AUSTRALIAN ENERGY MARKET COMMISSION

RULE

Rule determination

National Electricity Amendment (Clarifying mandatory primary frequency response obligations for bidirectional plant) Rule 2024

Proponent

Australian Energy Market Operator (AEMO)

7 March 2024

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About the AEMC

The AEMC reports to the energy ministers. We have two functions. We make and amend the national electricity, gas and energy retail rules and conduct independent reviews for the energy ministers.

Acknowledgement of Country

The AEMC acknowledges and shows respect for the traditional custodians of the many different lands across Australia on which we all live and work. We pay respect to all Elders past and present and the continuing connection of Aboriginal and Torres Strait Islander peoples to Country. The AEMC office is located on the land traditionally owned by the Gadigal people of the Eora nation.

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AEMC, Clarifying mandatory primary frequency response obligations for bidirectional plant, Rule determination, 7 March 2024

Summary

1 The Commission has decided to make a more preferable final rule (the "final rule") clarifying the mandatory primary frequency response (PFR) obligations of scheduled bidirectional units (i.e. batteries with a capacity of 5MW or greater) in response to a rule change request received from the Australian Energy Market Operator (AEMO). Under the final rule, batteries must provide PFR when they are exporting or importing energy, including when providing a regulation service. They do **not** need to provide PFR when idle or enabled solely for contingency FCAS.

2 The final rule promotes the long-term, predictable, and consistent provision of PFR and support system security as the thermal generation fleet is progressively replaced by variable renewable energy (VRE) and batteries in the transition to net zero. The secure decarbonisation of the power system depends on the long-term, consistent and predictable delivery of narrow-band primary frequency response to support the stable operation of the power system as the generation mix changes.

3 The final rule has been informed by stakeholder feedback and is consistent with the draft rule.

The final rule clarifies mandatory PFR obligations of bidirectional units when discharging, charging and enabled for market ancillary services

4 The final rule is unchanged from the draft rule. As illustrated in Figure 1 below, the core elements of the final rule will require scheduled bidirectional units (BDUs) to adhere to the primary frequency response requirements (PFRR) when they receive a dispatch instruction to:

- **generate a volume greater than zero MW** — commencing 3 June 2024
- **charge (consume electricity) at a volume greater than zero MW** (except for auxiliary loads) — commencing 8 June 2025
- **provide a regulation service** — commencing 8 June 2025.

5 Under the final rule, scheduled BDUs would **not** be required to adhere to the PFRR when at rest and enabled solely for contingency frequency control ancillary services (FCAS).

Figure 1: Mandatory PFR obligations under different operating modes

Operating state	Mandatory PFR obligations for scheduled bidirectional units
Dispatched generating state	✓ Required to adhere to the PFRR
Dispatched charging state	✓ Required to adhere to the PFRR (except when solely charging auxiliary loads)
When enabled for regulation FCAS	✓ Required to adhere to the PFRR
When enabled for contingency FCAS	X **Not** required to adhere to the PFRR (voluntary provision incentivised by frequency performance payments)
When at rest (not dispatched to consume, generate or enabled for FCAS)	X **Not** required to adhere to the PFRR (voluntary provision incentivised by frequency performance payments)

Note: The obligations on scheduled bidirectional units when discharging, charging, and enabled for regulation FCAS commence on 3 June 2024, 8 June 2025 and 8 June 2025 respectively.

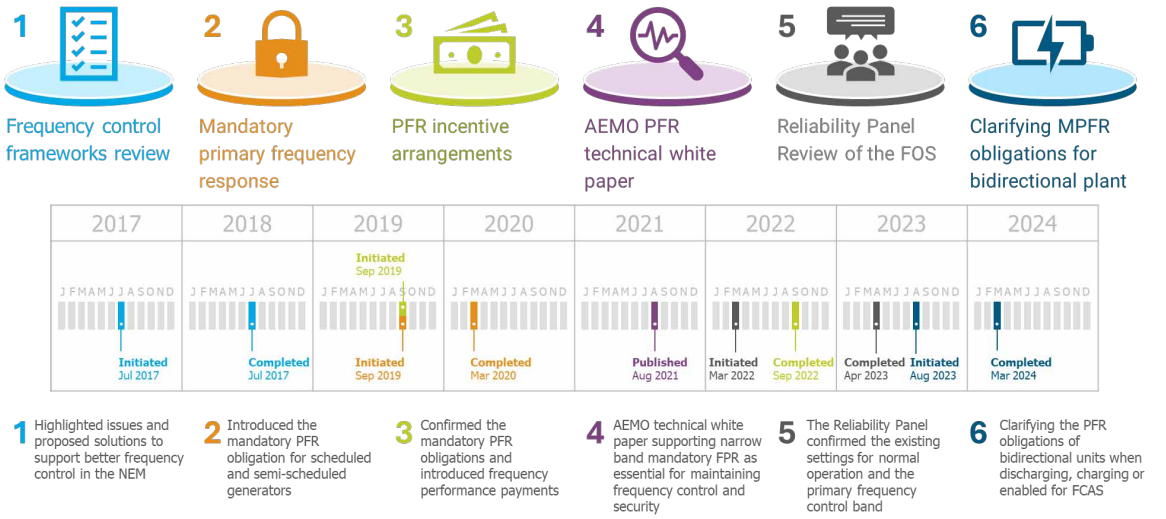
6 The Commission notes that a scheduled BDU may be technically capable of providing continuous narrow-band PFR when at rest and may choose to do so, the final rule is not intended to preclude

or restrict the provision of PFR in this case.[1]

7 The changes will not apply to pumped hydro storage given that they will not be classified as bidirectional units under the integrating energy storage systems (IESS) rule as they are incapable of linearly moving from one mode of operation to another (charging to discharging or vice versa). Under the final IESS rule these units will be classified as a scheduled generating unit and a scheduled load.

8 The Commission considers that these reforms build on several recent reforms that the Commission and the Reliability Panel have made to the frequency control frameworks — see Figure 2. These reforms culminate in providing AEMO with the tools it needs to manage the secure operation of the power system in accordance with the technical limits specified in the frequency operating standard (FOS). At the same time, the final rule delivers more efficient operation of power system plant by supporting the utilisation of the frequency control capability of bidirectional units, thereby lowering costs for consumers over the long term.

Figure 2: Timeline of Commission and Reliability Panel PFR projects



9 Consistent with the draft rule, the final rule includes several minor changes that will improve the effectiveness of the existing frequency control frameworks and promote long-term, predictable and consistent PFR provision:

- clarifying that scheduled bidirectional units will not need to renegotiate their connection agreement when revising PFR settings in accordance with the PFRR
- a minor amendment enabling AEMO to request that affected plant transmit the status of their frequency controller through existing communications equipment to improve AEMO's operational awareness of the frequency responsiveness of the system
- a minor amendment to clause 4.9.4(e) of the NER to clarify that semi-scheduled generators and scheduled bidirectional units must not change frequency control settings without the prior approval of AEMO.

1 The Commission understands that there may be benefits for a BDU to provide narrow band PFR when at rest, including increased contingency FCAS registration, simplified control systems and receipt of frequency performance payments which commence from 8 June 2025.

The Commission has considered stakeholder feedback in making its decision

10 Stakeholder input and feedback helped to shape our final determination. We obtained and considered wide-ranging stakeholder views via written submissions to a consultation paper, submissions to the draft determination, by direct engagement in bilateral and multilateral discussions and with our technical working group. In summary, stakeholders:

- strongly supported including scheduled bidirectional units in the mandatory PFR obligations when discharging
- expressed mixed views towards the proposal to require mandatory PFR when charging
- supported including scheduled bidirectional units in the mandatory PFR obligation when enabled for regulation FCAS
- strongly opposed the proposal to require PFR when enabled for contingency FCAS and idle.

11 Stakeholder submissions reinforced the Commission's concerns that the prolonged consideration of the mandatory PFR obligations at this time could act to increase the overall perceived financial risk faced by potential investors in power system plant. As such, the Commission has sought to quickly, transparently, and effectively progress this rule change project to provide certainty for investors and minimise inherent regulatory risk given the important role that batteries are likely to play in the future power system.

The final rule is consistent with the draft rule

12 The Commission's final rule clarifies the mandatory PFR obligations of scheduled bidirectional units when discharging, charging and enabled for regulation services. Informed by stakeholder feedback, the Commission decided against introducing the full range of obligations proposed by AEMO in the rule change request. The final rule also proposes several incremental changes (consistent with the draft rule) to promote the long-term and consistent provision of PFR.

The final rule will be implemented in two stages

13 Consistent with the draft rule, the final rule will be implemented in stages depending on operating mode. The obligation for scheduled bidirectional units to adhere to the primary frequency response requirements (PFRR) when:

- discharging will commence on 3 June 2024 — in line with the commencement of the integrating energy storage systems (IESS) rule that introduced the scheduled bidirectional units category
- charging or enabled for regulation services will commence on 8 June 2025 — in line with the start of frequency performance payments.

We assessed the final rule against five assessment criteria using regulatory impact analysis and stakeholder feedback

14 The Commission has considered the national electricity objective (NEO)[2] and the issues raised in the rule change request and assessed the final rule against five criteria outlined below. We gathered stakeholder feedback and undertook regulatory impact analysis in relation to these criteria.

15 The more preferable final rule contributes to achieving the NEO by:

2 Section 7 of the National Electricity Law (NEL).

- **Safety, security and reliability** — The Commission has considered the potential benefits associated with improvements to system security brought about by the final rule, weighed against the likely costs. In relation to system security, the rule extending the mandatory PFR obligations for scheduled bidirectional units is consistent with the NEO as the operational costs of compliance and service provision are less than the estimated system security benefits provided by the incremental provision of PFR.
- **Emissions reduction** — The final rule will widen the circumstances under which scheduled bidirectional units are required to provide PFR in accordance with the settings in the primary frequency response requirements. The provision of PFR by battery energy storage systems will play a crucial role in enabling the secure decarbonisation of the NEM's generation fleet as IBR progressively replaces thermal generation.
- **Principles of market efficiency** — The final rule will efficiently incentivise improved plant performance to help control power system frequency during normal operation. There are also expected benefits from enabling more targeted use of FCAS (particularly regulation services) and incentivising the efficient availability and use of batteries to support power system frequency.
- **Innovation and flexibility** — The final rule will ensure that the PFR frameworks reflect changes in generation fleet and remain effective in achieving security outcomes over the long-term in a changing market environment.
- **Principles of good regulatory practice** — The final rule promotes consistent market and regulatory arrangements for frequency control thereby promoting transparency and predictability and minimising investment uncertainty and risks for market participants.

These criteria are explained in detail in section 2.4.

Contents

1 The Commission has made a final determination

The Commission has decided to make a more preferable rule in response to a rule change request submitted by the Australian Energy Market Operator (AEMO). The rule change request proposed to clarify the mandatory primary frequency response (PFR) obligations of scheduled bidirectional plant (i.e. batteries with a capacity 5MW and greater) and promote the long-term, consistent and predictable provision of PFR. The final rule is consistent with the more preferable draft rule.

This chapter provides:

- Section 1.1 — an overview of the final rule
- Section 1.2 — a summary of how stakeholder feedback has shaped the final rule
- Section 1.3 — an overview of the interaction of this rule change with previous and ongoing reforms.

The following chapters of this paper set out:

- Chapter 2 — the Commission's assessment against the national electricity objective
- Chapter 3 — additional details on how the final rule will operate
- Appendix A — an overview of the rule making process
- Appendix B — an overview of the Commission's regulatory impact analysis
- Appendix C — legal requirements to make a rule
- Appendix D — overview of the mandatory PFR obligations of market participants.

In addition, the consultation paper provides further background and context, including:

- Appendix A — previous rule changes and consideration of the issues
- Appendix B — the costs and benefits of widespread PFR

The provision of primary frequency response has many benefits for frequency control, both during normal operation and following contingency events. However, the Commission also acknowledges that costs are incurred by generators and bidirectional units in providing this service.

As identified in AEMO's *Engineering Framework*, the reliable provision of PFR by inverter-based resources — including batteries — is crucial to enable the system secure operation at 100% instantaneous penetration of renewable energy generation.[3]

1.1 The final rule will clarify the obligations for scheduled bidirectional units

The final rule will clarify the enduring mandatory PFR obligations of scheduled bidirectional units. It also outlines under what operating conditions BDUs will be required to adhere to the applicable frequency response settings set out in the primary frequency response requirements (PFRR).

The changes do not apply to pumped hydro storage given that they will not be classified as bidirectional units under the IESS rule as they are incapable of linearly moving from one mode of operation to another (charging to discharging or vice versa). Under the final IESS rule these units will be classified as a scheduled generating unit and a scheduled load.[4]

The key features of the final rule are that scheduled bidirectional units will be required to adhere to the PFRR when they receive a dispatch instruction to:

3 AEMO, Engineering Roadmap to 100% Renewables, December 2022.

4 AEMC, Integrating energy storage systems in the NEM - final determination, 2 December 2021, p.91.

- generate a volume greater than zero MW — commencing 3 June 2024
- charge (consume electricity) at a volume greater than zero MW (except for auxiliary loads) — commencing 8 June 2025
- provide a regulation service — commencing 8 June 2025.

In addition, the final rule clarifies that:

- scheduled bidirectional units will **not** be required to renegotiate their connection agreement when adjusting PFR settings in accordance with the PFRR
- AEMO will be able to request that generators transmit the status of their frequency controller through existing Supervisory Control and Data Acquisition (SCADA) communications equipment.

The final rule also clarifies that scheduled bidirectional units would be encouraged to, but will **not** be required to, comply with the PFRR when enabled solely for contingency FCAS.[5]

The following sections provide a brief overview of each of these elements of the final rule along with the implementation timings of the new arrangements.

Further details on the elements of the final rule are included in chapter 3.

1.1.1 Scheduled bidirectional units will be required to adhere to the PFRR when discharging

The final rule places an obligation on all scheduled bidirectional units, dispatched to generate, to operate their plant in accordance with the performance parameters set out in the PFRR. The Commission considers that the obligation promotes the NEO, because it will:

- **promote power system security** and **emissions reduction** by making it clear that such units have to help the frequency responsiveness of the system, especially at times with high distributed photovoltaic (PV) — rooftop solar
- **promote the principles of good regulatory practice** by being consistent with the intent of the Commission's mandatory PFR and PFR incentive arrangements rules that
  - introduced the mandatory PFR obligation when generating and
  - established a long-term framework to sufficiently incentivise the provision of PFR as the system decarbonises
- **promote the principles of good regulatory practice** for scheduled bidirectional units since they would be subject to the same obligations as scheduled or semi-scheduled generators when discharging.

Under the final rule, the obligation on scheduled bidirectional units to adhere to the PFRR when discharging will commence on 3 June 2024.

1.1.2 Scheduled bidirectional units will be required to adhere to the PFRR when charging

The final rule places an obligation on all scheduled bidirectional units, dispatched to charge, to operate their plant in accordance with the performance parameters set out in the PFRR. The obligation does not apply to batteries when they are solely powering auxiliary loads. Under the final rule, the state of charge of the battery would need to increase for the mandatory PFR obligation to apply. The Commission considers that the obligation will:

5 The Commission understands that there may be benefits for a BDU to provide narrow band PFR when at rest, including increased contingency FCAS registration, simpler control systems and receipt of frequency performance payments which commence from 8 June 2025.

- **promote innovation and flexibility** by being consistent with the intent and outcome of the integrating energy storage systems (IESS) rule to recognise the advanced capabilities of scheduled bidirectional units when compared to scheduled loads
- **promote power system security** and **emissions reduction** by increasing the frequency responsiveness of the system, especially at times with high distributed photovoltaic (PV) — rooftop solar
- **promote market efficiency** by improving security outcomes and being unlikely to materially increase costs for consumers as the obligation would only slightly accelerate or moderate the battery's charge rate in response to frequency — it is unlikely to result in additional warranted cycles being expended
- **promote the principles of good regulatory practice** by improving regulatory certainty and minimising investment risk by setting enduring arrangements and clarifying the expected obligations of bidirectional units over the long-term.

Under the final rule, the obligation on scheduled bidirectional units to provide PFR when charging will commence on 8 June 2025, in line with the commencement of the frequency performance payments.

1.1.3 Scheduled bidirectional units will be required to adhere to the PFRR when enabled for regulation FCAS

The final rule places an obligation on all scheduled bidirectional units, dispatched to provide regulation FCAS, to operate their plant in accordance with the performance parameters set out in the PFRR. The Commission considers that the obligation will:

- **promote power system security** and **emissions reduction** by increasing the overall frequency responsiveness of the system and ensuring sufficient PFR will be available at times with low operational demand the high distributed photo-voltaic (i.e. rooftop solar)
- **promote market efficiency** by improving system security while not resulting in material incremental costs given the intrinsic link between regulation FCAS and PFR as both seek to ensure adequate frequency performance during normal operation.

Under the final rule, the obligation on scheduled bidirectional units to provide PFR when enabled for regulation FCAS will commence on 8 June 2025.

1.1.4 Scheduled bidirectional units will not be required to adhere to the PFRR when enabled for contingency FCAS

The Commission has concluded that the costs of introducing a mandatory PFR obligation for BDUs solely enabled for contingency FCAS would outweigh the benefits. As such, the Commission's view is that the proposed obligation would be unjustified and disproportionate, because:

- it would **conflict with the principle of market efficiency** as applying the obligation to BDUs solely enabled for contingency FCAS could result in material costs with the potential for unintended interactions with the contingency FCAS market
- it is **unlikely to promote power system security** as applying the obligation would be unlikely to result in material security improvements
- existing frameworks already incentivise the voluntary provision of PFR by BDUs enabled for contingency FCAS.

1.1.5 The final rule includes incremental changes to promote the long-term provision of PFR

In addition to the solutions proposed by AEMO, the final determination and rule also includes several minor and incremental changes that seek to improve the effectiveness of the existing frequency control frameworks and promote long-term, predictable and consistent PFR provision, including:

- clarifying that scheduled bidirectional units will **not** need to renegotiate their connection agreement when revising PFR settings in accordance with the PFRR
- a minor amendment enabling AEMO to request that affected plant transmit the status of their frequency controller through existing communications equipment to improve AEMO's operational awareness of the frequency responsiveness of the system
- a minor amendment to clause 4.9.4(e) of the NER to clarify that semi-scheduled generators and scheduled bidirectional units must not change frequency control settings without the prior approval of AEMO.

The Commission considers that the incremental changes:

- **promote flexibility** and **good regulatory practice** by ensuring that affected scheduled bidirectional units are not required to renegotiate their connection agreement if operating PFR settings consistent with their obligations under the PFRR
- **promote system security** and **emissions reduction** by ensuring AEMO has consistent visibility of the frequency responsiveness of the generation fleet
- promote **good regulatory practice** by ensuring that the rules are consistent as to the PFR obligations of generators and bidirectional units.

1.2 Stakeholders have shaped our final determination

Stakeholder input and feedback helped to shape our final determination. We obtained and considered stakeholder views via written submissions to a consultation paper[6] and to the draft determination[7]. The Commission's papers was complemented by continuous engagement with a diverse range of stakeholders directly in bilateral and multilateral discussions, as well as meetings of our technical working group.

There was strong feedback provided across stakeholder groups for proposed revisions to the mandatory PFR obligations of scheduled bidirectional units. In summary, stakeholders:

- strongly supported including scheduled bidirectional units in the mandatory PFR obligations when discharging and enabled for regulation FCAS
- expressed mixed views towards the proposal to require mandatory PFR when charging
- strongly opposed the proposal to require PFR when enabled for contingency FCAS and idle.

The Commission's decision-making was aided by this stakeholder feedback across diverse stakeholder groups, including gentailers, renewable developers, battery operators, original equipment manufacturers (OEMs), thermal generators, AEMO and industry groups. In addition, the Commission appreciates and acknowledges the contributions of the members of the frequency control technical working group (TWG) in helping the Commission come to a final determination.

In addition, the Commission wants to re-acknowledge feedback provided by several stakeholders that they remain opposed to the continuation of the mandatory PFR arrangements.[8] Although this

6 AEMC, Clarifying mandatory PFR obligations for bidirectional plant, Consultation paper, 3 August 2023.
7 AEMC, Clarifying mandatory PFR obligations for bidirectional plant, Draft determination, 30 November 2023
8 Submissions to the draft determination: EnergyAustralian, p.1; AEC, p.1; CS Energy, p.3; Stanwell, p.1.

rule change did not intend to re-prosecute the mandatory arrangements, the Commission continues to consider that the current mandatory PFR framework complemented by the incentive arrangements provides AEMO with the tools required to manage the secure operation of the power system within its technical limits. Importantly, the Commission remains convinced that the PFR arrangements promote the NEO and are a crucial tool to facilitate the secure decarbonisation of the generation fleet.

1.2.1 Stakeholder feedback guided our draft and final determinations

Engagement by stakeholders on detailed issues was also important in informing our draft and final determinations. For example:

- Shell Energy's feedback guided the Commission's views on the proposed obligations for batteries when enabled for regulation and contingency FCAS.[9]
- Tesla's feedback provided valuable insights thereby helping identify the expected costs of the proposed policy positions.[10]
- Iberdrola, Eku Energy, and Equis' submissions illustrated the regulatory risk and damage to investment certainty from the reconsideration of obligations that were recently settled.[11]
- Shell and AEMO provided valuable feedback on the potential need for variations to account for a possible reduction in PFR as the state of charge of a battery nears 100% or 0%.[12]

1.3 Interactions with previous and ongoing reforms

The consideration of this rule change request builds on previous work completed by the Commission and the Reliability Panel to establish enduring arrangements for the provision of PFR to maintain system security. Recent relevant projects include the:

- *Mandatory primary frequency response rule 2020*[13] which promoted power system security by introducing a mandatory obligation for scheduled and semi-scheduled generators to provide PFR.
- *Integrating Energy Storage Systems into the NEM rule 2021*[14] which introduced the new Integrated Resource Provider registration category to make it easier for energy storage systems to participate in the NEM. Under the IESS rule, standalone storage capable of linearly and smoothly transitioning from charging to discharging must be classified as a:
  - scheduled bidirectional unit if its capacity is 5MW and above
  - non-scheduled bidirectional unit, if its capacity is under 5MW.
- *Primary frequency response incentive arrangements rule 2022*[15] which established an enduring framework for the long-term provision of PFR in the NEM by confirming the mandatory obligations and introducing **frequency performance payments** — commencing on 8 June 2025.
- The Reliability Panel's *review of the frequency operating standard (FOS) 2022*[16] which revised the FOS to adapt to the changing nature of the power system as thermal generators are

9 Shell, submission so the consultation paper, 31 August 2023, p.5
10 Tesla, submission to the consultation paper, 31 August 2023, p.2.
11 Submissions to the consultation paper: Iberdrola, p.2, Eku Energy, p.3, Equis, p.2.
12 Submissions to the draft determination: Shell, p.3; AEMO, p.2.
13 See: https://www.aemc.gov.au/rule-changes/mandatory-primary-frequency-response
14 See: https://www.aemc.gov.au/rule-changes/integrating-energy-storage-systems-nem
15 See: https://www.aemc.gov.au/rule-changes/primary-frequency-response-incentive-arrangements
16 See: https://www.aemc.gov.au/market-reviews-advice/review-frequency-operating-standard-2022

increasingly displaced by inverter-based resources. The revised FOS confirmed the settings for normal operation, including the primary frequency control band (PFCB) that relates to the sensitivity for mandatory PFR provided by scheduled and semi-scheduled generators. The Panel's final determination included a recommendation that the Panel reconsider the appropriateness of the settings in the FOS by the end of 2027.

The Commission considers that these reforms together provide AEMO with the tools it needs to manage the secure operation of the power system in accordance with the technical limits specified in the FOS. In addition, the inclusion of incentive arrangements through the frequency performance payments which will commence on 8 June 2025 aim to deliver more efficient operation of, and investment in, power system plant. This will occur by encouraging innovation and deployment of new capabilities that would deliver lower overall frequency control costs for consumers over the longer-term.

Another current rule change being considered by the AEMC also has the potential to complement the new frequency performance payment arrangements and support the provision of voluntary frequency response by new classes of power system plant. The proposed "Light Scheduling unit" registration category could facilitate the integration of nonscheduled price responsive resources into market dispatch. The "light scheduling unit" approach, or similar, would support the provision of information to AEMO that better reflects the way these units respond to the wholesale energy price and improve the accuracy of market dispatch.[17] These new "Light Scheduling Units", or similar, if progressed would be likely candidates for voluntary provision of PFR to supplement the mandatory PFR arrangements.

A summary of the relevant rule change projects and the Reliability Panel review is available in Appendix A of the Consultation paper. [18]

The costs and benefits from the provision of narrow-band PFR have been thoroughly investigated by the Commission and Reliability Panel. Both the PFR incentive arrangements rule and 2022 review of the frequency operating standard projects supported the continuation of the current mandatory arrangements as a prudent solution to maintain satisfactory frequency control and thereby promote power system security.

A summary of the costs and benefits of narrow band PFR can be found in Appendix B of the Consultation paper. [19]

17 See: https://www.aemc.gov.au/rule-changes/integrating-price-responsive-resources-nem

18 See: https://www.aemc.gov.au/rule-changes/clarifying-mandatory-primary-frequency-response-obligations-bi-directional-plant

19 Ibid.

2 The rule will contribute to the energy objectives

The final rule will promote the national energy objective (NEO) because it will clarify the mandatory primary frequency response (PFR) obligations of scheduled bidirectional plant. The final rule will promote power system security and economic efficiency while improving regulatory certainty by establishing enduring arrangements with respect to the PFR obligations of batteries in the NEM.

This chapter explains why the Commission has made its final determination and the accompanying more preferable final rule. It outlines:

- Section 2.1 — how the final rule will promote the long-term interests of consumers
- Section 2.2 — how the final rule furthers the system services objective
- Section 2.3 — that the Commission has made a more preferable final rule
- Section 2.4 — how the final rule meets the assessment criteria set out in the consultation paper.

2.1 The Commission must act in the long-term interests of energy consumers

The Commission can only make a rule if it is satisfied that the rule will or is likely to contribute to the achievement of the relevant energy objectives.[20]

The NEO is:[21] [22]

> to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to—
>
> (a) price, quality, safety, reliability and security of supply of electricity; and
>
> (b) the reliability, safety and security of the national electricity system; and
>
> (c) the achievement of targets set by a participating jurisdiction—
>
> (i) for reducing Australia's greenhouse gas emissions; or
>
> (ii) that are likely to contribute to reducing Australia's greenhouse gas emissions.

The targets statement, available on the AEMC website, lists the emissions reduction targets to be considered, as a minimum, in having regard to the NEO.[23]

2.2 The system services objective for considering issues related to system services

The system services objective has been developed by the Commission to assess whether system services rule changes contribute to the NEO.

It reflects the trade-offs that are expected when considering issues related to the provision of system services and it is outlined in Box 1 below.

20 Section 88(1) of the NEL.

21 Section 7 of the NEL.

22 The NEO was updated on 21 September 2023 with the introduction of the *Statutes Amendment (National Electricity Laws) (Emissions Reduction Objectives) Act 2023*. We have applied the updated NEO in this final determination in line with the Act.

23 Section 32A(5) of the NEL.

Box 1: The system services objective

Establish arrangements to optimise the reliable, secure and safe provision of energy in the NEM, such that is it provided at efficient cost to consumers over the long-term, where 'efficient cost' implies the arrangements must promote efficient:

- short-run operation of,
- short-run use of,
- longer-term investment in, generation facilities, load, storage, networks (i.e. the power system) and other system service capability, in the context of the transition to a net zero system.

Efficient short-run operation refers to factors associated with the ability of the service design option to achieve an optimal combination of inputs to produce the demanded level of the service at least cost i.e. for a given level of output, the value of those resources (inputs) for this output are minimised.

Efficient short-run use refers to factors associated with the ability of a service design option to allocate limited resources to deliver a service, or the right combination of services, according to consumer preferences or system need.

Efficient longer-term investment refers to factors associated with the ability of the service design option to continue to achieve allocative and productive efficiencies over time. This means developing flexible market and regulatory frameworks, that can adapt to future changes.

2.3 The Commission has made a more preferable final rule

The Commission may make a rule that is different, including materially different, to a proposed rule (a more preferable rule) if it is satisfied that, having regard to the issue or issues raised in the rule change request, the more preferable rule is likely to better contribute to the achievement of the NEO.[24]

For this rule change, the Commission has made a more preferable final rule. The reasons are set out in section 2.4 below.

2.4 The Commission considered the more preferable final rule against the assessment criteria

The Commission has identified the following criteria to assess whether the proposed rule change, no change to the rules (business-as-usual), or other viable, rule-based options are likely to better contribute to achieving the NEO:

- **Safety, security and reliability** — the operational security of the power system relates to the maintenance of the system within pre-defined limits for technical parameters such as voltage and frequency. System security underpins the operation of the energy market and the supply of electricity to consumers.
- **Emission reductions** — the market and regulatory arrangements for frequency control should efficiently contribute to the achievement of government targets for reducing Australia's greenhouse gas emissions.

24 Section 91A of the NEL.

- **Principles for market efficiency** — the market and regulatory arrangements that relate to frequency control should result in efficient investment in, and operation of, energy resources to promote a secure supply of electricity for consumers. The frequency control frameworks should also seek to minimise distortions in order to promote the effective functioning of the market.
- **Innovation and flexibility** — regulatory arrangements must be flexible to changing market and external conditions. They must be able to remain effective in achieving security outcomes over the long-term in a changing market environment. Where practical, regulatory or policy changes should not be implemented to address issues that arise at a specific point in time.
- **Principles of good regulatory practice** — the market and regulatory arrangements for frequency control should promote transparency and be predictable, so that market participants can make informed and efficient investment and operational decisions.

These assessment criteria reflect the key potential impacts – costs and benefits – of the rule change request, for impacts within the scope of the NEO. Our reasons for choosing these criteria are set out in Chapter 4 of the consultation paper.

The Commission has undertaken regulatory impact analysis to evaluate the impacts of the various policy options against the assessment criteria. Appendix B outlines the methodology of the regulatory impact analysis.

The rest of this section explains why the final rule best promotes the long-term interest of consumers when compared to other options and assessed against the criteria, including why our more preferable final rule better promotes the NEO when compared to the AEMO's proposed solution and drafting.

2.4.1 Driving improved power system security

The mandatory PFR obligation has been shown to deliver improved control of system frequency, providing a solid operational foundation in the midst of increasing variability and uncertainty associated with the transition away from thermal generators to inverter-based resources. The final rule builds on previous reforms and seeks to promote system security by clarifying the operating modes under which scheduled bidirectional units will be required to be frequency responsive, thereby contributing to the effective and efficient management of frequency.

Effective, tight control of frequency is a necessity today and will be more so in the transition towards a power system that is increasingly dependent on variable and inverter-based generation and storage. AEMO considers that there are expected to be future operating conditions where large-scale centralised generation is increasingly displaced by variable renewable generation and distributed rooftop solar power, which provide limited or no PFR. During these future operating conditions, the level of PFR provided by scheduled bidirectional units when discharging or charging could play a crucial role in ensuring that the power system remains within its secure operating envelope.

The Commission has considered the potential benefits associated with improvements to system security brought about by the final rule, weighed against the likely costs. In relation to system security, the rule extending the mandatory PFR obligations for scheduled bidirectional units is consistent with the NEO as the operational costs of compliance and service provision are expected to be less than the estimated system security benefits provided by the incremental provision of PFR.

Further details on the Commission's view on the security benefits of the final rule are available in chapter 3.

2.4.2 Promoting emissions reduction and the secure decarbonisation of the generation fleet

The final rule will widen the circumstances under which scheduled bidirectional units are required to provide PFR in accordance with the settings in the primary frequency response requirements. The Commission considers that the provision of PFR by battery energy storage systems will play a crucial role in enabling the secure decarbonisation of the NEM's generation fleet as IBR progressively replaces thermal generation.

The maintenance of security, by ensuring that the system remains within its technical operating limits, enables the accelerated decarbonisation of the power system without needing to revert to market interventions to guarantee the reliability of energy supply. By making the final rule, the Commission seeks to ensure that batteries contribute by providing PFR in circumstances where they are actively participating in the energy market, and doing so will be unlikely to result in material incremental costs.

Further details on the Commission's view on the benefits of the final rule with respect to decarbonisation are available in chapter 3.

2.4.3 Ensuring the economically efficient maintenance of acceptable frequency performance

The Commission considers that there are a number of benefits that are likely to arise from the final rule, which outweigh both the implementation and ongoing operational costs. The final rule will efficiently incentivise improved plant performance to help control power system frequency during normal operation. There are also expected benefits from:

- enabling more targeted use of FCAS (particularly regulation services) and
- incentivising the efficient availability and use of batteries to support power system frequency.

The Commission's revisions to the mandatory PFR obligations of bidirectional units are limited to operating modes where:

- the incremental cost of providing PFR is likely to be insignificant and
- where batteries are likely to be adequately compensated by the frequency performance payments.

This conclusion is illustrated by the current reality that most batteries already and voluntarily adhere to the expanded mandatory PFR obligations, such as providing PFR when charging or providing regulation FCAS.

For operating modes where the cost of providing PFR is likely to be more significant, such as when idle or enabled solely for contingency FCAS, the Commission decided against implementing a mandatory obligation. However, the Commission still supports the voluntary provision of PFR by capable plant to benefit from existing arrangements, such as from:

- frequency performance payments
- increased contingency FCAS capacity
- simpler administrative processes and control settings.

Further details on the Commission's economic considerations are available in chapter 3.

2.4.4 Maintaining flexibility and enabling innovation in PFR provision

The Commission's final rule builds on the previous mandatory PFR rule and the PFR incentive arrangements rule that obligated scheduled and semi-scheduled generators to be frequency responsive when generating, and introduced frequency performance payments to both value the mandatory provision of PFR and incentivise its voluntary and long-term provision. By building on

the FPPs, the rule automatically adapts as system needs adjust over time. This is achieved through the financial weighting of payments by the price for regulation services and the scaling of payments by the aggregate requirement for corrective response (RCR) in each trading interval. Each of these values is expected to dynamically represent the need for frequency response and the associated value over time.

Further flexibility is embedded in the final rule in that the drafting ties the mandatory PFR obligations to the Primary frequency response requirements, which AEMO is required to consult on when developing. This provides flexibility for affected bidirectional plant to seek exemptions or variations based on their particular circumstances.

Further details on the Commission's considerations with respect to flexibility and innovation are available in chapter 3.

2.4.5 Aligning with the principles of good regulatory practice

The Commission's final determination and final rule clarifies the mandatory PFR obligations of bidirectional units. It promotes transparency and predictability thereby minimising investment and regulatory risks for battery developers. By clearly setting out the minimum mandatory PFR obligations expected of batteries the Commission is balancing the importance of certainty for AEMO, flexibility for battery operators and economic efficiency for consumers.

Further details on the Commission's considerations with respect to good regulatory practice are available in chapter 3.

3 How our rule will operate

The final rule seeks to clarify the enduring mandatory PFR obligations of scheduled bidirectional units. The final rule also outlines under what operating conditions BDUs will be required to adhere to the applicable frequency response settings set out in the primary frequency response requirements.

In summary, scheduled BDUs will be required to provide PFR in accordance with the PFRR:

- when they have received a dispatch instruction to generate a volume greater than zero MW — commencing from 3 June 2024 (section 3.1.1)
- when they have received a dispatch instruction to charge (consume electricity) at a volume greater than zero MW — commencing from 8 June 2025[25] (section 3.1.2)
- when they receive a dispatch instruction to provide a regulation service — commencing from 8 June 2025 (section 3.1.3).

Scheduled BDUs will **not** be required to provide PFR when they have not received a dispatch instruction to generate or consume electricity — i.e are at rest. In addition, enablement to provide contingency FCAS would not trigger a requirement to provide continuous narrow band PFR. Therefore, a scheduled BDU that is enabled to provide contingency FCAS but is not dispatched in the energy market to generate or consume electricity will not be required to comply with the PFRR.

The Commission notes that a scheduled BDU may be technically capable of providing continuous narrow-band PFR when at rest and **may choose to do so**, the final rule is not intended to preclude or restrict the provision of PFR in this case. [26] (section 3.2.1)

This section provides an overview of the Commission's final determination, including:

- Section 3.1 — clarifying the mandatory PFR obligations for scheduled bidirectional units
- Section 3.2 — the final rule would not apply the full obligations proposed by AEMO.

3.1 Clarifying the mandatory PFR obligations for scheduled bidirectional units

Box 2: The Commission's final determination is to extend the mandatory PFR obligations to apply to scheduled bidirectional units

The Commission's final rule requires scheduled bidirectional units to adhere to the PFRR when:

- discharging commencing on 3 June 2024 — in line with the commencement of the IESS rule
- charging commencing on 8 June 2025 — in line with the start of the frequency performance payments
- enabled for regulation services commencing on 8 June 2025 — in line with the start of the frequency performance payments.

Batteries will **not** be subject to the obligation when:

25 Scheduled bidirectional units will not be required to provide PFR when solely powering auxiliary loads. The mandatory obligation only applies when the scheduled bidirectional unit's state of charge increases.

26 The Commission understands that there may be benefits for a BDU to provide narrow band PFR when at rest, including increased contingency FCAS registration, simplification of control systems and receipt of frequency performance payments which commence from 8 June 2025.

- solely powering auxiliary loads (the obligation only applies if the state of charge of the battery is increasing)
- idle (at 0 MW)
- enabled solely for contingency FCAS.

The Commission's final rule also make several additional changes to promote the consistent and predictable provision of PFR, including:

- clarifying that scheduled bidirectional units will not be required to renegotiate their connection agreement when revising PFR settings in accordance with the PFRR
- refinements to the monitoring and control requirements to improve AEMO's operational visibility of the frequency responsiveness of the system
- minor changes to clause 4.9.4(e) of the NER to clarify that semi-scheduled generating units may not change frequency response settings without prior approval of AEMO
- consequential changes to the requirements of the PFRR, AEMO's ability to grant an exemption from, or variation to, any of the PFR parameters set out in the PFRR, and the references to the PFR obligations in the signpost notes in clause S5.2.5.11.

The final rule clarifies the mandatory PFR obligations of scheduled bidirectional units. It would not apply to pumped hydro storage that continues to be registered as a scheduled generator and scheduled load following the implementation of the IESS rule. The final rule establishes an enduring framework to provide battery operators with certainty and minimise regulatory risk. The Commission understands stakeholder concerns with the re-prosecution of the obligations faced by bidirectional units but considers that the final obligations on bidirectional units effectively balance the security benefits provided by batteries with the incremental costs incurred.

This section outlines:

- Section 3.1.1 — that scheduled BDUs will be required to adhere to the PFRR when discharging
- Section 3.1.2 — that scheduled BDUs will be required to adhere to the PFRR when charging (except when powering auxiliary loads)
- Section 3.1.3 — that scheduled BDUs will be required to adhere to the PFRR when enabled for regulation FCAS
- Section 3.1.4 — other incremental changes to promote the long-term provision of PFR.

3.1.1 Scheduled bidirectional units will be required to adhere to the PFRR when discharging

The final rule places an obligation on all scheduled bidirectional units, dispatched to generate, to operate their plant in accordance with the performance parameters set out in the PFRR.

The following section sets out the Commission's justification in applying the obligation to scheduled bidirectional units, including that it is consistent with previous determinations and promotes power system security by ensuring that scheduled bidirectional units face the same obligations as scheduled and semi-scheduled generators when discharging.

The final rule promotes good regulatory practice and system security by retaining the obligations scheduled bidirectional units currently face when discharging

AEMO's rule change request identified uncertainties in relation to the obligations that apply to scheduled bidirectional units to provide PFR. In particular, AEMO identified that following the

commencement of the integrating energy storage systems (IESS) rule in June 2024, batteries that were previously classified as scheduled generating units will switch over to being classified as scheduled bidirectional units and will no longer be required to provide PFR when generating.

As outlined in the consultation paper, the Commission recognises that this outcome is the result of an inadvertent drafting omission. It is also consistent with the mandatory PFR and the PFR incentives final determinations for scheduled bidirectional units to provide PFR while discharging (generating).[27]

The mandatory PFR final determination set out that the obligation applies to all scheduled and semi-scheduled generators:[28] [29]

> The final rule places an obligation on all scheduled and semi-scheduled generators who have received a dispatch instruction to generate to a volume greater than 0 MW, to operate their plant in accordance with the performance parameters set out in the Primary frequency response requirements as applicable to that plant.

In recognition that the obligation would also apply to batteries, it was specifically drafted to manage concerns raised by operators of battery energy storage systems that they would be disproportionally burdened by a mandatory approach as they are always available to the market even when not enabled for energy or FCAS.[30]

Stakeholders broadly supported the Commission's view that the proposal would be consistent with previous determinations

In submissions to the consultation paper and draft determination, stakeholders broadly and consistently agreed with the Commission's view that an obligation on scheduled bidirectional units to provide PFR when discharging would be consistent with previous determinations.[31] [32]For example, Eku Energy's submission to the consultation paper noted that:[33]

> Eku Energy views that the proposal to require scheduled BDU to provide Primary Frequency Response (PFR) when generating (following the commencement of the IESS rule on 3 June 2024) addresses an inadvertent drafting omission and is largely an administrative matter.

Several stakeholders, such as Stanwell and SnowyHydro, opposed the proposal as they do not support any mandatory obligations on bidirectional units or on generators to provide PFR.[34] Stanwell contended that:[35]

> Both the imposition of mandatory PFR and the additional obligations proposed for bidirectional units do not appear to be consistent with the NEO.

The Commission notes the view of some stakeholders with respect to the continuation of the mandatory PFR arrangements. However, the Commission remains supportive of its previous determination and considers that the mandatory PFR arrangements, combined with the upcoming

27 AEMC Clarifying mandatory PFR obligations for bidirectional units - consultation paper, 3 August 2023, p.5.

28 Prior to the commencement of the IESS rule, batteries are registered as both scheduled generators and scheduled loads

29 AEMC, Mandatory primary frequency response - final determination, p.44, 26 March 2020

30 AEMC, Mandatory primary frequency response - final determination, p.88, 26 March 2020

31 Submissions to the consultation paper: Equis, p.2., ACEnergy, p.2., Akaysha Energy, p.1., Origin Energy, p.1., CS Energy, p.1., AEC, p.2., Alinta, p.1., Tesla, p.1., AEMO, p.2., EnergyAustralia, p.2., BayWa, p.1., CEC, p.1., Engie, p.1., Iberdrola, p.2., Tilt Renewables, p.2.

32 Submissions to the draft determination: AEC, p.1., CS Energy, p.2., Origin Energy, p.1.

33 Eku Energy, submission to the consultation paper, 31 August 2023, p.1.

34 SnowyHydro, submission to the consultation paper, 31 August 2023.

35 Stanwell, submission to the consultation paper, 31 August 2023, p.2.

incentive payments, provide AEMO with the tools it needs to manage the secure operation of the power system in accordance with the technical limits specified in the frequency operating standard (FOS).

The continuation of the mandatory PFR arrangements complemented by FPPs, promotes the NEO by providing an enduring framework to support the long-term provision of PFR and effectively control power system frequency as the generation fleet decarbonises. The Commission also notes that the Reliability Panel has committed to reconsidering the appropriateness of the settings in the FOS pertinent to mandatory PFR by 2027, following sufficient operational experience with frequency performance payments in effect.[36]

The inclusion of incentive payments — commencing on 8 June 2025 — aims to deliver more efficient operation of, and investment in, power system plant. This will occur by encouraging innovation and deployment of new capabilities that will deliver lower overall frequency control costs for consumers over the longer-term.

The final rule promotes good regulatory practice by ensuring scheduled bidirectional units are subject to the same obligations as scheduled and semi-scheduled generators

Stakeholder submissions to the consultation paper largely agreed with the Commission's view that the obligation on scheduled bidirectional units when discharging is consistent with the existing obligations faced by both scheduled and semi-scheduled generators.[37] In its submission, Alinta Energy noted that it:[38]

> Supports the proposal to clarify that scheduled BDUs be required to provide PFR when discharging... there is no reason to exclude scheduled BDUs from the requirements of mandatory PFR which otherwise apply to other generation types in the NEM.

The final rule to apply mandatory PFR to scheduled bidirectional units when discharging, promotes the NEO by:

- ensuring that all large-scale generators participating in the power system are subject to consistent and transparent obligations
- improving system security by ensuring the adequate provision of PFR to maintain frequency control as synchronous generators are progressively replaced by inverter-based resources (IBR).

The mandatory PFR obligation when discharging will be implemented in line with the commencement of the IESS rule

The final rule sets out that the mandatory obligation on scheduled bidirectional units will commence on **3 June 2024.** This timing aligns with the commencement of the IESS rule change and the introduction of the scheduled bidirectional units category. The commencement of the obligation will not result in any material changes for battery operators, as they will continue to be subject to the same obligations as they are currently facing when operating as scheduled generators.

Given that the mandatory PFR obligation will require generators to adhere to the Primary Frequency Response Requirements (PFRR), the Commission is aware that AEMO will need to

36 Reliability Panel, Review of the frequency operating standard - final determination, 6 April 2023, p. iv.
37 Given that batteries are currently classified as scheduled generators when dispatched, the rule will represent a continuation of existing obligations.
38 Alinta, submission to the consultation paper, 31 August 2023, p.1.

update the requirements to reflect any additional obligations faced by bidirectional units. In its submission to the consultation paper, AEMO noted that:[39]

> AEMO asks the AEMC to consider explicitly providing for a PFRR consultation process that will be achievable between the date of the final rule and 3 June 2024.

AEMO's submission to the draft determination reemphasised the need for revisions to the PFRR upon completion of the final determination, noting that:[40]

> There is only a small window after the Final Determination and the rule commencing for AEMO to consult on the PFRR.

As such, the Commission has sought to complete the project in time for AEMO to consult on and revise the PFRR. However, the Commission also understands that a short delay is unlikely to be material — as confirmed in AEMO's submission to the draft determination — as batteries are not expected to seek to revise their frequency response settings if the obligations were to temporarily lapse for a short period.[41]

3.1.2 Scheduled bidirectional units will be required to adhere to the PFRR when charging

The final rule places an obligation on all scheduled bidirectional units, dispatched to charge, to operate their plant in accordance with the performance parameters set out in the PFRR. The obligation does not apply to batteries when solely powering auxiliary loads. Under the final rule, the state of charge of the battery needs to be increasing for the mandatory PFR obligation to apply.

Under the final rule, the obligation on scheduled bidirectional units to provide PFR when charging will commence on 8 June 2025, in line with the commencement of the frequency performance payments.

The IESS rule sought to recognise the more advanced capabilities of bidirectional units compared to scheduled loads

The final rule obligations on scheduled bidirectional units when charging aligns with the outcome and intent of the integrating energy storage systems rule. The IESS rule introduced the bidirectional unit category to simplify the registration and classification process for storage and hybrid systems and to recognise the advanced technical requirements, such as the capability to be frequency responsive. In the final determination, the Commission clarified that:[42]

> Integrated Resource Providers (IRPs) are required to ensure that all of their generating units and bidirectional units meet the technical requirements for frequency control in clause S5.2.5.11 (clause 4.4.2(b)).

As such, the required capabilities of bidirectional units exceed those of scheduled loads, as:[43]

> AEMO understands that most existing scheduled loads in the NEM, other than batteries, are not technically capable of meeting the requirements of the PFRR.

39 AEMO, submission to the consultation paper, 31 August 2023, p.3.
40 AEMO, submission to the draft determination, 25 January 2024, p.2.
41 Ibid.
42 AEMC, IESS final determination, 2 December 2021, p.100.
43 AEMO, submission to the mandatory PFR consultation paper, 31 October 2019, p.8.

Given that bidirectional units will operate as a separate category following the implementation of the IESS rule, it is now possible to distinguish between BDUs and the wider scheduled load category to apply requirements based on unit capability and the long-term benefits to consumers.

The Commission notes that this outcome is not inconsistent with the treatment of scheduled loads under the mandatory PFR or PFR incentive arrangements rules as that decision hinged on AEMO's consistent advice that:[44]

> It is desirable that PFR from batteries is consistent over their entire operating range, from full charge to full discharge. The AEMC is currently considering AEMO's rule change request ERC0280 - Integrating Energy Storage Systems into the NEM. If a new category of Registered Participant is created to cover owners/operators of batteries, AEMO will review the PFRR to address their inclusion at that time.

The obligation to provide PFR when charging promotes power system security by providing consistent and predictable PFR

The Commission considers that applying the mandatory PFR obligation to scheduled bidirectional units when charging promotes power system security as the power system decarbonises. The final rule:

- increases the pool of PFR available as thermal generators are progressively replaced by variable renewable energy, especially at times with high distributed PV
- ensures that connected plant operate with consistent control systems, thereby providing AEMO with a greater understanding of the system's response to contingency events
- promotes the secure decarbonisation of the power system.

Scheduled BDUs providing PFR will support system security at times with high rooftop solar

Several stakeholder submissions to the consultation paper identified the benefits to system security if batteries were required to provide PFR when charging.[45] ACEnergy's submission concluded that:[46]

> Requiring bidirectional units to provide PFR when charging is appropriate. As it is expected that bidirectional units will charge at periods when low-cost generation is prevalent, and such generation sources do not necessarily provide PFR, it is appropriate that bidirectional units contribute to PFR while charging.

Iberdrola's submission noted that despite not currently supporting the introduction of a mandatory obligation when charging:[47]

> In the future, requiring batteries to provide MPFR while charging is not unreasonable, pending feedback from existing battery operators. At this time, Iberdrola Australia already voluntarily provides this service from our batteries to support the operation of the grid.

This reinforces the view set out in AEMO's rule change request. That is, that expanding the mandatory obligation to scheduled BDUs will enhance system security as batteries will contribute to the control base and provide PFR, as required, at a very low incremental cost to battery operators.

44 AEMO, submission to the mandatory PFR consultation paper, 19 October 2019, p.8.
45 Submissions to the consultation paper: ACEnergy, p.2, Akaysha Energy, p.1, EnergyAustralia, p.3.
46 ACEnergy, submission to the consultation paper, 31 August 2023, p.2.
47 Iberdrola, submission to the consultation paper, 31 August 2023, p.6.

The improvement to system security has been found to provide benefits to consumers related to the avoidance of costs associated with load interruptions and excess procurement of frequency control services. This underlying assumption was tested in the Panel's *Review of the frequency operating standard 2022* where GHD analysis confirmed that narrow frequency control results in:[48]

- lower aggregate frequency control costs for consumers
- improved system resilience to non-credible contingency events.

Operating with consistent and predictable control settings promotes system security

AEMO's rule change request articulated a concern that the existing rules inhibit the continuous application of PFRR control settings.[49] AEMO's concern is that the existing requirements do not support future operational outcomes where control system settings are applied consistently and predictably and that this could undermine system security during future operational periods where there is a small volume of synchronous thermal plant online.

When batteries are operating commercially, AEMO's rule change request considered that they should be obligated to operate with continuous PFR settings across operating modes as:[50]

> Ideally all units should always operate with control settings consistent with the PFRR, and thus provide a continuous proportional response from the [primary frequency control band] PFCB and throughout the full range of operating frequency. This should include those batteries enabled for contingency FCAS as proportional controllers.

Related to the consistency and predictability of PFR provision while charging, the AEC's submission notes that a mandatory obligation would be unnecessary as:[51]

> If FPP performs as hoped, those bidirectional units that can perform this service at low costs are likely to voluntarily provide it.

The Commission notes the AEC's feedback that units would likely voluntarily provide PFR if sufficiently incentivised. However, it is clear from AEMO's rule change request that there are security benefits to bidirectional units operating with consistent and predictable frequency response modes. The Commission's view is that placing a mandatory obligation on market participants, as opposed to relying on the incentive arrangements, can only be justified if the incremental cost faced by the affected party is likely to be immaterial in comparison to the benefits. The Commission is satisfied that the consistency and predictability benefits outweigh the costs of introducing a mandatory obligation, given that:

- the cost of providing PFR when charging is unlikely to significantly increase operational costs and
- that batteries will be compensated through frequency performance payments.

Mandatory PFR obligations when charging promotes the secure decarbonisation of the power system

As identified in AEMO's *Engineering Framework*, consistent, predictable and reliable PFR is crucial to enable the secure decarbonisation of the power system and the operation of the power system

48 Reliability Panel, Review of the frequency operating standard 2022 - final determination, 7 April 2023, p.11.
49 AEMO rule change request.
50 AEMO rule change request, p.16.
51 AEC, submission to the consultation paper, 31 August 2023, p.2.

at 100% instantaneous penetration of renewables.[52] In the *Engineering Roadmap to 100% renewables* publication, AEMO noted that it would need to:[53]

> Assess narrow-band primary frequency response needs as increasing DPV displaces frequency responsive plant online in the daytime.

The Commission agrees that the mandatory obligation on batteries when charging will increase AEMO's confidence that sufficient PFR will be available at times with high distributed generation and low operational demand. Having sufficient confidence in the security of the power system in those circumstances should enable a more rapid and efficient decarbonisation of the power system. It will also help minimise the need to curtail renewable generation to ensure the aggregate frequency responsiveness of the system is sufficient to manage credible and non-credible contingency events.

The obligation to provide PFR when charging is unlikely to materially increase costs

In the consultation paper, the Commission sought stakeholder views on the expected incremental cost of being responsive to frequency when charging. Views expressed in submissions[54] ranged from the costs being significant, such as from Origin stating that:[55] [56]

> The proposal will require batteries to respond to frequency deviations over a broader range of battery operating modes. This will result in the additional cycling of batteries which will increase wear and tear, potentially eroding effective asset life.

Or, that the costs would likely be immaterial, such as from Tesla:[57]

> Tesla does not believe this is a material issue as experience in the Australian market suggests that the optimised bidding strategy typically results in the battery being dispatched under AGC the clear majority of the time... [if] the battery is dispatched under AGC >90% of the time — it would result in increased energy throughput of <1% based on Tesla internal analysis.

The Commission also understands that most batteries in the NEM already voluntarily provide PFR when charging and that revising frequency control settings to not provide PFR could be costly to implement and difficult to justify given the increasingly complex control system required.[58]

As such, guided by stakeholder feedback and internal analysis, the Commission is comfortable concluding that the provision of PFR when charging is unlikely to result in material incremental costs. The final rule obligation will mirror the existing requirements on batteries when discharging and will only result in a slight increase or decrease in charge rate in response to local frequency measurements. Subject to the battery's charge rate not crossing 0MW, the battery is not likely to experience any increased throughput or cycling by being frequency responsive, all while benefiting from frequency performance payments.

52 AEMO, Engineering Roadmap to 100% Renewables, December 2022.

53 Ibid., pp.73-74.

54 Note: several stakeholder submissions did not differentiate between the cost of providing PFR when charging specifically. Instead, they also included the cost of providing PFR when enabled for market ancillary services.

55 Submissions to the consultation paper: Shell Energy (alongside when enabled for C-FCAS), p.5, Eku Energy (alongside when enabled for C-FCAS), p.4,

56 Origin Energy, submission to the consultation paper, 31 August 2023, p.1. Note: the Origin submission does differentiate between the cost of providing PFR when charging and when enabled for market ancillary services.

57 Tesla, submission to the consultation paper, 31 August 2023, p.2.

58 Submissions to the consultation paper: Akaysha Energy, p.2, Iberdrola, p.7.

However, the Commission agrees that providing PFR when idle (at 0MW) would result in material costs as batteries would exhaust warranted cycles by continuously crossing 0MW as they switch between charging and discharging. As such, the Commission's final rule provides that batteries will not be required to provide PFR when idle or solely powering auxiliary systems, such as fans or control systems as such a scenario could result in unwarranted costs being incurred.

The final rule minimises regulatory uncertainty and investment risk

The Commission is aware that stakeholders may have concerns that prolonged consideration of obligations on batteries to provide PFR could increase the uncertainty around technical obligations and act to increase the perceived investment risk for grid-scale battery energy storage systems. The frustration with the re-prosecution of the requirements for scheduled bidirectional units was clearly articulated in many stakeholder submissions,[59] in particular Iberdrola noted:[60]

> While AEMO and the AEMC have framed this rule change as "seeking to resolve uncertainty", it is problematic to reopen issues that were considered only 8 months earlier (and that were supported by three years of discussion and analysis). Regulatory uncertainty risks delaying critical investment and places State and Commonwealth decarbonisation targets at risk, which we consider should be a key focus of Australia's key regulatory bodies.

The Commission notes stakeholder sentiment that reconsidering the mandatory PFR settings for bidirectional units exposes existing assets and new investments to increased uncertainty and risk. However, as explained below, the Commission's reconsideration of the PFR obligations for bidirectional units is consistent with previous determinations where a desire to eventually reconsider the obligations of batteries was foreshadowed.

We have therefore sought to promptly resolve the remaining issues through this rule change request to establish enduring arrangements and clarify the PFR obligations of batteries over the longer term. The Commission hopes that it negates the need for another complex and potentially disruptive project following the implementation of the frequency performance payments.

Stakeholder submissions noted the outcome of the Commission's previous determinations and the conflict with technology neutrality

As outlined above, the new bidirectional unit category gives the Commission the ability to differentiate between the capabilities of bidirectional units and those of scheduled loads. Stakeholder submissions to the consultation paper questioned the Commission's proposal on the basis that it:

- could conflict with the previous PFR determinations that did not introduce an obligation when charging[61]
- would conflict with the principle of technology neutrality to apply more extensive obligations on BDUs when operating as a load[62]
- would place batteries at an unfair disadvantage as they would still remain liable for transmission and distribution costs.[63]

59 Stakeholder submissions to the consultation paper: Equis, p.2, Eku Energy, p.3, Tesla, p.4, Iberdrola, p.2, CEC, p.3, Tilt Renewables, pp.1-2.
60 Iberdrola, submission to the consultation paper, 31 August 2023, p.2.
61 Submissions to the consultation paper: AEC, p.2, Stanwell, pp.6-7, EnergyAustralia, pp.2-3, Shell Energy, p.5, Iberdrola, p.3.
62 Submissions to the consultation paper: Equis, p.2, Alinta, p.2, BayWa, pp.1-2, Fluence, p.2, the CEC, p.2.
63 Submissions to the consultation paper: Equis, p.2, BayWa, pp.1-2, Fluence, p.2, Iberdrola, p.3.

The Commission views that the obligation is consistent with previous determinations

The Commission notes stakeholder feedback with respect to the previous consideration of a mandatory obligation to provide PFR when charging. In the mandatory PFR final determination, the Commission decided against applying the mandatory PFR obligation to scheduled loads, including charging battery energy storage systems:[64]

> When operating in a charging mode, battery energy storage systems will be treated the same as other scheduled loads, which are not required to provide PFR.

The Commission recognised that the obligations on batteries may be reconsidered if a new market registration category were introduced, concluding that:[65]

> The Commission also notes that arrangements for energy storage systems will be considered through the upcoming rule change, Integrating energy storage systems into the NEM. AEMO has stated that, if a new category of Registered Participant is created to cover owners/operators of batteries, it will review the PFRR to address their inclusion at that time.

As outlined above, as part of the IESS final determination the Commission created a new class of registered unit — the scheduled bidirectional unit — and required that all generating and bidirectional units must meet the minimum requirements for frequency control.[66]

As such, the Commission considers that it is consistent with previous determinations to reconsider a mandatory obligation on scheduled bidirectional units when charging. At the time, the Commission and AEMO both articulated a desire to reconsider the appropriateness of the settings once the IESS rule was completed. In response to AEMO's rule change request, the Commission has undertaken that process.

Placing an economically immaterial obligation solely on bidirectional units does not conflict with technology neutrality

Stakeholder submissions to the consultation paper noted the tension with the principle of technology neutrality if the Commission were to introduce obligations that apply solely to bidirectional units and not scheduled loads. Equis noted that:[67]

> Imposing this obligation on charging or un-dispatched BESS is costly and inconsistent with the concept of technological neutrality.

The Commission agrees with stakeholders that placing specific obligations on bidirectional units and not scheduled loads, in general, could conflict with technology neutrality and result in undesirable outcomes if the cost of compliance were material. However, in the case of charging BDUs, the Commission has concluded that the security benefits provided by the obligation would significantly outweigh the likely marginal costs incurred by battery operators — illustrated by the current reality of battery operators providing PFR when charging voluntary and without compensation.[68] As such, due to the insignificant cost that would be incurred by the bidirectional units and the security benefits to the overall energy system as thermal generators retire, the Commission considers that it is in the long-term interests of consumers.

64 AEMC, Mandatory primary frequency response - rule determination, 26 March 2020, p.46.
65 Ibid., p.99.
66 AEMC, IESS final determination, p.100.
67 Equis, submission to the consultation paper, 31 August 2023, p.2.
68 Submission to the consultation paper: Iberdrola, p.6; Akaysha Energy, p.2.

Scheduled bidirectional units remain liable for transmission and distribution charges despite providing PFR

Several stakeholder submissions to the consultation paper argued that, given batteries are subject to transmission use of system (TUOS) charges like other scheduled loads, they should not be subject to greater obligations when operating as a load.[69] For example, Equis' submission noted:[70]

> If BDUs are considered loads when allocating TUOS charges (as per the AEMC's final IESS rule change), then it follows that they should only face the same obligations as loads, when charging, and loads are under no PFR obligations when they are consuming power from the power system.

The Commission notes that under the IESS rule, the default position is not that storage must pay network charges. Rather, storage participants can choose the service they need and whether they go through the process of obtaining a negotiated or prescribed shared transmission service.[71] The IESS final determination also noted many existing batteries have already negotiated low or zero network charges with their TNSP and that:[72]

> New transmission–connected storage participants will be able to negotiate arrangements with TNSPs in the same way existing storage participants have. The Commission expects that, in accordance with the NER, TNSPs will negotiate price and service levels that are consistent with those that have been negotiated for existing storage participants.

As such, the Commission does not consider that batteries being subject to network charges is sufficient justification to reject AEMO's proposed mandatory PFR obligation when charging.

Stakeholders identified a mistake in the Commission's draft determination that implied that the mandatory PFR obligation when charging would represent a continuation of current obligations

Stakeholders correctly identified a drafting oversight in the draft determination, that incorrectly asserted that batteries are currently obligated to adhere to the PFRR when charging.[73] As identified in the Shell submission:[74]

> Batteries currently have no obligation to provide MNBPFR [mandatory narrow-band PFR] when charging in the rules so this cannot be viewed as a continuation of the existing obligations.

The Commission agrees that batteries have not been required to adhere to the PFRR when charging in the past. As such, the new obligations do not represent a continuation of previous requirements, unlike the mandatory PFR obligation when discharging. We have rectified the error in the final determination and acknowledge the oversight in the draft determination.

The obligation on scheduled BDUs when charging does not apply when solely powering auxiliary systems

In response to stakeholder feedback, the final rule excludes the powering of auxiliary systems. Bidirectional units not explicitly increasing their state of charge but drawing power (for example, for cooling or to power control systems) are not subject to the mandatory PFR obligation. The

69 Submissions to the consultation paper: Equis, p.2, BayWa, pp.1-2, Fluence, p.2, Iberdrola, p.3.
70 Equis, submission to the consultation paper, 31 August 2023, p.2.
71 AEMC, Integrating energy storage systems - final determination, 2 December 2021, p.52.
72 Ibid., p.vii, p.53.
73 Submissions to the draft determination: Shell, p.3; CS Energy, p.2.
74 Shell, submission to the draft determination, 25 January 2024, p.3.

drafting seeks to reduce the costs incurred by the bidirectional unit operator as the continuous provision of PFR when idle — or close to 0MW — could result in material cycling costs.

Units solely powering auxiliary systems are not actively participating in the energy market, and as such, we consider that it would be a disproportionate burden for those units to be required to comply with the PFRR at those times. Despite this, we still support and encourage the continuous and voluntary provision of PFR by bidirectional units to benefit from FPPs and support power system security.

Scheduled bidirectional units' PFR may be limited as it approaches being fully charged or fully discharged

Submissions to the draft determination by AEMO and Shell identified the risk of non-compliance with their PFR obligations for scheduled bidirectional units as they near fully charged or fully discharged.[75] As AEMO noted in its submission:[76]

> AEMO understands that a battery's charge rate reduces as the state of charge (SOC) nears maximum charge and this may affect the quality of primary response. AEMO considers the obligation to comply with the PFRR is to operate the plant with required settings and does not obligate quality of the response, for example stored energy, headroom, or specifying a particular operating control mode.

The Commission agrees with Shell and AEMO that, in those operational circumstances, batteries should be provided a variation to account for throttled PFR responses to avoid the risk of plant damage and non-compliance with the rules. Charge rate limits when reaching maximum or minimum state of charge seek to prevent any of the battery cells being overcharged which — in a worse case scenario — could result in the thermal run-away and fire. Limiting the rate of charge at the BESS level allows for careful control of charging across all parallel cells to ensure none are overcharged.

However, the Commission does not consider the rules to be the appropriate avenue through which to provide the variation. Instead, we consider it better placed in the PFRR, where AEMO could periodically update the variation without requiring revisions to the rules. This would allow for a more flexible approach to adjusting this over time as technology evolves. As an example, clause 6.6.(a) of the PFRR already provides a similar variation for generators whose PFR response may be impacted to maintain operation between the generators maximum and minimum operating levels:[77]

> The ability of an Affected GS to provide PFR will be affected from time to time by one or more of the factors or causes detailed below, in which case the Affected GS will not be required to provide PFR to the extent that its ability to do so is impacted by the relevant factor or cause:
>
> ...
>
> (b) to maintain operation between the Affected GS' Maximum Operating Level and Minimum Operating Level;
>
> ...

75 Submission to the draft determination: AEMO, p.2; Shell Energy, p.2.
76 AEMO, submission to the draft determination, 25 January 2024, p.2.
77 AEMO, Primary frequency response requirements, 8 May 2023, p.11.

The obligation on scheduled bidirectional units when charging will commence in line with FPPs

The final rule sets out that the mandatory obligation on scheduled bidirectional units commences on **8 June 2025** in line with the commencement of the frequency performance payments. In doing so, the Commission seeks to ensure that scheduled BDU operators are adequately compensated for the provision of PFR when charging. In addition, we understand that most, if not all, bidirectional units are already voluntarily providing PFR at all times and, as such, any security benefit from bringing forward the obligation would likely be insignificant.

3.1.3 Scheduled bidirectional units will be required to adhere to the PFRR when enabled for regulation FCAS

The final rule places an obligation on all scheduled bidirectional units, dispatched to provide regulation FCAS, to operate their plant in accordance with the performance parameters set out in the PFRR.

The following section sets out the Commission's justification for applying the mandatory obligation to scheduled bidirectional units, including that it promotes power system security, emissions reduction and market efficiency by increasing the frequency responsiveness of the system at minimal incremental cost as the system continues to decarbonise.

The obligation when enabled for regulation FCAS promotes system security by increasing the overall frequency responsiveness of the system

AEMO's rule change request identified a concern around the certainty that there will be sufficient PFR in the future to support system security on an ongoing basis.[78] AEMO's view is that:[79]

> As the installation of batteries continues in greater numbers and at larger scale, combined with the retirement of large thermal generating units, their contribution to maintaining good frequency control via the provision of PFR will become increasingly important, and may be insufficient if excluded across significant periods of their operation.

The Commission's mandatory PFR determination omitted batteries enabled solely for FCAS from the mandatory obligations. AEMO's rule change proposal requested the Commission reconsider this omission in light of the introduction of the new bidirectional unit category, the expected increase in the number of batteries connecting to the grid, and the scheduled commencement of frequency performance payments in 2025.

The Commission has concluded that introducing an obligation for scheduled bidirectional units enabled for regulation FCAS to provide PFR promotes power system security and is in the long-term interests of consumers. It supports the adequate provision of PFR to meet future system security needs during operational periods where there is a small volume of synchronous units online and low operational demand.

Several stakeholder submissions supported the proposal to require plant enabled solely for regulation FCAS to adhere to the PFRR given that both products are intended to account for frequency deviations during normal operation.[80] For example, AGL's submission concluded that:[81]

> For regulation FCAS we consider a requirement that bidirectional units be required to provide PFR sensible as being enabled for regulation FCAS requires a unit to be constantly

78 AEMO, Engineering Roadmap to 100% Renewables | FY2024 Priority actions, 10 July 2023, p.14.
79 Ibid., p.13.
80 Stakeholder submissions to the consultation paper: AGL, p.2.
81 AGL, submission to the consultation paper, 31 August 2023, p.2.

> adjusting for frequency deviations anyway.

Frequency performance payments are intrinsically linked to regulation FCAS prices

The Commission's final determination is based on the understanding that the provision of PFR when enabled for regulation FCAS is unlikely to materially increase operational costs. As both products seek to manage frequency deviations during normal operation, the Commission considers that the incremental cycling cost is unlikely to be material, and that bidirectional units will be adequately compensated through regulation FCAS payments and FPPs.

Several stakeholders recommended limits to PFR responses when enabled for regulation FCAS

Shell and the AEC's submission to the draft determination generally supported the Commission's draft determination to require batteries to provide MPFR when enabled for regulation FCAS.[82] However, the AEC stated that:[83]

> This obligation should only extend to the regulation FCAS enablement level.

Despite the stakeholder feedback, the Commission has decided against limiting the obligation to the regulation FCAS enablement level as the potential negative outcomes do not justify the likely increase in complexity were such a limit practically implemented. Given the relative stability of frequency following the implementation of mandatory PFR, it is unlikely that batteries' PFR provision would exceed their regulation FCAS enablement amount. As noted in AEMO's submission:[84]

> With frequency tightly controlled, a battery that operates with "narrow-band" PFR will have to do little work, because primary response on the unit is in proportion to the change in frequency.

Even in the unlikely case that it did occur, the Commission considers that the frequency performance payments the unit would be entitled to — intrinsically linked to the regulation FCAS price in that dispatch interval — would be sufficient compensation. Furthermore, the Commission appreciates that disentangling the provision of PFR related solely to the provision of regulation FCAS when a battery is simultaneously charging or discharging, or dispatched for contingency FCAS would be exceedingly difficult and may negate any benefits from the introduction of such a limit.

The obligation on scheduled bidirectional units when enabled for regulation FCAS commences on 8 June 2025

The mandatory obligation on scheduled bidirectional units commences on **8 June 2025** in line with the commencement of the frequency performance payments. In doing so, the Commission seeks to ensure that BDU operators are adequately compensated for the provision of PFR when enabled for regulation FCAS. In addition, we understand that most scheduled bidirectional units are already providing the service voluntarily, meaning that there is unlikely to be any security benefits in bringing forward the obligation.

82 Submissions to the draft determination: Shell, p.2; AEC, p.2.
83 AEC, submission to the draft determination, 25 January 2024, p.2.
84 AEMO, submission to the draft determination, 24 January 2024, p.2.

3.1.4 Other changes to promote the long-term provision of consistent and predictable PFR

In addition to the solutions proposed by AEMO, the Commission has considered whether other amendments could help address the issue identified in the rule change request and support system security and the long-term provision of PFR. As such, the Commission implemented other measures that complement the incoming frequency performance payment arrangements to support the provision of consistent and predictable PFR and address the issues identified by AEMO. These are:

- Extending clause 5.3.9(a1) to include scheduled bidirectional units to ensure that they are not required to renegotiate their connection agreements when modifying frequency response settings in compliance with the PFRR.
- Refinements to the monitoring and control requirements in clause S5.2.6.1 to clarify that AEMO may request that the status of the frequency controller be transmitted using existing communications equipment.
- Minor addition to clause 4.9.4(e) of the NER to clarify that semi-scheduled generators may not change frequency response settings without the prior approval of AEMO. The IESS rule change will include scheduled bidirectional units in this provision when it commences on 3 June 2024.
- Consequential changes to the requirements of the PFRR, AEMO's ability to grant an exemption from, or variation to, any of the PFR parameters set out in the PFRR, and the references to the PFR obligations in the signpost notes in clause S5.2.5.11.

Scheduled bidirectional units will not be required to reopen their connection agreement when adjusting PFR settings in compliance with the PFRR

In discussions with the Commission, stakeholders identified the risk that revising the frequency response settings of a bidirectional unit — in accordance with the PFRR — could require the renegotiation of pertinent parts of their connection agreement at significant cost and the risk of material uncertainty.

This interaction was similarly identified by stakeholders in response to the mandatory PFR draft determination.[85]

AEMO's submission to the mandatory PFR draft determination recommended that the final rule include a provision to suspend the application of clause 5.3.9(d) of the NER for approved changes to plant to comply with the PFRR.[86] AEMO noted that:

> After having reviewed a substantial number of GPS applicable to the generating systems that will be affected by the proposed rule, AEMO considers that there is a need to expressly confirm that clause 5.3.9 of the NER does not apply to Generators where the only changes made to plant to meet the PFRR are, for example:
>
> - distributed control systems (DCS) load controllers
> - deadbands and droop settings in governor control software
> - governor gains (Kp and Ki) and deadband software.

Submissions to the draft determination supported the Commission's decision to exempt BDUs from the

85 Submissions to the mandatory PFR draft determination: AGL, p.3; CEC, p.4; Goldwind, p.2; Meridian Powershop, p.3.

86 Clause 5.3.9(d) specifies the alterations to plant equipment that could necessitate a renegotiation of the connection agreement.

5.3.9 process when adhering to the PFRR

The Commission's final rule extends the provision to include scheduled bidirectional units to ensure that compliance with the PFRR does not require batteries to reopen the relevant parts of their connection agreement. Submissions to the draft determination strongly supported the proposal, considering it an:[87] [88]

> Important point and Tesla supports the extension of the current application of clause 5.3.9(d) to confirm that Scheduled Bidirectional Units would also not be subject to a clause 5.3.9 renegotiation for the purposes of PFR compliance

To promote predictability and security the final rule allows AEMO to request that units regularly transmit the status of their frequency controller

AEMO's rule change request identified the need for predictable and consistent PFR to control power system frequency and thereby maintain security. The Commission recognises that there is a need for AEMO to have visibility over the frequency responsiveness of power system plant such that AEMO's power system models accurately reflect the real behaviour of the power system. The accuracy of power system models is a fundamental element in AEMO being able maintain system security by effectively predicting how the power system will respond to disturbances.

As such, to promote AEMO's operational visibility of the frequency responsiveness of the system, the final rule revises the monitoring and control requirements[89] requiring affected plant transmit the status of their frequency controller to AEMO. The Commission's proposal seeks to improve AEMO's operational awareness of the system's response to contingency events while limiting costs by leveraging existing SCADA communications equipment.

Stakeholder submissions to the draft determination generally supported the decision to increase AEMO's operational awareness of the frequency responsiveness of the power system.[90] Tesla noted that it is:[91]

> Broadly supportive of this proposed addition and does not feel like it would result in significant additional work to provide AEMO this additional data point. Note that our assumption is that providing AEMO with the "status" of the frequency controller, just refers to providing a signal as to whether it is on or off.

The Commission agrees with Tesla's assumption, that the affected units would only be required to transmit if the frequency controller is activated or deactivated to minimise administrative and implementation costs for both generators and AEMO.

The final rule clarifies that semi-scheduled generators and scheduled bidirectional units may not change frequency response settings without prior approval of AEMO

Clause 4.9.4(e) of the NER states that a scheduled generator (and scheduled bidirectional unit once the IESS rule commences) may not change its frequency response modes without the prior approval of AEMO. Despite dating since the start of the NEM, the clause in question has been somewhat superseded by the:

87 Submissions to the draft determination: EnergyAustralia, p.2; Origin Energy, p.1; Tesla, p.2; CS Energy, p.3.
88 Tesla, submission to the draft determination, 30 January 2023, p.2.
89 Clause S5.2.6 of the NER.
90 Submissions to the draft determination: EnergyAustralia, p.2; Tesla, p.1;
91 Tesla, submission to the draft determination, 30 January 2023, p.1.

- requirements for both scheduled and semi-scheduled units to adhere to the requirements in the PFRR when generating
- requirements for scheduled bidirectional units to adhere to the PFRR when generating, charging or enabled for regulation FCAS.

The drafting of NER cl 4.9.4(e) reflects a historical view that semi-scheduled generator were not able to provide primary frequency response

In 2008, the Commission published the final determination in the *Central Dispatch and Integration of Wind and Other Intermittent Generation* rule that introduced the semi-scheduled classification.[92]

NEMMCO's[93] rule change proposal sought to amend clause 4.9.4(e) to apply the same dispatch-related limitations to semi-scheduled generators as currently apply for scheduled generating units.[94]

Stakeholder submissions questioned the need for the proposed provision on the basis that it would be above and over that agreed in the performance standards. With Auswind noting that:[95]

- Wind turbines by definition do not have a 'frequency response mode', rather they simply follow the system frequency.
- The provision infers a control function that does not exist.

Despite the fact that at the time the Commission agreed with stakeholder submissions that NEMMCO did not sufficiently justify the need for the requirement that semi-scheduled generators have a PFR facility, the current requirements under the rules require semi-scheduled generators be frequency responsive and adhere to the PFRR when generating. As such, the Commission considers that including semi-scheduled generators in this clause is consistent with their existing obligations under the NER.

The proposal promotes consistent and predictable PFR

As discussed above, it is now technically feasible for variable renewable generation, including wind and solar, to operate in a frequency response mode and in accordance with the frequency response technical requirements specified in S5.2.5.11, as required by the mandatory primary frequency response obligation. At the same time there is a recognition that the pool of frequency responsive plant will need to expand in order to maintain system security during periods of 100 per cent renewable operation. As such, the Commission is convinced that requiring that frequency responsive plant that have registered their frequency response settings with AEMO, may not change these settings, unless by approval of AEMO, promotes the consistent and predictable provision of PFR.

3.2 The final rule will not apply the full obligations proposed by AEMO

92 See: https://www.aemc.gov.au/rule-changes/central-dispatch-and-integration-of-wind-and-other

93 From 1 July 2009 NEMMCO ceased operations with the roles and responsibilities transferred to AEMO

94 NEMMCO, Rule change request - Semi-Dispatch of Significant Intermittent Generation, 23 April 2007, p.49.

95 Auswind submission to the Semi-dispatch of Significant Intermittent Generation consultation paper, 10 July 2007, p.30.

Box 3: The Commission's final determination is not to apply the full range of obligations proposed by AEMO

The Commission has decided against introducing an obligation for bidirectional units to adhere to the PFRR when enabled solely for contingency FCAS, because:

- batteries are likely to incur material costs due to expending additional warranted cycles
- the obligation would be unlikely to materially improve system security outcomes
- there are sufficient incentives for BDUs to voluntarily provide PFR.

AEMO's rule change request sought to clarify the mandatory PFR obligations faced by scheduled bidirectional units by applying the obligation when charging, discharging or enabled for market ancillary services (regulation and contingency FCAS). AEMO's rule change request did not propose that scheduled BDUs be required to provide PFR when idle and not enabled for contingency FCAS.

The Commission's final rule applies the mandatory PFR obligation to bidirectional units when:

- discharging — in line with the existing obligations faced by batteries
- charging — except for when a battery is solely powering its auxiliary systems
- enabled for regulation FCAS — given the intrinsic link between the provision of PFR and regulation services.

The Commission has concluded that the costs of the additional obligations proposed by AEMO outweigh the benefits. As such, the Commission seeks to clarify that scheduled bidirectional units will **not** be required to be PFR responsive when enabled solely for contingency FCAS.

In addition, the final rule will not require a bidirectional unit to provide PFR when at rest, i.e. not dispatched to generate or consume electricity or enabled to provide a regulation service (sitting at 0MW).

3.2.1 Scheduled bidirectional units will not be required to adhere to the PFRR when enabled solely for contingency FCAS

The Commission has concluded that the costs of introducing a mandatory PFR obligation for BDUs solely enabled for contingency FCAS outweighs the benefits. As such, the Commission's final determination is that the proposed obligation would be unjustified and disproportionate, because:

- applying the obligation to BDUs solely enabled for contingency FCAS could result in material costs with the potential for unintended interactions with the contingency FCAS market
- applying the obligation would be unlikely to result in material improvements to system security
- existing frameworks already sufficiently incentivise the voluntary provision of PFR by BDUs enabled for contingency FCAS.

This section outlines the Commission's reasoning in greater detail.

Applying the mandatory PFR obligation to bidirectional units solely enabled for contingency FCAS

could result in material operational costs

Stakeholder submissions to the consultation paper strongly opposed the proposed application of the mandatory PFR obligation to units solely enabled for contingency FCAS due to the material costs that would be incurred by operators of bidirectional units.[96] For example, Equis noted that:[97]

> Mandating a BDU to provide PFR when the BDU is not being dispatched but only enabled for FCAS services would force the BESS to cycle at all times and thereby consume its finite energy throughput capacity a lot faster than anticipated without being remunerated for the additional cost of energy throughput. It is akin to forcing an open cycle gas turbine to generate electricity during energy market trading intervals where the electricity price is below its short run marginal cost (i.e. during the vast majority of the year) only to be able to mandate it to provide PFR.

Akaysha supported the proposed obligation, noting that — subject to frequency performance continuing to be narrowly controlled:[98]

> Batteries should contribute their services in accordance with their technical capabilities. Such an approach would lead to an enhanced efficiency of the overall electricity system.

AEMO's submission to the consultation paper also supported the proposed extension of the obligation but noted that the proposal should take into consideration the costs incurred and that this element is a secondary priority compared to batteries providing PFR when charging or discharging[99]

> AEMO accepts that if the balance of costs does not support this element of the proposal, it should not proceed. The immediate priority to adequately support the power system is for scheduled BDUs to comply with the PFRR when both charging and discharging, with FCAS presently a secondary matter.

In addition, as identified in their submission to the consultation paper, Shell Energy has provided the Commission with confidential data illustrating the potential cost on a BESS operator and the wider market of implementing the proposed increased PFR obligations.[100] The confidential data confirmed that battery operators could be exposed to substantial and uncontrollable costs, including round-trip efficiency losses, net energy storage losses, and considerable micro-cycling when providing PFR with a generation or charging dispatch target of 0MW.

Submissions to the consultation paper and the draft determination supported the Commission's position

Based on stakeholder feedback and internal analysis, the Commission's view is that requiring batteries to provide PFR when enabled for contingency FCAS would likely result in material costs being incurred by the operators as they deplete warranted cycles. This compares unfavourably to the proposed obligation when charging or discharging where we concluded that providing PFR will be unlikely to result in any incremental degradation as the charging or discharge rate will only marginally increase or decrease in response to frequency.

96 Submissions to the consultation paper: Equis, p.2, ACEnergy, pp.1-2, Origin Energy, p.1, CS Energy, p.1, AEC, pp.2-3, Stanwell, pp.6-8, Tesla, p.6, EnergyAustralia, p.3, Shell Energy, p.5, Toshiba, p.1, BayWa, pp.1-2, Eku Energy, p.4, Fluence, p.2, AGL, p.2, GridBeyond, p.1, Iberdrola, p.2, Tilt Renewables, p.1, FlowPower, p.1, Engie, p.1, CEC, p.1.

97 Equis, submission to the consultation paper, 31 August 2023, p.2.

98 Akaysha Energy, submission to the consultation paper, 31 August 2023, p.1.

99 AEMO, submission to the consultation paper, 31 August 2023, p.3.

100 Shell, submission so the consultation paper, 31 August 2023, p.5

Stakeholder submissions to both the consultation paper[101] and the draft determination[102] strongly supported the Commission's position to not introduce an obligation for bidirectional units when idle or enabled solely for contingency FCAS.

The cost impact on batteries could be somewhat alleviated by setting multiple droop settings

Several stakeholder submissions noted that the cost of providing PFR when enabled for contingency FCAS could be somewhat alleviated by bidirectional units adjusting droop settings to desensitise the response within the normal operating frequency band (NOFB). For example EnergyAustralia noted that:[103]

> The obligation to keep reserves available for PFR provision while resting, will take away stored energy for use in contingency FCAS markets. While this can be partially controlled through carefully set droop settings, the overall cost impact may mean that battery operations need to adjust their FCAS offers upwards or remove their asset from the market.

Despite this, the Commission still considers that placing an obligation solely on bidirectional units to provide PFR when enabled for contingency FCAS would subject batteries to unjustified costs without resulting in a material improvement in system security. In addition, the voluntary provision of PFR by all units, including those enabled only for contingency FCAS, continues to be encouraged and incentivised through the frequency performance payments.

The obligation could have unintended consequences on the contingency FCAS market

In response the consultation paper, several stakeholder submissions noted that applying the obligation to bidirectional units solely enabled for contingency FCAS may result in batteries increasing their contingency FCAS offers or reducing availability, both of which would not be in the long-term interests of consumers.[104]

The Commission agrees with stakeholder submissions and considers that applying a mandatory obligation in this case could result in increased costs as battery operators are required to increase bids in response to increased costs, or are required to withdraw capacity to remain within their allocation of daily warranted cycles. The potential for these increased costs is outlined in AGL's submission:[105]

> Requiring the provision of PFR when enabled for contingency FCAS will increase costs and physical degradation of bidirectional units and impact warranties for units from suppliers which have total cycle limits that capture these adjustments.

Applying the mandatory PFR obligation to bidirectional units solely enabled for contingency FCAS would be unlikely to materially promote power system security

AEMO's rule change request proposed to require that scheduled bidirectional units enabled for contingency FCAS provide PFR. AEMO's justification closely aligns with the reasoning outlined above with respect to the requirement for scheduled BDUs to provide PFR when charging — outlined in section 3.1.2. AEMO considers that the proposed change is required to provide the necessary and ongoing support for power system security into the future as thermal generators

101 Submissions to the consultation paper: Equis, p.2; ACE Energy, pp.1-2; Origin Energy, p.1; CS Energy, p.1; AEC, pp.2-3; Stanwell, pp.6-8; Alinta, p.2; EnergyAustralia, pp.3-4; BayWa, pp.1-2; Eku Energy, p.4; Fluence, p.2; CEC, p.1, Engie, p.1, Iberdrola, p.2; Tilt Renewables, p.1.

102 Submissions to the draft determination: Shell Energy, p.1; EnergyAustralia, pp.1-2; AEC, p.3; CS Energy, p.3; Origin, p.1; EUAA, p.1; Stanwell, p.1.

103 EnergyAustralia, submission to the consultation paper, 31 August 2023, pp.3-4.

104 Submissions to the consultation paper: Equis, p.3, ACEnergy, p.1, Origin Energy, p.1, Stanwell, p.9, AEC, pp.2-3, EnergyAustralia, pp.2-3.

105 AGL, submission to the consultation paper, 31 August 2023, p.2.

are increasingly replaced by inverter baser resources and Distributed Photo-Voltaic (DPV) — roof-top solar generation.

AEMO considers that the proposal aligns with the general economic and system security logic underpinning the mandatory PFR requirements and hinges on the view that:

- increasing the supply of PFR is crucial to ensure system frequency is adequately controlled thereby promoting system security as thermal generators continue to retire
- ensuring connected batteries operate with consistent control settings — irrespective of operating mode — promotes power system security.

The marginal increase in PFR would not be significant relative to the size of the NEM

With respect to AEMO's view that increasing the amount of PFR by including batteries enabled for contingency FCAS in the existing mandatory obligations, the Commission considers that the marginal increase in the amount of PFR is insufficient to outweigh the costs incurred by the bidirectional units. Stakeholder submissions have noted that the mandatory provision of PFR by units solely enabled for contingency FCAS would result in material cycling costs as they would be required to continuously respond to frequency when they would otherwise be idle.

In addition, as AEMO identified in their *Enduring frequency response requirements for the NEM* technical white paper, the need for PFR is large, distributed and expected to grow over time. AEMO noted that:[106]

> Sufficiency over the range of plausible power system operational conditions will require:
>
> - Contribution from a large fraction of the fleet – this is distinctly different to existing FCAS markets, which can allocate reserve requirements to a smaller number of providers.
> - Geographic diversity in provision – this is fundamental to power system performance under normal conditions, and system resilience during abnormal system events and network outages/contingencies

Given that AEMO considers that a high aggregate level of frequency responsiveness, with contributions from a large fraction of the generation fleet, is a critical prerequisite to maintain security as synchronous generators retire,[107] the Commission does not consider that the marginal contribution from bidirectional units enabled solely for contingency FCAS would result in a material improvement in system security.

This view is supported by AEMO's submission to the consultation paper, in which AEMO argued that the obligation would support power system security and that it should be subject to a cost-benefit analysis, but conceded that:[108]

> The immediate priority to adequately support the power system is for scheduled BDUs to comply with the PFRR when either charging or discharging. FCAS is presently a secondary matter, although this may change as the transition continues.

106 AEMO, Enduring frequency response requirements for the NEM - technical white paper, August 2021, p.4.
107 Ibid.
108 AEMO, submission to the consultation paper, 31 August 2023, p.1.

AEMO's submission to the draft determination repeated its recommendation that the Commission alter the final rule to require scheduled BDU compliance with the PFRR when enabled solely for contingency FCAS to:[109]

- better control power system frequency
- improve the operation of all FCAS markets by better pricing dispatch errors in the cost allocation of regulation FCAS
- avoid unintended consequences and confusion if BDUs are consistently changing deadband settings based on the type of dispatch instruction it receives.

Despite these benefits, AEMO does concede that:[110]

> if batteries solely enabled for contingency FCAS are not obligated to provide PFR, it is unlikely to be a security problem.

Given that:[111]

> At least today, batteries are infrequently enabled solely for contingency FCAS and very rarely are they not dispatched for any market service at all.

Consistent control settings across operating modes allows for improved management of contingency events

AEMO's rule change request proposed requiring scheduled BDUs to have consistent frequency control settings across operating modes. AEMO contends that this would promote power system security and reliability by supporting consistent and predictable PFR and providing AEMO with a greater understanding of the system's response to contingency events. This would support the accurate modelling of the power system response to system disturbances, which is necessary to plan for and implement operational controls to keep the system in a secure operating state, such that it can recover from credible contingency events.

The Commission agrees with AEMO, that consistent and predictable PFR would support power system security by providing AEMO with the confidence that the system will respond to contingency events as expected. However, the Commission does not consider that a mandatory obligation would best promote the NEO. Instead, there is a risk that increasing costs on batteries providing contingency FCAS may incentivise them to elect not to provide contingency FCAS when idle and desynchronise from the grid resulting in less resources being available to respond to contingency events. In addition, the final rule introduces additional transparency measures to ensure that AEMO is continuously aware of, and confident in, the frequency response modes of batteries operating in the system.

Existing frameworks sufficiently incentivise the voluntary provision of PFR by BDUs enabled solely for contingency FCAS

Stakeholder submissions to the consultation paper noted that a mandatory obligation could be unnecessary as there are currently several incentives for batteries to remain frequency responsive at all times,[112] including when enabled solely for contingency FCAS. These include:

- frequency performance payments — commencing in 2025

109 AEMO, submission to the draft determination, 24 January 2024, p.2.
110 Ibid., p.1.
111 Ibid., p.2.
112 Submission to the consultation paper: Iberdrola, p.6;

- the FCAS market ancillary service specification — which allows batteries to account for their PFR response when bidding contingency FCAS capacity
- the complexity of developing dynamic settings to change frequency response mode depending on the battery's operating state.

The introduction of FPPs could incentivise batteries to provide PFR voluntarily when enabled for FCAS

AEMO is currently developing the procedures and processes to implement the new frequency performance payment arrangements which will take effect from 8 June 2025. These new arrangements are designed to value PFR provided under the mandatory arrangement and are also expected to incentivise additional frequency response from plant that are not covered by the mandatory PFR obligation.

The Commission considers that FPPs will be factored in by operators of bidirectional units when considering whether it is worthwhile to continuously provide PFR, irrespective of operating mode. As explained above, the Commission does not consider that a mandatory obligation is warranted given the high likelihood that batteries would incur material costs, instead, as noted in the AEC's submission:[113]

> If FPP performs as hoped, those bidirectional units that can perform this service at low costs are likely to voluntarily provide it.

Under the MASS, PFR is accounted for when offering contingency FCAS

Stakeholders have noted that batteries may be willing to continuously provide PFR on a voluntary basis to maximise contingency FCAS capability. Units responding to frequency within the NOFB are considered as contributing towards the delivery requirements for contingency FCAS as outlined in the market ancillary service specification (MASS):[114]

> Any frequency response provided within the NOFB by an FCAS facility providing PFR, is considered as contributing towards its delivery requirements for Contingency FCAS.

As such, the Commission considers that there is a strong enough incentive for bidirectional units to voluntarily choose to always be PFR responsive, including when dispatched solely for contingency FCAS, to maximise the amount of contingency FCAS they are allowed to offer under the MASS. Conversely, if a battery opted to no longer provide PFR when enabled solely for contingency FCAS, AEMO would be required to adjust their offered contingency FCAS capability to reflect their delayed response to contingency events.

In its submission to the draft determination, Shell sought clarification of the calculation of PFR contributions to the calculation of contingency FCAS provision. Shell stated that:[115]

> The provision of [narrow-band PFR] NBPFR can result in deviations away from a generating unit's or bi-directional unit's (BDU) dispatch target by a significant value even though power system frequency remains close to 50 hertz. It is unclear to Shell Energy that the current MASS calculation fully captures such on outcome for BDU.

The Commission understands that AEMO's MASS FCAS verification tool was updated in August 2023 to include a manual baseline override to recognise the frequency response already being

113 AEC, submission to the consultation paper, 31 August 2023, p.2.
114 AEMO, market ancillary service specification, 9 October 2023, p.12.
115 Shell Energy, submission to the draft determination, 25 January 2024, p.2.

provided by an FCAS facility prior to the frequency exciting the NOFB. As outlined in the MASS, AEMO notes:[116]

> Any frequency response provided within the NOFB by an FCAS Facility providing PFR, is considered as contributing towards its delivery requirements for Contingency FCAS.

Dynamic PFR settings would result in increased complexity and costs for battery operators

The final incentive raised by stakeholders is that battery operators may decide to continuously provide PFR to reduce administrative costs and simplify operations. Iberdrola noted that:[117]

> Many batteries should choose to voluntarily provide this service, particularly when the Frequency Performance Payments framework commences in 2025 or simply to simplify operations.

The Commission's view is consistent with previous determinations

The Commission's final rule is consistent with previous determinations that excluded batteries from the MPFR requirements when enabled solely for contingency FCAS.[118] As identified by several stakeholders, the Commission only recently confirmed the existing settings through the *primary frequency response incentives arrangements* final determination. Referring to the power conferred to the AEMC under section 94 of the NEL, to reject rule change requests previously considered within 12 months, Equis noted that:[119]

> This proposal has already been rejected twice by the AEMC, most recently in September 2022 and that the AEMC should not consider the same request again within a 12-month period.

Iberdrola added that:[120]

> The AEMC already provided recent final determinations on these issues, and AEMO has not provided in their submission any new analysis or evidence (nor have there been any fundamental changes in the grid or policy in the past 8 months) that should change the Commission's previous determinations.

The Commission remains convinced that applying the obligation solely to bidirectional units would be discriminatory as they are expected to incur material costs. As noted in the final determination of the *Mandatory primary frequency response* rule:[121]

> Unlike other generation technologies, battery energy storage systems are capable of providing a frequency response when they are neither charging nor discharging, ie neither supplying nor consuming energy from the grid. Under the final rule, generators that are not dispatched in the energy market to generate electricity are not required to operate in a frequency response mode in accordance with the PFRR... The Commission considers that the application of the mandatory PFR requirement to battery energy storage systems that are not dispatched to generate electricity would be discriminatory, as other generation

116 AEMO, Market ancillary service specification, 9 October 2023, p.12.
117 Iberdrola, submission to the consultation paper, 31 August 2023, p.2.
118 AEMC, PFR incentive arrangements - final determination, 8 September 2022, p.29.
119 Equis, submission to the consultation paper, 31 August 2023, p.2.
120 Iberdrola, submission to the consultation paper, 31 August 2023, p.2.
121 AEMC, Mandatory primary frequency response - final determination, 26 March 2020, p.46.

technologies cannot provide PFR unless they are online and generating.

As such, the Commission has concluded, in line with previous determinations, that there is insufficient justification and that it would not be in the long-term interests of consumers to apply the obligation to bidirectional units when only enabled to provide contingency FCAS.

A Rule making process

A standard rule change request includes the following stages:

- a proponent submits a rule change request
- the Commission initiates the rule change process by publishing a consultation paper and seeking stakeholder feedback
- stakeholders lodge submissions on the consultation paper and engage through other channels to make their views known to the AEMC project team
- the Commission publishes a draft determination and draft rule (if relevant)
  - stakeholders lodge submissions on the draft determination and engage through other channels to make their views known to the AEMC project team
- the Commission publishes a final determination and final rule (if relevant).

You can find more information on the rule change process on our website.[122]

A.1 AEMO proposed to widen the PFR obligations of BDUs to include when discharging, charging and enabled for market ancillary services

In its rule change request, *Clarifying mandatory primary frequency response obligations for batteries*, AEMO identified a concern that the existing mandatory and incentive arrangements for primary frequency response may not be sufficient to support effective control of power system frequency over the long-term. In particular, AEMO proposed changes to the NER that would clarify the obligation for batteries to adhere to the PFRR in different operating modes, including:

- while discharging
- while charging and
- while enabled to provide a market ancillary service — in effect, enabled for regulation or contingency frequency control ancillary services (FCAS).

AEMO considered that clarifying the frequency response obligations for batteries is important as they are expected to play a crucial operational role in the future power system, especially during operation of the system with 100% renewable generation. Periods with sufficient renewable energy resource potential in the NEM to meet 100% of operational demand are expected to begin in 2025 at the earliest and be increasingly common in the future.[123]

A.1.1 Issue 1 – Non-inclusion of scheduled bidirectional units in the PFR obligation when discharging

AEMO's rule change request identified uncertainties in relation to the obligations that apply to scheduled bidirectional units to provide PFR. In particular, AEMO identified that following the commencement of the IESS rule in June 2024, batteries that were previously been classified as scheduled generating units will switch over to being classified as scheduled bidirectional units and will no longer be required to provide PFR.[124]

The Commission recognises that this outcome is the result of an inadvertent drafting omission and that it is consistent with the Mandatory PFR final determination and the PFR incentives final determinations for scheduled bidirectional units to provide PFR while discharging (generating).

122 See our website for more information on the rule change process: https://www.aemc.gov.au/our-work/changing-energy-rules

123 AEMO, Engineering Roadmap to 100% Renewables | FY2024 Priority actions, 10 July 2023, p.8.

124 Batteries with a storage capacity 5MW and greater will be reclassified as scheduled BDUs, below 5MW will be non-scheduled BDUs.

For further details on the inadvertent omission of scheduled bidirectional units from the mandatory PFR obligations see Chapter 2 of the consultation paper.

A.1.2 Issue 2 – Uncertainty around the long-term provision of consistent and predictable PFR

In addition to rectifying the omission of scheduled BDUs from the mandatory PFR obligations when discharging (issue 1), AEMO's rule change request identified a concern around the certainty that there will be sufficient PFR in the future to support system security on an ongoing basis.

AEMO's rule change request identified that the rules currently only require batteries to adhere to the PFRR when operating as a scheduled generator. The rules do not require:

- battery energy storage systems to operate in frequency response mode when charging
- batteries enabled for market ancillary services to provide PFR when they have a zero dispatch target for energy.

AEMO's rule change proposal requested that the Commission reconsider its previous determinations in light of the introduction of the new bidirectional unit category, the expected increase in the number of batteries connecting to the grid and the scheduled commencement of frequency performance payments in 2025.

AEMO's concern is that the existing NER does not support future operational outcomes where control system settings are applied consistently and predictably and that this could undermine system security during future operational periods where there is a small volume of synchronous thermal plant online.[125]

AEMO considers that it is appropriate that all capable energy production technologies should comply with the PFRR and in particular that batteries be required to provide PFR irrespective of the type of dispatch instruction they receive. Battery energy storage systems have demonstrated the ability to provide a high quality frequency response across their full range of operating modes. Given the expectation for increasing volumes of batteries to be deployed over coming years, AEMO considers it a priority that batteries provide consistent and predictable PFR across their full range of operating modes when operating commercially in the NEM. AEMO does not propose that BDUs be required to provide PFR when at rest and note dispatched to generate electricity, consume electricity, or provide a market ancillary service.[126]

For further details on AEMO's concerns with respect to the long-term provision of PFR see Chapter 2 of the consultation paper.

A.2 The process to date

On 3 August 2023, the Commission published a notice advising of the initiation of the rule making process and consultation in respect of the rule change request.[127] A consultation paper identifying specific issues for consultation was also published. Submissions closed on 31 August 2023. The Commission received 25 submissions as part of the first round of consultation. The Commission considered all issues raised by stakeholders in submissions. Issues raised in submissions are discussed and responded to throughout the draft determination.

On 30 November 2023, the Commission published a notice advising of the publication of a draft determination and draft rule.[128] Submissions to the draft determination closed on 25 January

125 AEMO, Engineering Roadmap to 100% Renewables, December 2022, p.14.
126 Ibid., p.26.
127 This notice was published under section 95 of the NEL.
128 This notice was published under section 99 of the NEL.

2024. The Commission received 10 submissions as part of the second round of consultation. The Commission considered all issues raised by stakeholders in submissions. Issues raised in submissions are discussed and responded to throughout this final determination.

B Regulatory impact analysis

The Commission has undertaken regulatory impact analysis to make its final determination.

B.1 Our regulatory impact analysis methodology

We considered a range of policy options

The Commission compared a range of viable policy options that are within our statutory powers. The Commission analysed these options: the rule proposed in the rule change request; a business-as-usual scenario where we do not make a rule; and a more preferable rule featuring different permutations of PFR obligations based on battery operating modes. These options are described in chapter 3.

We identified who would/will be affected and assessed the benefits and costs of each policy option

The Commission's regulatory impact analysis for this rule change used both qualitative and quantitative methodologies. It involved identifying the stakeholders impacted and assessing the benefits and costs of policy options. The depth of analysis was commensurate with the potential impacts. Where commensurate and feasible, the Commission has quantified the impacts. The Commission focused on the types of impacts within the scope of the NEO.

Table B.1 summarises the regulatory impact analysis the Commission undertook for this rule change. Based on this regulatory impact analysis, the Commission evaluated the primary potential costs and benefits of policy options against the assessment criteria. The Commission's determination considered the benefits of the options minus the costs.

Table B.1: Regulatory impact analysis methodology

Assessment criteria	Primary costs Low, medium or high	Primary benefits Low, medium or high	Stakeholders affected	Methodology QT = quantitative, QL = qualitative
Safety, security and reliability	Costs could be incurred by generators (L/M)	Improvements to system security (M)	• Battery operators / developers • AEMO	• QL: stakeholder advice on costs of BESS providing PFR • QT: GHD modelling performed for Panel's review of the frequency operating standard (FOS)
Principles of market efficiency	Frequency performance payments (M)	Reduction in cost of other ancillary services (primarily regulation FCAS) (L/M)	• All generators • Market customers	• QL: assessment of benefits of BESS providing PFR. • QL: stakeholder feedback to assess all benefits and costs • QL: consideration of what units would be classified as bidirectional units now and in the future.
Innovation and flexibility	Nil	Nil	• Battery operators / developers • All generators	• QL: assessment aggregate frequency responsiveness of the NEM as synchronous units retire. • QL: proportion of PFR that could be provided by batteries over time.
Implementation considerations	Implementation costs (L)	Nil	• Battery operators / developers • AEMO	• QL: assessment of expected implementation costs for AEMO. • QL: assessment of capabilities of BESS', are the units capable of having multiple PFR settings depending on if it is charging, discharging, active for market ancillary services.
Principles of good regulatory practice	Nil	Predictability and regulatory stability (L)	Nil	QL: could improvements in transparency, compliance and eligibility result in greater competition and improved efficiency.

C Legal requirements to make a rule

This appendix sets out the relevant legal requirements under the NEL for the Commission to make a final rule determination.

C.1 Final rule determination and final rule

In accordance with section 102 of the NEL, the Commission has made this more preferable final rule in relation to the rule proposed by the Australian Energy Market Operator (AEMO).

The Commission's reasons for making this final rule determination are set out in chapter 2.

A copy of the more preferable final rule is attached to and published with this final determination. Its key features are described in chapter 3.

C.2 Power to make the rule

The Commission is satisfied that the more preferable final rule falls within the subject matter about which the Commission may make rules.

The more preferable final rule falls within section 34 of the NEL as it relates to the operation of the national electricity system for the purposes of the safety, security and reliability of that system under section 34(1)(a)(ii) and the activities of persons (including Registered participants) participating in the national electricity market or involved in the operation of the national electricity system under section 34(1)(a)(iii).

C.3 Commission's considerations

In assessing the rule change request the Commission considered:

- its powers under the NEL to make the final rule
- the rule change request
- submissions received during first round consultation
- the Commission's analysis as to the ways in which the final rule will or is likely to contribute to the achievement of the NEO
- submissions received during second round consultations
- views expressed by the technical working group (TWG)
- the application of the final rule to the Northern Territory

There is no relevant Ministerial Council on Energy (MCE) statement of policy principles for this rule change request.[129]

C.4 Making electricity rules in the Northern Territory

The NER, as amended from time to time, apply in the Northern Territory, subject to modifications set out in regulations made under the Northern Territory legislation adopting the NEL.[130] Under those regulations, only certain parts of the NER have been adopted in the Northern Territory.

129 Under s. 33 of the NEL and s. 73 of the NGL the AEMC must have regard to any relevant MCE statement of policy principles in making a rule. The MCE is referenced in the AEMC's governing legislation and is a legally enduring body comprising the Federal, State and Territory Ministers responsible for energy. On 1 July 2011, the MCE was amalgamated with the Ministerial Council on Mineral and Petroleum Resources. In December 2013, it became known as the Council of Australian Government (COAG) Energy Council. In May 2020, the Energy National Cabinet Reform Committee and the Energy Ministers' Meeting were established to replace the former COAG Energy Council.

130 These regulations under the NT Act are the National Electricity (Northern Territory) (National Uniform Legislation) (Modifications) Regulations 2016

The more preferable final rule does not relate to parts of the NER that apply in the Northern Territory. As such, the Commission has not considered Northern Territory application issues.

C.5 Civil penalty provisions and conduct provisions

The Commission cannot create new civil penalty provisions or conduct provisions. However, it may recommend to the Energy Ministers' Meeting that new or existing provisions of the NER be classified as civil penalty provisions or conduct provisions.

The NEL sets out a three-tier penalty structure for civil penalty provisions in the NEL and the NER.[131] A Decision Matrix and Concepts Table,[132] approved by Energy Ministers, provide a decision-making framework that the Commission applies, in consultation with the AER, when assessing whether to recommend that provisions of the NER should be classified as civil penalty provisions, and if so, under which tier.

Subject to consulting with the AER, the Commission proposes to make the following civil penalty recommendations to the Energy Ministers' Meeting in relation to the final rule. The AER has indicated it supports these recommendations.

Table C.1: Civil penalty provision recommendations

Rule	Description of rule	Proposed classification	Reason
Clause 4.4.2(c1)	Requirement on Scheduled Generators, Semi-Scheduled Generators and Integrated Resource Providers to operate its scheduled generating unit, semi-scheduled generating unit or scheduled bidirectional unit in accordance with the Primary Frequency Response Requirements when generating a volume greater than zero MW, consuming electricity other than as an auxiliary load and when providing a regulation service.	Retain as tier 1	Compliance with the clause is necessary to ensure the effective operation, and reliability, of the system, and AEMO's ability to operate the power system efficiently
Clause 4.9.4(e)	Prohibits a Scheduled Generator, Semi-Scheduled Generator or Scheduled Integrated Resource Provider from changing the frequency response mode of its	Retain as tier 1	Compliance with the clause is necessary to ensure the effective operation, and reliability, of the system, and AEMO's

131 Further information is available at https://www.aemc.gov.au/regulation/energy-rules/civil-penalty-tools

132 The Decision Matrix and Concepts Table is available at: https://web.archive.org.au/awa/20210603104757mp_/https://energyministers.gov.au/sites/prod.energycouncil/files/publications/documents/Final%20-%20Civil%20Penalties%20Decision%20Matrix%20and%20Concepts%20Table_Jan%202021.pdf

Rule	Description of rule	Proposed classification	Reason
	scheduled generating unit, semi-scheduled generating unit or scheduled bidirectional unit without the prior approval of AEMO, unless in the Generator's or Integrated Resource Provider's reasonable opinion public safety would otherwise be threatened or there would be a material risk of damaging equipment of the environment.		ability to operate the power system efficiently

Where the draft rule amends provisions that are currently classified as civil penalty provisions, the Commission does not propose to recommend to the Energy Ministers' Meeting any changes to the classification of those provisions.

D Overview of the mandatory PFR obligations of market participants

As part of the Clarifying mandatory primary frequency response (PFR) for bidirectional plant rule, the Commission has sought to clarify the mandatory PFR obligations of generating plant in the NEM. This overview seeks to provide market participants with a summary of the obligations under the rules of their plant based on operating mode.

The Commission wants to emphasise that the mandatory PFR obligations under the rules represent the **minimum** provision of PFR (illustrated in Figure D.1 below). **The provision of PFR beyond the minimum requirements set out in the primary frequency response requirements (PFRR) is allowed and encouraged** through the frequency performance payments.

Figure D.1: Mandatory PFR obligations under different operating modes

Operating state	Mandatory PFR obligations	
	Scheduled & Semi-Scheduled Generators	*Scheduled Bidirectional Units*
Dispatched generating state	✓ Required to adhere to the PFRR	
Dispatched charging state		✓ Required to adhere to the PFRR (except when solely powering auxiliary loads)
When enabled for regulation FCAS		✓ Required to adhere to the PFRR
When enabled for contingency FCAS		X **Not** required to adhere to the PFRR (voluntary provision incentivised by frequency performance payments)
When at rest (not dispatched to consume, generate or enabled for FCAS)		X **Not** required to adhere to the PFRR (voluntary provision incentivised by frequency performance payments)

Source: AEMC

Note: The obligations on scheduled bidirectional units when discharging, charging, and enabled for regulation FCAS commence on 3 June 2024, 8 June 2025, and 8 June 2025 respectively. Greyed out areas represent operating states that scheduled or semi-scheduled generators are technically incapable of meeting without being dispatched into the energy market.

This document sets out the mandatory PFR obligations of market participants, it outlines:

- Appendix D.1 — the mandatory PFR obligations when dispatched to generate
- Appendix D.2 — the mandatory PFR obligations when dispatched to charge
- Appendix D.3 — the mandatory PFR obligations when enabled for regulation services
- Appendix D.4 — the mandatory PFR obligations when enabled for contingency services
- Appendix D.5 — the mandatory PFR obligations when at rest (at 0MW).

D.1 Mandatory PFR obligations when dispatched to generate

Under clause 4.4.2(c1) of the final rule, any scheduled generator, semi-scheduled generator or scheduled integrated resource provider (from 3 June 2024)[133] that has received a dispatch instruction to generate a volume greater than zero MW must operate its generating system in accordance with the settings set out in the PFRR. The PFRR must not require:

133 The IESS rule introduced the new Integrated Resource Provider (IRP) category. Under the rule, an IRP must classify standalone storage — 5MW and above — as a scheduled bidirectional unit unless the unit does not transition linearly through zero. If the unit does not have that capability, the unit must remain classified as a scheduled generating unit and a scheduled load.

- any affected generators to maintain stored energy for the purposes of complying with the mandatory PFR obligation[134], or
- the installation or modification of equipment to monitor and record the PFR responsiveness of the plant to ensure compliance with the obligation.[135]

Under clause 4.4.2A(b)(2) of the NER, any scheduled generator, semi-scheduled generator or scheduled bidirectional unit may seek an exemption or variation — approved by AEMO — from any primary frequency response parameters applicable to its generating system or integrated resource system.

D.2 Mandatory PFR obligations when dispatched to charge

Under the final rule the Commission revised the mandatory PFR obligations of scheduled integrated resource providers. From 8 June 2025, scheduled bidirectional units will be required to adhere to the PFRR when charging (other than when solely powering auxiliary loads).[136]

Under clause 4.4.2(c1) of the final rule, any scheduled integrated resource provider will be required to operate their scheduled bidirectional unit in adherence with the PFRR when consuming electricity (other than as an auxiliary load). Affected scheduled bidirectional units are not required to maintain stored energy for the purposes of complying with the mandatory PFR obligation.

D.3 Mandatory PFR obligations when enabled for regulation services

Under the final rule, the Commission revised the mandatory PFR obligations of scheduled integrated resource providers. From 8 June 2025, scheduled bidirectional units will be required to adhere to the PFRR when enabled for regulation services (regulation FCAS).

Under clause 4.4.2(c1) of the final rule, any scheduled integrated resource provider will be required to operate their scheduled bidirectional unit in adherence with the PFRR when enabled for regulation FCAS. Affected scheduled bidirectional units are not required to maintain stored energy for the purposes of complying with the mandatory PFR obligation.

D.4 Mandatory PFR obligations when enabled for contingency services

The rules do not require scheduled generators, semi-scheduled generators or scheduled integrated resource providers to adhere to the PFRR when enabled solely for contingency FCAS. However, the Commission **encourages,** and **the rules incentivise, the voluntary and continuous provision of PFR irrespective of operating mode.**

D.5 Mandatory PFR obligations when at rest

The rules do not require scheduled generators, semi-scheduled generators or scheduled integrated resource providers to adhere to the PFRR when idle (at rest at 0MW). However, the Commission **encourages,** and **the rules incentivise, the voluntary and continuous provision of PFR irrespective of operating mode.**

134 Clause 4.4.2A(c)(1)
135 Clause 4.4.2A(c)(2)
136 The obligation would not apply unless the state of charge of the battery is increasing.

Abbreviations and defined terms

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AGC	Automatic generation control system
CER	Consumer energy resource
CF	Contribution factor
Commission	See AEMC
DER	Distributed energy resource
DPV	Distributed photovoltaics
ESB	Energy Security Board
ESS	Essential system services
FCAS	Frequency control ancillary service
FFR	Fast frequency response
FOS	Frequency operating standard
FPP	Frequency performance payment
GW	Gigawatt
IBR	Inverter-based resources
MASS	Market ancillary service specification
MW	Megawatt
NEL	National Electricity Law
NEM	National Electricity Market
NEO	National Electricity Objective
NER	National Electricity Rules
NOFB	Normal operating frequency band
PFCB	Primary frequency control band
PFR	Primary frequency response
PFRR	Primary frequency response requirements
RCR	Requirement for corrective response
RoCoF	Rate of change of frequency
VRE	Variable renewable energy (generation)
Proponent	The individual / organisation who submitted the rule change request to the Commission