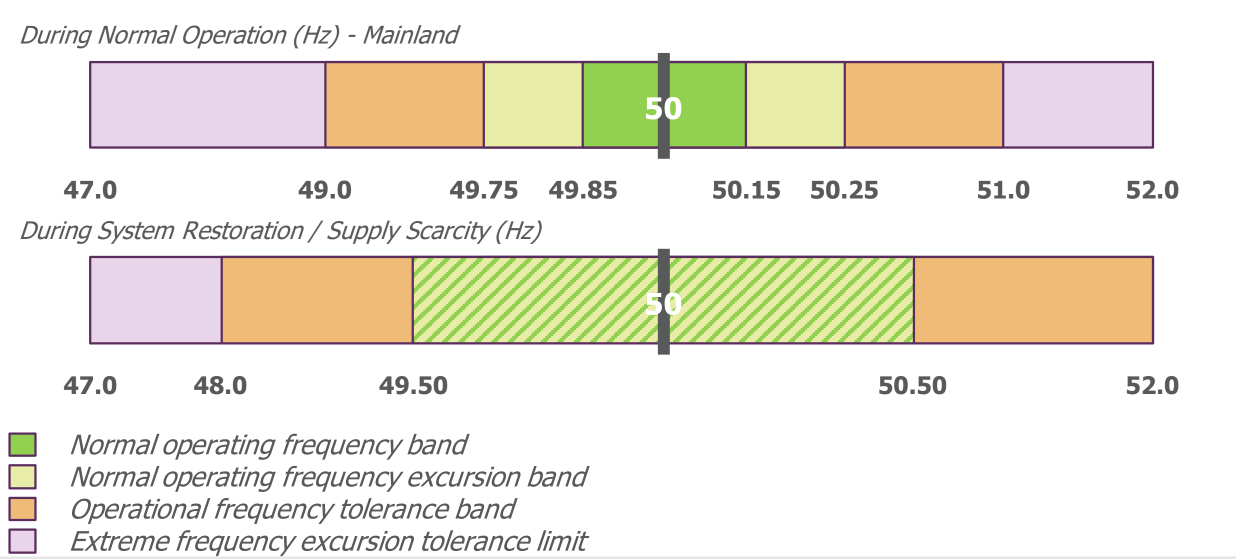
Retaining and renaming the existing settings for supply scarcity is in the interests of consumers as it:

1 Enables an accelerated reconnection of load following a significant event

The increased flexibility to allow for wider frequency outcomes when reconnecting load

2 Improves the predictability and simplicity by renaming the band

“System Restoration” fixes the misnomer by better reflecting the original purpose



2.6 – THE DRAFT FOS – SETTINGS FOR NORMAL OPERATION

In the context of the improvement in frequency performance after mandatory PFR and the upcoming introduction of the PFR performance payments, the Panel has determined to maintain, confirm and clarify the certain settings in the FOS:

- Maintains the NOFB as 49.85 – 50.15Hz
  Maintains the NOFEB as 49.75 – 50.25Hz
  (for both the mainland and Tasmania)
- Confirms the PFCB as 49.985 – 50.015 Hz
  (consistent with the current setting in the NER)
- Clarifies that the target for frequency performance in the NEM is 50 Hz

Advice and analysis provided by AEMO and GHD showed that control of frequency close to 50Hz delivers:

1 Improved power system security

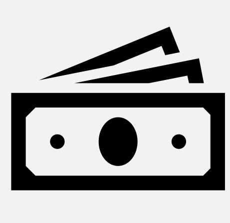
The settings would effectively control frequency around 50Hz

2 Improved power system resilience

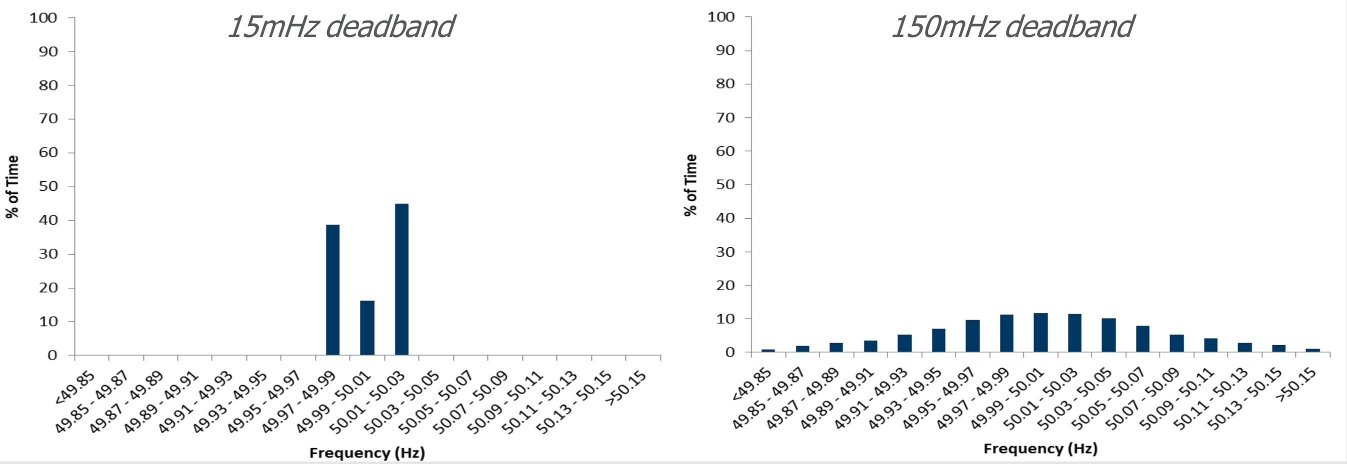
The settings would reduce the risk and volume of UFLS

3 Reduced aggregate costs for frequency control

The settings would reduce the overall work done to control system frequency



Modelled frequency distributions at different PFCB deadbands
(GHD advice to the Reliability Panel's review of the FOS)



2.7 – THE DRAFT FOS – LIMIT ON ACCUMULATED TIME ERROR

Following commentary in the previous review of the FOS, the Panel has decided to update the limit for accumulated time error in the draft FOS. The draft FOS:

Removes the 15 second limit on accumulated time error for the mainland and Tasmania

Maintains a requirement for AEMO to monitor and report on the accumulation of time error in the mainland and Tasmania

The updated settings for accumulated time error are in the interests of consumers because they:

1. Promote efficient procurement of ancillary services

Removing the requirement for AEMO to procure additional ancillary services

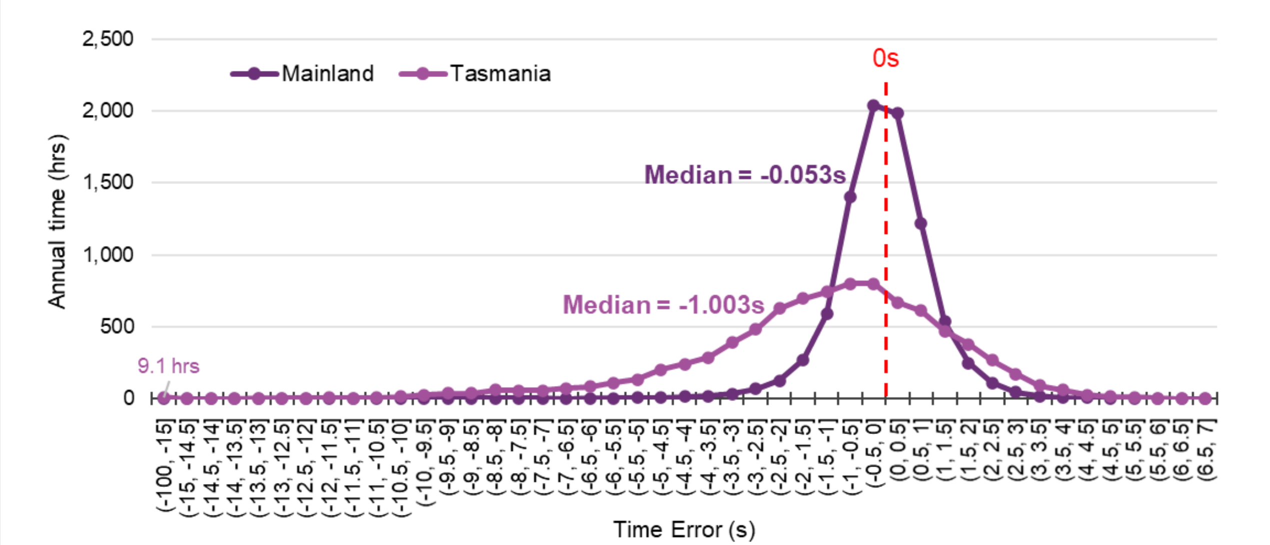
2. Maintain the current transparency, simplicity and predictability levels

The FOS would maintain the monitoring and reporting obligations on AEMO

3. Are unlikely to result in a material deterioration of system security

It is unlikely that consumers would be negatively affected by the change

Time error distribution in FY2022
(AEMO advice to the Reliability Panel's review of the FOS, p.55)



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PRESENTATION ON THE GHD ADVICE

REVIEW OF THE FREQUENCY OPERATING STANDARD

GHD Advisory

→ David Bones
Luke Hyett

GHD advice for the Reliability Panel FOS review

Welcome

GHD Advisory

Tasks & Purpose

→ We performed 2 separate tasks to inform the FOS review

Task 1 – PFCB modelling

GOAL: To model the economic and security effects of varying the Primary Frequency Control Band (PFCB).

We investigated the impact of varying the PFCB on:

- Frequency control under normal system conditions.
- Ability to control frequency within the NOFB.
- Resilience of the power system to significant contingency events.
- Ability to resynchronise islanded regions.
- Costs associated with PFR and Regulation FCAS.

Task 2 – RoCoF policy review

GOAL: to understand the approach to RoCoF in other power systems.

We surveyed a number of international power system operators to develop an understanding of:

- The method various operators use to specify limits for the RoCoF and their experience with RoCoF events.
- Whether a maximum allowable credible contingency size is specified.
- Whether a maximum allowable time error is specified in each jurisdiction and, if so, the purpose for monitoring time error.

GHD Advisory

Primary Frequency Control Band (PFCB) modelling

→ **Results for normal and post-contingent operation**

SUMMARY OF GHD's PFCB MODELLING RESULTS

SO WHAT? GHD's frequency and economic modelling show that setting the Primary frequency control band (PFCB) closer to 50Hz delivers improved system resilience and controls frequency at a lower overall cost compared to a wider settings.

1. Normal Operation and the PFCB

The PFCB dictates how tightly frequency is managed around 50 Hz.

The aggregate cost of controlling frequency normal operation is expected to increase as the PFCB is widened – this is driven by the increased work for units enabled to provide regulation FCAS, which exceeds any reduction in PFR work done

Key findings:

- Frequency is essentially uncontrolled inside the PFCB. This means that wider PFCB settings (e.g. 150, 500 mHz) do not provide effective control of frequency during normal operation
- Neither forecast error nor generation mix significantly impacts frequency control, if plant are responsive to frequency changes
- Similar patterns are observed in both the 2022 and 2033 scenarios, except that:
    - in 2022, disabling a proportion of synchronous plant response (for example, 50 or 70%) results in severely diminished frequency control outcomes
    - in 2033, better frequency performance is expected despite that only 30% of VRE plant is assumed to respond to an under frequency – this is due to the expected overbuilding of renewable generation capacity, combined with expected curtailment of VRE output and faster response times

2. System resilience benefits

Widening the PFCB leads to degraded system resilience outcomes following non-credible contingency events.

Key findings:

- Widening the PFCB leads to**:**
    - significantly worse frequency nadirs
    - significantly longer frequency recovery times
    - increased probability of load shedding → increased costs of lost load
    - Reduced likelihood of rapid resynchronisation following a separation event. → increased length of load shedding and increased vulnerability to further subsequent events

For the 2033 study:

- The increase in expected load shedding for 2033 is less severe than in 2022. This is due to the increased speed of response from inverter-based generation, which makes up a larger proportion of the generation fleet. (Assumes that 30% of VRE plant provide raise response due to overbuilding of VRE and associated curtailment)

3. Overall comments

Narrower PFCB settings:

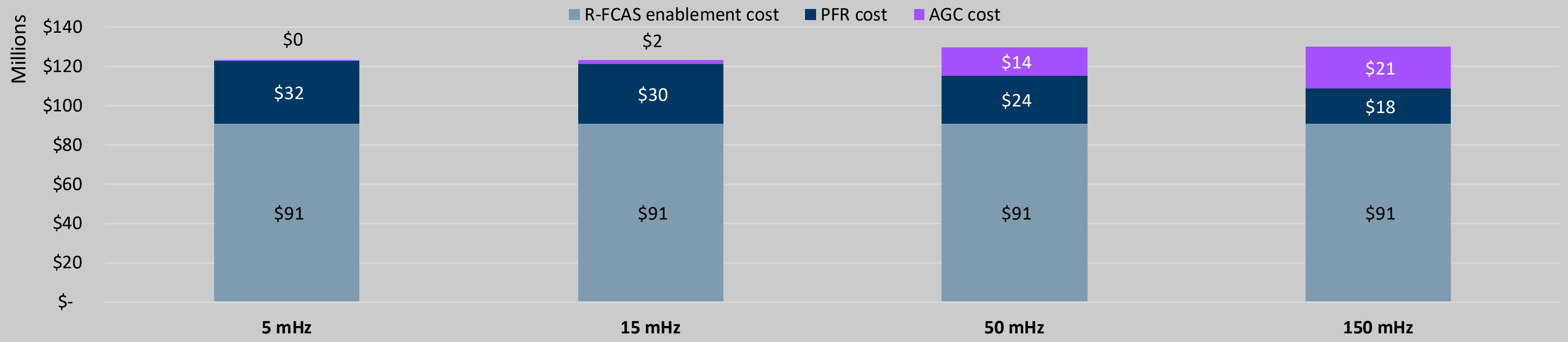
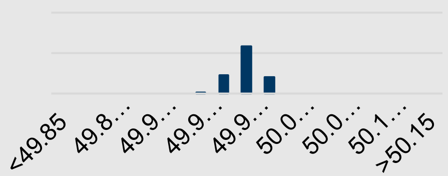
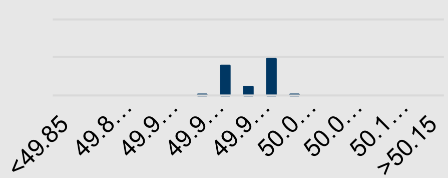
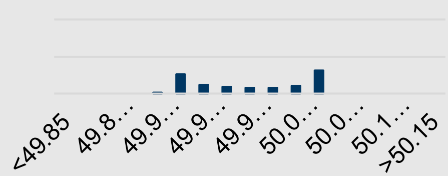
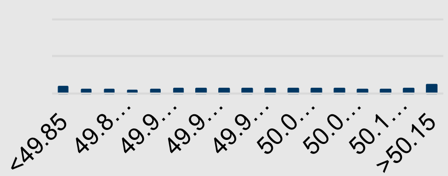
- **Improve system security and resilience by providing a frequency 'safety net' to non-credible contingency events**
- **Maintain system security at a lower overall costs for consumers.**

Key findings:

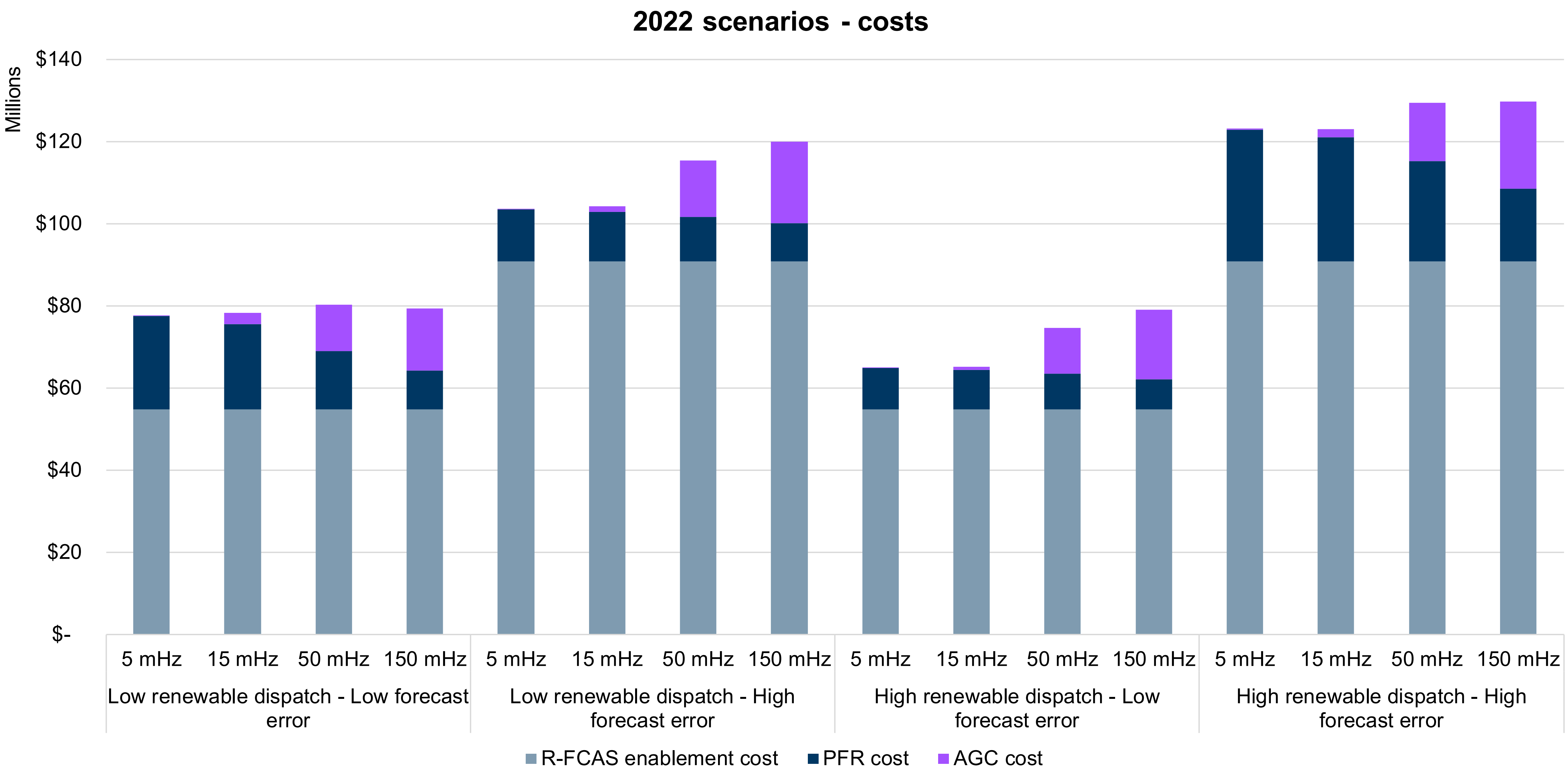
- A narrow setting for the PFCB is required to mitigate the impact of non-credible events in the current power system. The case for this narrow requirement is strengthened for 2022 by the prevalence of relatively slow responding plant. The 2033 results show that wider PFCB settings could deliver equivalent active power response due to faster response times for IBR

Aggregate modelling result - Impact of changing the PFCB

2022 High VRE output, High forecast error

Criteria	± 5 mHz	± 15 mHz	± 50 mHz	± 150 mHz
Costs during Normal operation				
Frequency distribution				
Normal frequency range (99^{th} percentile)	49.98 - 50.02	49.97 - 50.03	49.94 - 50.06	48.84 - 50.16
NOFB FOS Met?	Y	Y	Y	N
Resilience = estimated load shedding for key non-credible contingencies	Not studied	600 MW ($25.5m) - Heywood	Not studied	880 MW ($37.4m) - Heywood (+$11.9m)
Resilience = % of time frequency is sufficiently aligned to support resynchronization	Not studied	39%	Not studied	5.5% (resynchronization is more than 7 times more unlikely)

Aggregate modelling result – Costs of changing the PFCB



Conclusion

– A wider PFCB doesn't result in an overall lower cost for consumers due to increased work done by R-FCAS generators
– The PFCB setting impacts the ability to maintain frequency within the NOFB specified in the Frequency Operating Standard
– A narrower PFCB increases system resilience compared to a wider setting
– Increased system resilience reduces the probability of customer load shedding
– The optimal setting of a PFCB should consider the costs attributable to generators relative to the power system resilience costs
– There may be a need to review the PFCB setting after the PFR incentives scheme is implemented in the NEM

Based on our results, there is no compelling reason to move away from the current PFCB (+/- 15 mHz), as no substantial reductions in costs to consumers have been identified, and a significant reduction in power system resilience is observed as the PFCB is widened.

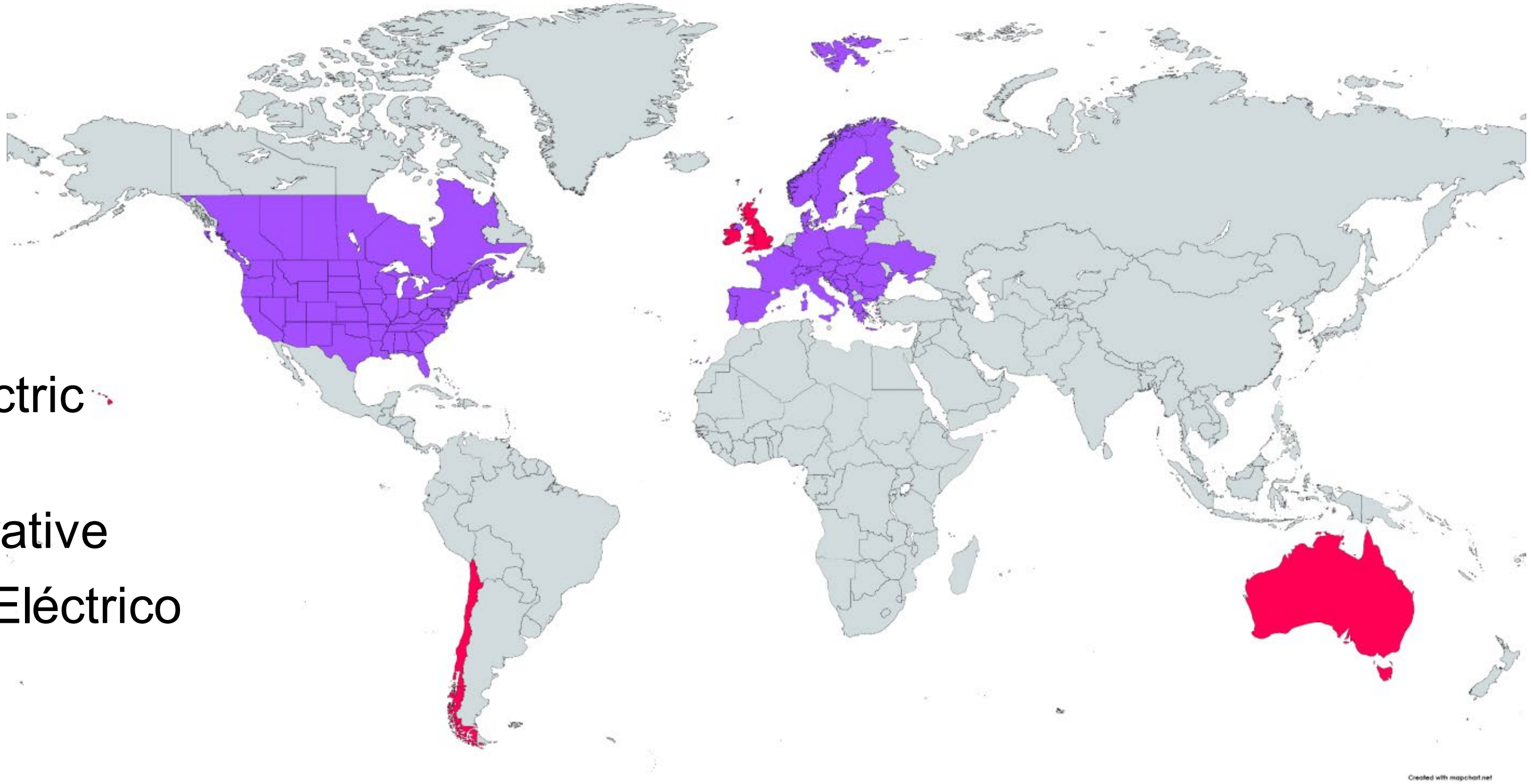
GHD Advisory

Rate of Change of Frequency (RoCoF) Policy Review

→ A comparison of relevant jurisdictions

RoCoF – Comparator systems

- Western Australia – AEMO WA
- Ireland – EirGrid
- European grid – ENTSO-E
- Great Britain – National Grid
- United States – NERC
- United States – Hawaiian Electric
- United States – Kauai Island Utility Cooperative
- Chile – Coordinador Eléctrico Nacional



GHD INTERNATIONAL SURVEY FINDINGS ROCOF MANAGEMENT

GHD Advisory

SO WHAT? **GHD's survey of international approaches to RoCoF management provides a basis for the establishment of RoCoF limits for the NEM.**

1. Experience with high RoCoF

Smaller systems with fewer interconnections experience the highest RoCoF.

Key findings:

- Smaller power systems have experienced the highest RoCoF
- For larger systems, the highest RoCoF events are expected following events that lead to the formation of islands that are separated from the primary interconnected system
- ENTSO-E review of global experience with high RoCoF events suggests that emergency controls like UFLS may not manage to prevent blackouts if RoCoF exceeds 0.5 Hz measured over 500 ms (1 Hz/s)

2. Generator RoCoF ride-through requirements

Many grid codes specify minimum RoCoF ride through requirements, but system operators are concerned about the capabilities of legacy plant.

Key findings:

- Grid codes commonly specify a RoCoF ride-through requirement for generators
- Many operators are concerned that legacy generation may not comply with RoCoF ride-through requirements, which could exacerbate a future event should generators trip
- Of the entities surveyed, only EirGrid had direct experience investigating generator ride-through capability
- Aside from the Loss of Mains detection concern in the UK and the trip of a small liquid fuelled synchronous generator in Hawaii, no survey respondents were able to identify actual events where a large utility-scale generating system tripped due to experiencing high RoCoF

3. Operational RoCoF standards and control measures

Specifying an operational RoCoF limit in the FOS may assist in maintaining system security and provide guidance for connected generators on what they are expected to withstand.

Key findings:

- While a number of system operators consider the operational need to limit RoCoF to achieve power system security, only AEMO (WEM) is required to meet a safe RoCoF limit specified in a FOS or equivalent regulation
- None of the respondents identified plans to modify existing FOS or equivalent regulations to include a specific RoCoF requirement
- Specifying a safe RoCoF limit in the NEM FOS in a similar manner to the WEM FOS may assist in maintaining system security and provide better guidance for stakeholders regarding the RoCoF they should experience
- If a safe RoCoF limit is to be included in the NEM FOS, the operating practices adopted in other jurisdictions may help inform an appropriate initial setting (e.g. 1 Hz/s over 500 ms as specified for ENTSO-E & EirGrid and 0.5 Hz/s for the WEM)

GHD INTERNATIONAL SURVEY FINDINGS – OTHER ISSUES

GHD Advisory

SO WHAT? **GHD's survey of international approaches to management of largest credible contingency risk and frequency time error provides a basis for the Panels consideration of these issues in the NEM FOS.**

1. Largest contingency size

The survey feedback does not provide evidence to support the inclusion of a limit on the largest credible contingency size in the NEM FOS.

The economic and security trade-offs are potentially better managed through other grid connection processes.

Key findings:

- Approaches taken to manage contingency size include:
- Hawaii - standard connection processes for units under 20 MW
- WA – WEM - co-optimisation between contingency risk and procurement of contingency reserves
- GB National Grid - limit (1.8 GW) on maximum contingency size
- No jurisdiction other than GB, formally specify a largest contingency limit in their standards
- In the NEM - AEMO and transmission network operators manage the size of connecting generators through the connections process by considering the impact on inter and intra-regional power transfers

2. Frequency time error requirements

While most survey responders track and correct for accumulated time error, only WA and the NEM specify an explicit frequency time error limit in their frequency operating standards.

Key findings:

- WA – time error <10 s for 99% of the time over any rolling 30-day period
- NEM – time error <15 s
- The review of time error correction completed by NERC across the period from 2008 to 2015 indicates that there may be little value in continuing to correct time error in the NEM, and it appears that the practice is in the process of being suspended in North America
- However, experience in Hawaii suggests that even if the requirement to control to a particular time error is removed from the NEM FOS, there could still be value in monitoring time error. Investigating the observed trends might highlight a need to adjust frequency control settings

GHD Advisory

*Thank You

→ ghd.com/advisory

DISCUSSION

Discussion and Q&A

4

PRESENTATION ON THE AEMO ADVICE

REVIEW OF THE FREQUENCY OPERATING STANDARD

Reliability Panel's Frequency Operating Standard

AEMO FOS Advice

December 2022

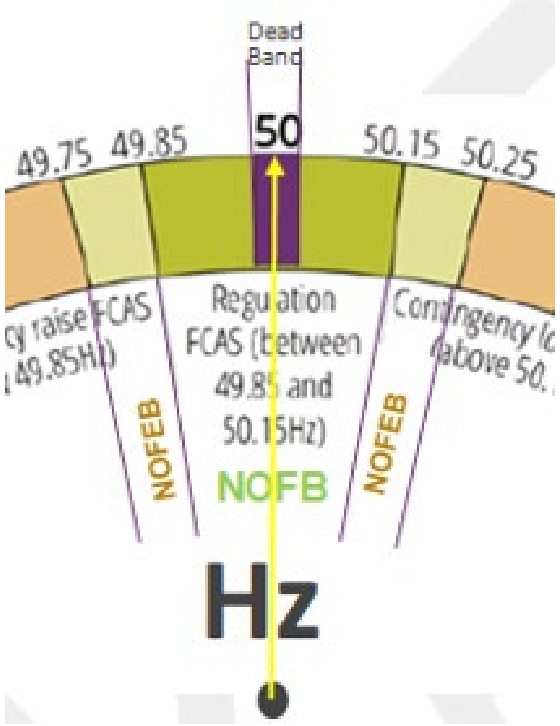
1. Frequency performance during normal operation
1b. Primary Frequency Control Band
2. Limits on operational RoCoF
3. Settings for contingency events
4. Limits on accumulated time error

1. Settings for Frequency performance during 'Normal Operation'

AEMO advice:

No change to the settings for frequency performance during normal operation on the Mainland or Tasmania

- The NEM power system is in the early stages of a complete transformation of generation, transmission, distribution and consumer load technologies and operation. However, the physics, science and electrical engineering principles remain the same.
- Frequency is a critical technical property for the stability of the power system. Frequency control principles have not changed.
- Mandatory narrow band PFR enabled successful control of the NEM to be reinstated after a period of unacceptable poor control of frequency.
- The NEM power system is now in a strong position to enable a transition to renewable energy sources with a firm basis of known frequency control practices.
- Given the extreme volume of work to be completed by the energy industry to facilitate the transformation, amending the normal operation parameters of the FOS are not a priority at this point in time and changes could present unknown risks.
- AEMO notes that investigations into the NOFEB requirements and capabilities in Tasmania are ongoing and AEMO may propose a modification via a submission at a later date.

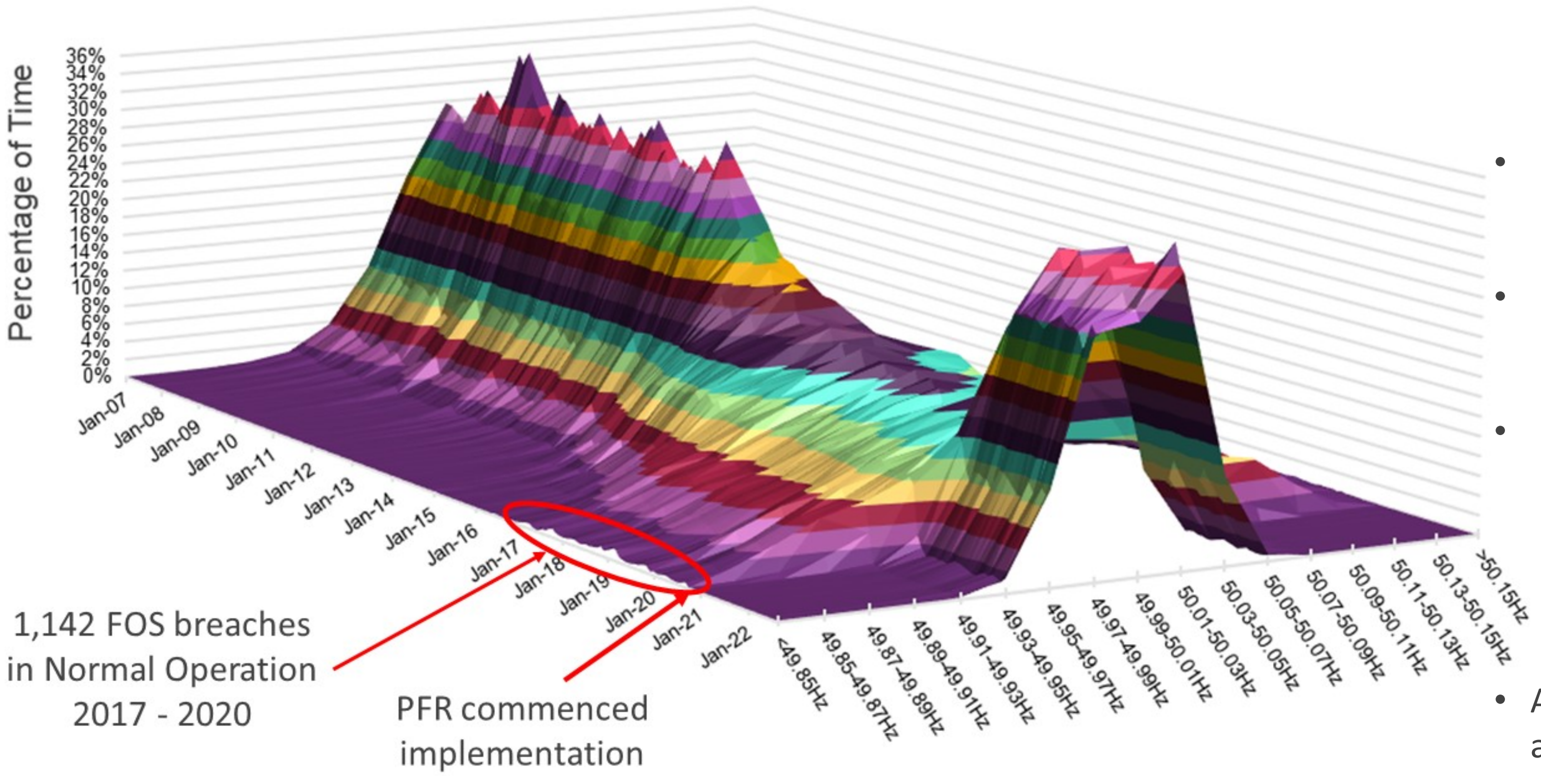


1b) Primary Frequency Response control band

AEMO advice:

1. No change to the Primary Frequency Response Control Band

AEMO recommends, to remove all doubt, the FOS clearly states the target frequency for the NEM is 50 Hz.

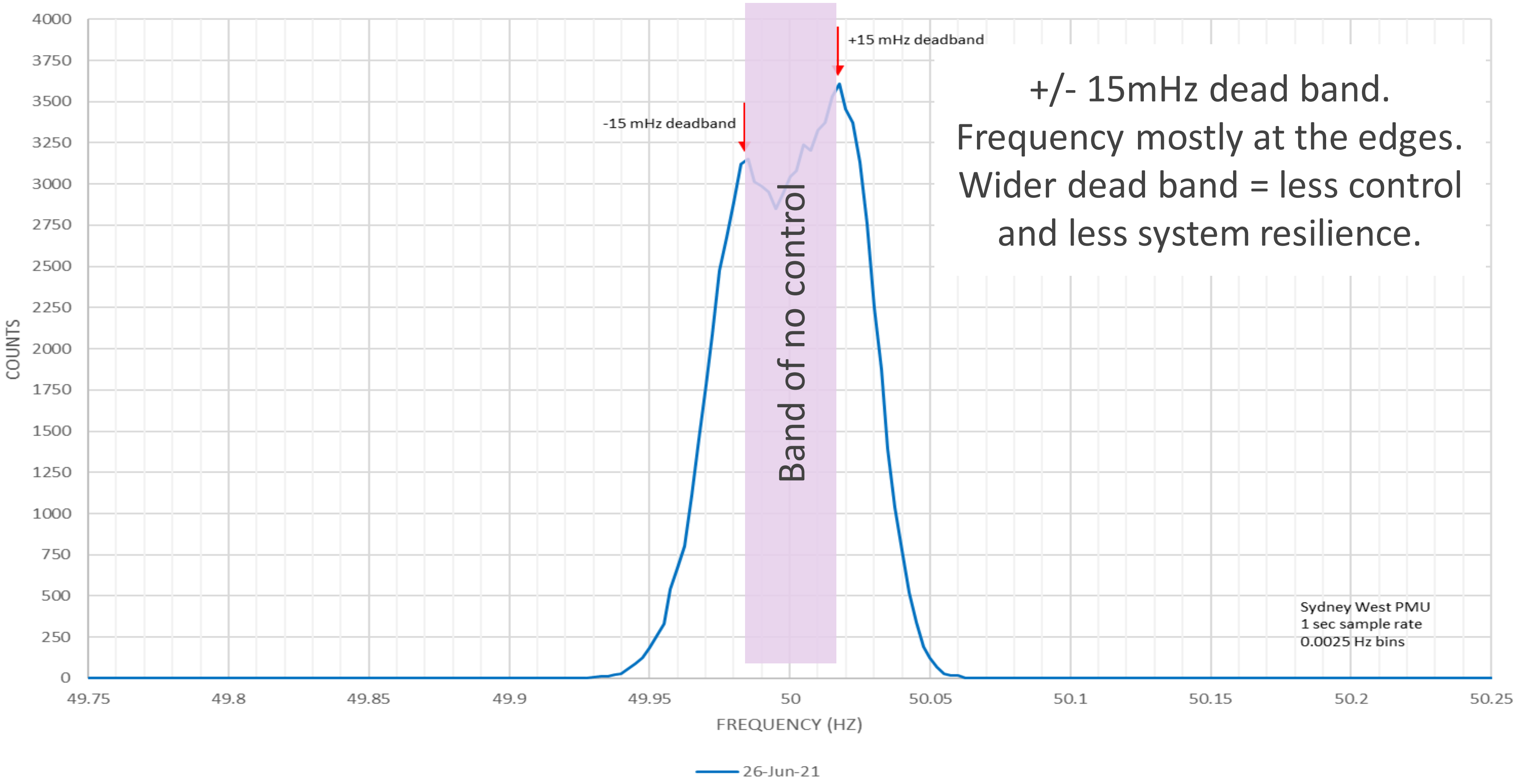


- Narrow band PFR has proven to improve frequency control as seen in 2020.
- A well controlled system has significantly increased system resilience
- PFR has proven to:
  1. **reduce load shedding in events**
  2. **enable faster recovery and synchronisation post event**
  3. **hold the system together to prevent events**
- AEMO through the PFR Requirements can design and stagger responses if needed, in line with best practice control.

1b) Primary Frequency Response control band

Benefits of PFR

The dead band specifies an operating zone around the nominal 50 Hz frequency where the generator will not adjust its power in response to frequency deviations. Presently 10% of the NOFB has no controlled response to local frequency.



2. System limits for Rate of Change of Frequency (RoCoF)

AEMO advice:

- FOS should include a limit for RoCoF on the mainland of 1 Hz/s, measured as not exceeding 0.5 Hz change over any 500ms averaging period.

- Tasmanian RoCoF for credible events be limited to +/- 3 Hz/s measured as not exceeding 0.75 Hz over any 250ms averaging period.

- FOS should include a reasonable endeavours RoCoF limit of 3 Hz/s measured as not exceeding 0.9 Hz over any 300 milliseconds (ms) averaging period for non-credible contingency events on both the mainland and Tasmania.

- No RoCoF limit in the FOS for protected events. Instead, AEMO proposes that RoCoF limits for protected events be applied on a case-by-case basis during the establishment of each protected event.

2. System limits for Rate of Change of Frequency (RoCoF)

RoCoF limits for credible contingencies in normal and island operation - Mainland

- Studies completed by AEMO in detail over many years indicate that:
  - AEMO investigations reveal that there is not much known about the withstand capabilities of some thermal generator technologies beyond 1 Hz/s.
  - Experiences in the NEM from actual events where generators successfully ride through RoCoF of up to +/-1.2 Hz/s.
  - Distribution-connected inverters have been bench tested with the majority of inverter types in Australia proven not to have any settings that would disconnect the inverter due to RoCoF less than +/-4 Hz/s.
  - Investigations reveal that Australian inverter types do not have the loss of mains issue that was found in inverters in the UK and Ireland.

RoCoF limits for credible contingencies in normal and island operation - Tasmania

Tasmania has had RoCoF protection in place for many years.

- The processes in place in Tasmania are designed to automatically sense a fast RoCoF event and accelerate mitigating actions to provide the network with the best chance of being controlled and returned to a stable operating condition.
- AEMO considers this to be a very successful, proven, well designed and prudent approach to the management of frequency in the Tasmanian system.
- AEMO recommends the FOS reflect the existing RoCoF management in place in Tasmania

3. Settings for Contingency Events

3.1 - No change in the contingency bands that apply for credible generation, load, and network events in the FOS.

3.2 - No change in the contingency bands that apply for non-credible generation, load, and network contingency events in the FOS.

3.3 - A limit of 144 MW apply to all generation, load, network and separation events as defined in the FOS and should not exceed 144 MW in Tasmania, unless a specific control scheme is in place and implemented by the Tasmania NSP with the approval of AEMO.

3.4 - The FOS should not include a limit on the maximum credible contingency event for the mainland system.

3.2 Supply Scarcity

Re-name "Supply Scarcity" to System Restoration to reflect what it is for – The term "Supply Scarcity" causes much confusion.

AEMO recommends replacing:
"Generation event, load event or network event"
In the FOS Table A5, with:

"a Generation event, load event or separation event during load restoration following a contingency event."

- <u>Supply Scarcity</u> is defined in the FOS as: the condition where load has been disconnected either manually or automatically, other than in accordance with dispatch instructions or service provision, and not yet restored to supply.

- NEMMCO delayed restoring load until FCAS available to maintain within the FOS for a credible event – at this time FCAS support was not available from neighbouring regions and UFLS load was already shed.

- AER investigation recommended NEMMCO refer clarification of the FOS for periods of "Supply Scarcity" to the Reliability Panel. This formed part of the 2009 FOS

- The context of the FOS review of supply scarcity throughout the 2009 Reliability Panel review is explained as ….a Generation event, load event or separation event during load restoration following a contingency event.

- AEMO believes there is merit in the intent, application and reasoning of the Supply Scarcity conditions and bands in the FOS

- AEMO believes the confusion is simply in the name – <u>Supply Scarcity</u>.

- Supply Scarcity has a different meaning in the english language, the FOS and the NER.

- Same FOS settings to apply.

4 Limits on Accumulated Time Error

The Reliability Panel consider removing a time error limit from the FOS, recognising AEMO will still monitor and control time error as necessary.

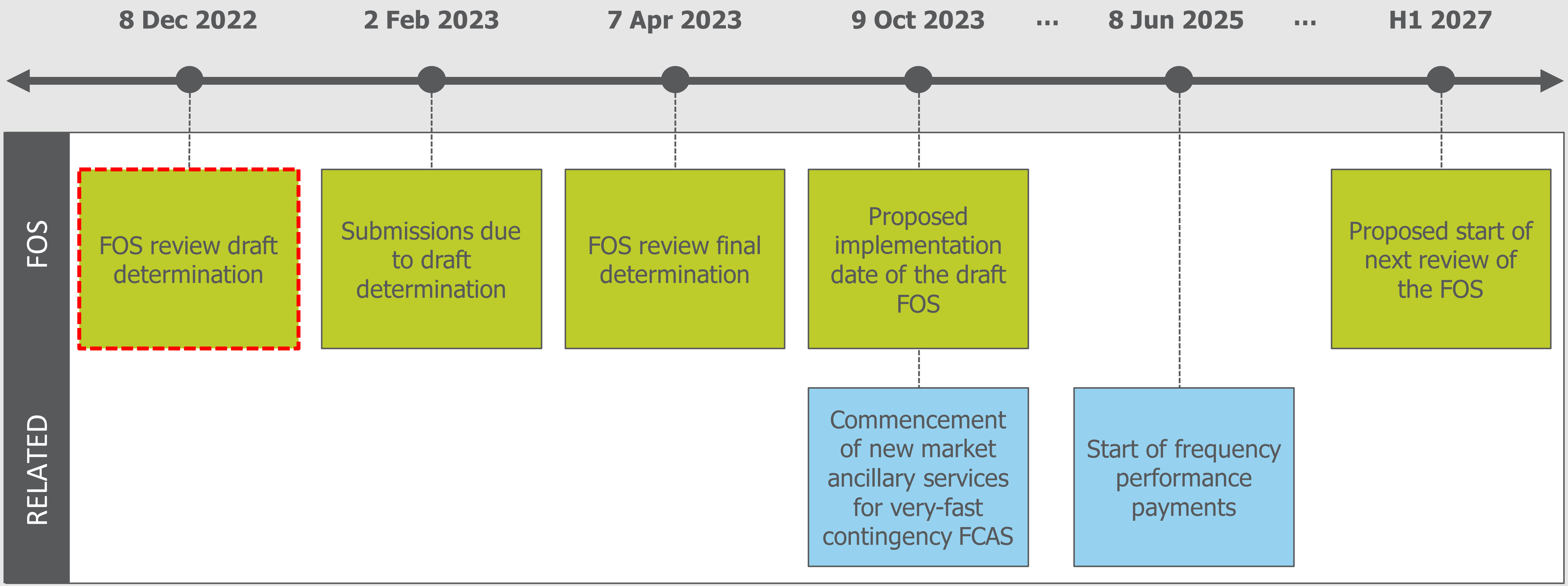
AEMO is to be transparent and report to the market through the quarterly frequency reports when time error has been reset.

5

IMPLEMENTATION AND FUTURE WORK

REVIEW OF THE FREQUENCY OPERATING STANDARD

5.1 – PROPOSED IMPLEMENTATION TIMING



5.2 – FUTURE WORK

This review of the FOS will help to inform relevant future work to be undertaken by the AEMC.

The draft determination also includes recommending timings on the future review of the FOS .

Arrangements for the efficient provision of inertia

The RoCoF limits included in the draft FOS provide an important input into the Commission's assessment of the AEC rule change request for the Efficient provision of inertia.

The initial post-contingent RoCoF is a function of contingency size and the level of inertia present on the power system. Therefore, defining a RoCoF limit helps to better define the required frequency outcomes and therefore support ongoing efforts by AEMO to "research the application and benefits of physical and synthetic inertia" in the power system.

Future review of the FOS

The Panel recommends that a follow-up review of the FOS be planned to commence in the first half of 2027.

This allows for further operational experience with new market and regulatory arrangements in place. Specifically, the Panel notes the relevance of the new frequency performance payments arrangements that commence on 8 June 2025.

The proposed timing for a follow-up review allows for a period of almost 2 years to monitor the impact of the frequency performance payments on frequency performance in the NEM, including the degree to which the incentive arrangements deliver increased voluntary PFR.

DISCUSSION

Discussion and Q&A

6

NEXT STEPS

SETTINGS IN THE FREQUENCY OPERATING STANDARD

6.1 – NEXT STEPS

Submissions to the draft determination must be provided to the Panel by **Thursday 2 February 2023**

We will consult further with stakeholders through our technical working group and through bilateral meetings with the team.

*Contact **Ben Hiron** if interested in arranging a meeting*

We plan to publish a final determination by **April 2023**

RELIABILITY
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