~~Interim~~ Primary Frequency Response Requirements

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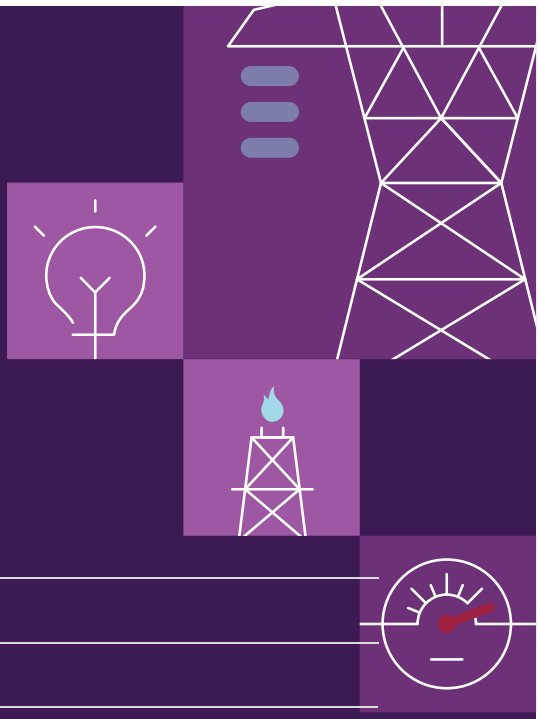
AUSTRALIAN ENERGY MARKET OPERATOR



~~Version Release History~~

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Current version release details

Version	Effective date	Summary of changes
12.0	4 June 20208 May 2023	First versionFinal requirements following National Electricity Amendment (Primary frequency response incentive arrangements) Rule 2022

Note: There is a full version history at the end of this document.

1. ~~INTRODUCTION~~ Introduction

1.1. Purpose and scope

These are the ~~interim~~ *primary frequency response requirements* (**PFRR**) made under ~~clauses 11.112.2 and~~clause 4.4.2A(a) of the National Electricity Rules (~~**PFRR**~~**NER**).

The PFRR have effect only for the purposes set out in the ~~National Electricity Rules (**NER**).~~ NER. The NER and the *National Electricity Law* prevail over the PFRR to the extent of any inconsistency.

1.2. Definitions and interpretation

1.2.1. Glossary

Terms defined in the *National Electricity Law* and the NER have the same meanings in these PFRR unless otherwise specified.

Terms defined in the NER are intended to be identified in these PFRR by italicising them, but failure to italicise a defined term does not affect its meaning.

The words, phrases and abbreviations in ~~Table 1~~the table below have the meanings set out opposite them when used in this document.

~~**Table 1 Defined terms**~~

Term	Definition
Affected Generator	A *Scheduled Generator* ~~and~~or a *Semi-Scheduled Generator*.
Affected GS	The *generating system* of an Affected Generator.
Affected GS' Deadband	For an Affected GS, the deadband with which it will be operated in accordance with AEMO's approval ~~under section .~~.
DCS	Distributed control systems.
Droop	As defined in ~~clause~~NER S5.2.5.11(a~~) of the NER.~~).
LNSP	The *Local Network Service Provider* in respect of an Affected GS
NER	National Electricity Rules. NER followed by a number indicates the corresponding rule or clause of the NER.
MASS	*market ancillary service specification*.
Maximum Operating Level	As defined in ~~clause~~NER S5.2.5.11(a~~) of the NER.~~).
Minimum Operating Level	As defined in ~~clause~~NER S5.2.5.11(a~~) of the NER.~~).
OEM	Original equipment manufacturer.
PFCB	*Primary frequency control band* (as at 8 May 2023, it is 49.~~985Hz~~985 Hz to 50.~~015Hz~~015 Hz).
PFR	*Primary frequency response*.
PFRP	*Primary frequency response parameters*.
PFRR	*Primary frequency response requirements*.
PFR Settings	The *frequency response mode* ~~settings~~characteristics (deadband, droop and response time) applicable to an Affected GS, as approved by AEMO ~~in accordance with section .~~.
P_{MAX}	As defined in section 3.3.

Term	Definition
~~Proposed PFR Settings~~	~~The *frequency response mode* settings (deadband, droop and response time) applicable to an Affected GS proposed by an Affected Generator in accordance with section 5.~~
~~Results~~	~~As defined in section 5.1(a).~~
RMS	Root mean square.

1.2.2. Interpretation

The following principles of interpretation apply to these PFRR unless otherwise expressly indicated:

(a) These PFRR are subject to the principles of interpretation set out in Schedule 2 of the National Electricity Law.

(b) References to *frequency* should be read as referring to *frequency* as measured at an Affected GS' *connection point*.

(c) Units of measurement are in accordance with the International System of Units.

(d) A reference to a document or a provision of a document are to that document or provision as amended, replaced or novated from time to time.

1.3. Related documents

Title	Location
GPS Compliance Assessment And R2 Model Validation Test Plan Template For Conventional Synchronous Machines	https://www.aemo.com.au/-/media/Files/Electricity/NEM/Network_Connections/Transmission-and-Distribution/Generating-System-Test-Plan-Template-for-Conventional-Synchronous-Machines.pdf.
GPS Compliance Assessment And R2 Model Validation Test Plan Template For Power Electronic Interfaced Nonsynchronous Generation Technologies	https://aemo.com.au/-/media/files/electricity/nem/network_connections/transmission-and-distribution/generating-system-test-template-for-non-synchronous-generation.docx.
Market Ancillary Service Specification	https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/ancillary-services/market-ancillary-services-specification-and-fcas-verification-tool.
SO_OP3715 Power System Security Guidelines	https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/system-operations/power-system-operation/power-system-operating-procedures

2. Requirement to provide PFR

2.1. Basic requirement

Unless exempt under section 6.5 or exempted by AEMO under section 6.4.3, and subject to variation either under section 6.6 or as granted by AEMO under section 6.4.3, Affected Generators must commence providing PFR every time they receive a *dispatch instruction* ~~in the *spot market* of >0 MW~~as specified in NER 4.4.2(c1) in respect of an Affected GS, in accordance with its PFR Settings.

~~(a) In respect of an Affected Generator and an Affected GS, the requirement under paragraph (a) applies from the date specified by AEMO under section or , as applicable.~~

2.2. No stored energy to meet requirement

As ~~required~~indicated by ~~clause~~NER 4.4.2A(c~~) of the NER,~~), there is no requirement for Affected Generators to maintain headroom, footroom or stored energy in their Affected GSs for the purpose of providing PFR.

2.3. Interaction between dispatch instructions and PFR Settings

2.3.1. Energy

Where an Affected Generator receives a NER 4.9.2 *dispatch instruction* in respect of an Affected GS ~~for~~to *generate* a quantity of *energy* greater than 0 MW, the Affected GS' output is to be varied in accordance with the PFR Settings. If the *dispatch instruction* is received by AGC, the desired output should be the summation of the AGC setpoint and the PFR Settings~~.~~ as described in section 10.3 of the *market ancillary service specification* (**MASS**[1]).

2.3.2. Regulation FCAS

(a) Where an Affected Generator receives a NER 4.9.3A *dispatch instruction* in respect of an Affected GS for a quantity of Regulation FCAS **and** a NER 4.9.2 *dispatch instruction* to *generate* a quantity of *energy* greater than 0 MW in a *trading interval*, the Affected GS' desired output should be the ~~summation~~sum of the AGC setpoint and the PFR Settings as described in section 10.3 of the MASS.

(b) Where an Affected Generator receives a NER 4.9.3A *dispatch instruction* in respect of an Affected GS for a quantity of ~~Contingency FCAS, but that~~Regulation FCAS only (with no NER 4.9.2 *dispatch instruction* to *generate* in the same *trading interval*), the Affected ~~GS~~GS' desired output is ~~not *dispatched* to provide *energy* in~~ the ~~same *dispatch interval*,~~AGC setpoint. The Affected GS may also provide PFR (but is not required to ~~provide PFR.~~do so).

2.3.3. Contingency FCAS

Where an Affected Generator receives a NER 4.9.3A *dispatch instruction* in respect of an Affected GS for a quantity of Contingency FCAS:

(a) if it has not also received a NER 4.9.2 *dispatch instruction* in respect of the Affected GS to *generate* a quantity of *energy* greater than 0 MW in the same *trading interval*, the Affected GS may also provide PFR (but is not required to do so); and

(b) in all cases, the Affected GS must comply with the requirements for the relevant Contingency FCAS, as set out in the MASS.

2.3.4. Semi-Dispatch

Where an Affected GS is operating in a *semi-dispatch interval* and a *frequency* deviation would cause an increase in output, where possible, the Affected GS' output should be increased to

[1] Version 7.

provide PFR~~.~~ even if this might exceed the Affected GS' *dispatch level* for that *semi-dispatch interval*[2].

2.4. Changes to PFR Settings

Once an Affected GS' PFR Settings are approved by AEMO, the Affected Generator:

(a) must not adjust the PFR Settings of the Affected GS without AEMO's prior approval, consistent with the requirement in NER 4.9.4(e);

(b) may subsequently apply for an exemption from any of the PFRP for the Affected GS in accordance with sections 6.2 and 6.4;

(c) may subsequently apply for a variation (or a further variation as applicable) of any of the PFRP for the Affected GS in accordance with sections 6.3 and 6.4; and

(d) may subsequently agree with AEMO to vary any of the PFRP in accordance with section 6.8.

3. Primary frequency response parameters

3.1. General

Three PFRP are set out in section 3 – deadband, droop and response time.

The PFR Settings for an Affected GS must be consistent with the PFRP, or a variation must be applied for, as outlined in section 6~~.~~.

3.2. Affected ~~GS~~GS' deadband

3.2.1. Affected GS' deadband ~~to be specified in AEMO's response~~

Subject to section 3.2.2~~Each Affected Generator must operate its Affected GS~~ and any variation or exemption granted in accordance with ~~its~~these PFRR, an Affected ~~GS' Deadband as specified in AEMO's response in accordance~~GS must be operated with ~~section . a~~ deadband equal to the PFCB.

For the avoidance of doubt, ~~this~~the Affected GS' Deadband applies at the *connection point*.

~~A.1.1 End point for all Affected GS~~

~~As outlined in section , an Affected Generator may advise AEMO whether it wishes to alter the deadband setting for an Affected GS to reach the Affected GS' Deadband in one or two steps.~~

~~Subject to section , AEMO intends that Affected GS be operated at a deadband at the PFCB.~~

3.2.2. Operating with narrower deadband acceptable

~~While~~Provided AEMO ~~cannot require any Affected GS' Deadband to be narrower than the PFCB~~agrees, an Affected ~~GS~~Generator may ~~be operated~~ operate its Affected GS with ~~a~~

[2] Note that compliance with *dispatch instructions* in these circumstances is addressed in NER 4.9.8(a1).

~~narrower deadband provided AEMO is aware of the~~an Affected GS' deadband ~~at all times~~that is narrower than the PFCB.

3.3. Droop

For all Affected GS, subject to any variation or exemption granted in accordance with these PFRR, Droop at the *connection point* must be set to less than or equal to 5%.

The change in *frequency* is to be measured from the upper or lower limit (as applicable) of the Affected GS Deadband, as shown in Equation 1.

Equation 1:

$$\boldsymbol{Droop}\ (\%) = \mathbf{100} \times \frac{\Delta \mathbf{F/50}}{\Delta \mathbf{P}/\boldsymbol{P_{MAX}}}$$

where:

ΔF is the frequency deviation beyond the limit of the Affected GS Deadband, in Hz.

ΔP is *active power* change, in MW.

P_{MAX} is the Maximum Operating Level in MW[3].

Droop may be asymmetrical for over- and under-*frequency* responses.

Droop may be different for different levels of *frequency* change.

The droop characteristic should not exhibit any step changes in MW as *frequency* changes.

3.4. Response time

Subject to any variation or exemption granted in accordance with these PFRR, an Affected GS should be capable of achieving a 5% change in *active power* output within no more than 10 seconds, resulting from a sufficiently large positive or negative step change in *frequency* greater than the Affected GS' Deadband and less than or equal to 0.5 Hz.

The response time is measured from when the *frequency* crosses the limit of the Affected GS' Deadband until *active power* reaches a 5% change based on P_{MAX}. The sustained change in *active power* resulting from the *frequency* step, may be greater than 5%, in order to demonstrate this capability.

For the avoidance of doubt, a more rapid change in output in response to a change in *frequency* is acceptable, and *plant* should not be deliberately slow or reduce its response to match this minimum requirement.

An Affected GS' control settings must ensure an *adequately damped* response to a change in *frequency*.

The change in an Affected GS' *active power* output following a *frequency* deviation outside the Affected GS' Deadband must commence with no delay beyond that inherent in the *plant* and *plant* controls.

[3] Or the capacity of in-service *generating units* where multiple *generating units* are aggregated in a single Affected GS.

4. Additional performance requirements

4.1. No withdrawal of response

Where it is safely and stably capable of doing so and considering *plant* load controllers or distributed control systems (**DCS**) and governor response, an Affected GS should continue to deliver PFR until *frequency* returns to be within the Affected GS' Deadband.

PFR should not be deliberately withdrawn or defeated by a *plant* load controller to return an Affected GS to a *market dispatch* target while *frequency* remains outside the Affected GS' Deadband.

4.2. Range of response

The magnitude of an Affected GS' *active power* change that results from *frequency* deviating from 50 Hz must not be unnecessarily limited.

Subject to section 6.6, an Affected GS should not use load limiters or similar controls to limit or restrict the Affected GS' response to a level below what could otherwise be safely and stably delivered, if that limiter were not in place.

4.3. Continuity of response

Subject to NER 4.4.2(c1), PFR must remain continuously enabled at the PFR Settings, unless agreed with AEMO, independent of *ancillary services enablement*.

~~5. INITIATION OF APPLICATION~~

~~A.2 Existing affected generators~~

~~By the date specified in , each Affected Generator must:~~

~~(a) assess the ability of each of its Affected GS to meet the PFRP and submit to AEMO the results of that assessment in the form shown in (**Results**);~~

~~(b) using the form in :~~

~~(i) provide its Proposed PFR Settings for each Affected GS;~~

~~(ii) advise whether it wishes to alter each Affected GS' Deadband to ±0.015Hz in one step, or first ±0.05Hz and then to ±0.015Hz on dates to be co-ordinated by AEMO;~~

~~(iii) how the Affected Generator proposes to demonstrate *plant* stability; and~~

~~(c) if the Affected Generator wishes to apply for exemption from, or variation to, the application of the PFRP to an Affected GS, submit an application in the relevant form specified in section .~~

~~**Table 2 Due dates for Affected Generator self-assessments**~~

~~Nameplate rating of Affected GS~~	~~Self-assessment due~~
~~>200 MW~~	~~28 August 2020~~
~~Between 200 MW and 80 MW~~	~~19 November 2020~~

Nameplate rating of Affected GS	Self-assessment due
<80 MW	17 February 2021

If a group of Affected Generators with a common parent company wish to submit the Results of each Affected GS together, they may do so, provided each Affected Generator is clearly identified and confirmation of the relationship between the specified Affected Generators is provided with the Results.

A.3 Connection applicants

Prior to the commencement of commissioning, NER 4.4.2(c1) permits, but does not require, the PFR Settings of Affected GSs comprising battery energy storage systems to be disabled or changed while they are consuming *energy* or *enabled* to provide a *market ancillary service* without a concurrent *dispatch instruction* to *generate energy*. Relevant Affected Generators wishing to apply different settings for an Affected GS in these periods may do so if they have obtained AEMO's prior approval for the application of settings as required by NER 4.9.4(e) (and S5.2.2 where applicable), and included those settings in the *Power System Setting Data Sheet* for the Affected GS.

5. PFR settings to be addressed as part of connection application process

A *Connection Applicant* proposing to *connect* a *generating system* that will comprise *scheduled generating units* or *semi-scheduled generating units* (or any combination of the two) must either:

(a) notifyagree with AEMO as part of the Proposedits connection application the PFR Settings for that *generating system*, which must be within the PFRP using the form in ; ; or

(b) seek an exemption from, or variation to, the application of the PFRP in accordance with section 6;.

and submit to AEMO either the notice of the Proposed PFR Settings, or application for exemption/variation, with its application for registration as a *Generator*.

6. AEMO ASSESSMENT

A.4 Insufficient information

If AEMO considers that an Affected Generator has not provided enough information for AEMO to assess the capability of an Affected GS to meet the PFRP, AEMO will forward a request to the Affected Generator specifying the further information required within 5 *business days* of receiving the Affected Generator's Results.

The Affected Generator must provide the further information requested within 5 *business days* of receiving AEMO's request.

6.1.1. Extension of time

In its absolute discretion, AEMO may grant the Affected Generator additional time to provide the Results, or further information requested under section , if AEMO is satisfied that an Affected Generator cannot reasonably provide the Results, or further information, within the required time.

A.5 AEMO response

6.1.2. Discussions to precede response

AEMO will discuss each Affected Generator's Results with the relevant Affected Generator within 20 *business days* of receiving the relevant Results, or any further information requested under section , whichever is the later.

AEMO's aim is to co-ordinate the commencement of the provision of PFR in blocks of Affected GSs, having due regard to *power system security* and stability of *plant*. AEMO will be seeking to organise the commencement of the provision of PFR by Affected GSs in blocks of sufficient size so as to minimise the impact on each Affected GS as much as possible.

Hence, AEMO will contact as many Affected Generators as possible to co-ordinate the commencement dates of their provision of PFR but will notify each Affected Generator of the PFR Settings and other information relevant to the commencement of the provision of PFR by each of its Affected GS individually.

AEMO will consult with an Affected Generator who indicates a preference to narrow deadband settings to meet the Affected GS' Deadband in two steps, to determine suitable dates and the transition process. This will allow observation of the impact of the changes on *power system security* and stability of *plant*.

6.1.3. AEMO response to confirm PFR Settings and other matters

Unless an Affected Generator has applied for a variation, in which AEMO will respond in accordance with section , AEMO will respond to each Affected Generator using the form in to confirm the following details with respect to each Affected GS:

(a) PFR Settings;

(b) the scope of works to be effected to meet one or more PFRP;

(c) whether the settings will be altered to meet the Affected GS' Deadband in one or two steps, as contemplated by section ; and

(d) the date by which the Affected GS must commence providing PFR in accordance with the PFR Settings.

6.1.4. Extension of time if Affected Generator not ready by specified date

If an Affected Generator is not likely to be ready to provide PFR in accordance with these PFRR by the date confirmed by AEMO, the Affected Generator must notify AEMO promptly and, if appropriate, seek an extension of time, with reasons and supporting information, which AEMO will consider and respond within 20 *business days* of receipt of the application for extension.

~~7.~~6. Exemptions and variations

~~7.1.~~6.1. Principles

~~Clause~~NER 4.4.2B(a) ~~of the NER~~ specifies the factors that AEMO must have regard to when considering whether to approve an application for exemption from, or variation to, any of the PFRP. The remainder of section 6.1 provides high-level guidance on the evidence AEMO may need from an Affected Generator to demonstrate why an application for exemption or variation should be granted based on one or more of those factors.

~~7.1.1.~~6.1.1. Capability

If an Affected Generator's application for exemption is on the basis that an Affected GS is either inherently incapable of or is not designed with an underlying capability for operating in *frequency response mode,* the Affected Generator must demonstrate this incapability.

This may be done by providing AEMO with copies of relevant original equipment manufacturer (**OEM**) specifications or test results from the OEM.

Where OEM information is not available, for example due to the age of the Affected GS or the status of the OEM, the Affected Generator will need to provide a recent assessment of *plant* capability from a suitably qualified and experienced consulting engineer, including any information about the risk to the safe or stable operation due to a requirement to provide PFR by reference to the Affected GS' underlying design.

~~7.1.2.~~6.1.2. Stability

If an Affected Generator's application for exemption or variation is on the basis that an Affected GS will operate unstably in *frequency response mode,* the Affected Generator must provide evidence of test results or other technical information, such as evidence from the OEM or a suitably experienced consulting engineer, to demonstrate the unstable operation.

~~Whether this has the potential to impact *power system security* is a matter for AEMO.~~

AEMO may consider *power system security* issues when considering applications for variation or exemption. For instance, it may be necessary to vary an Affected GS' PFR Settings to address interactions with other *generating systems*, or broader *power system* dynamics.

~~7.1.3.~~6.1.3. Physical characteristics

If an Affected Generator's application for exemption or variation is based on other physical characteristics that affect the Affected GS' ability to operate in *frequency response mode*, the Affected Generator will need to consider the type of evidence that will substantiate the claim. For example:

(a) *Dispatch* inflexibilities – this is included in section 6.6~~7.6~~ as a standing ~~exemption~~variation and no application is necessary where this is the only basis for an application for variation.

(b) Energy constraints – this is included in section 6.6~~7.6~~ as a standing ~~exemption~~variation and no application is necessary where this is the only basis for an application for variation.

(c) Licensing or other conditions of operation – if a regulatory licence to operate restricts the operation of an Affected GS to such an extent that it will not be able to operate in *frequency response mode* under certain conditions, the Affected Generator will need to provide AEMO with a copy of the relevant licence and other relevant information about its enforceability and evidence of when the conditions are likely to occur.

(d) Connection agreement – if there are any restrictions in an Affected Generator's *connection agreement* with its LNSP that impact the Affected Generator's ability to provide PFR in accordance with an Affected GS' PFR Settings, the Affected Generator will need to provide AEMO with a copy of the relevant parts of the *connection agreement* and any other information about its enforceability and evidence of when the restrictions are likely to apply.

~~7.1.4.~~6.1.4. Costs ~~vs~~versus market turnover

If an Affected Generator's application for exemption or variation is on the basis that the costs likely to be incurred in modifying an Affected GS to operate in *frequency response mode* and the costs of operating the Affected GS in *frequency response mode* relative to the *market* revenue derived during its expected operating hours are unreasonably onerous, the Affected Generator must provide supporting documentation evidencing the expected capex and opex costs of modifying and operating the Affected GS.

~~7.2.~~6.2. Application for exemption

Where an Affected Generator seeks an exemption from the requirement to operate an Affected GS in accordance with these PFRR, it must submit an application for exemption to AEMO in the form in Appendix A ~~at the same time as it submits the Affected GS Results,~~ detailing the grounds for seeking exemption, with reasons and supporting evidence.

For the avoidance of doubt, Affected Generators do not need to submit an application for exemption where section 6.5~~76.5~~ applies to the Affected GS.

~~7.3.~~6.3. Application for variation

Where an Affected Generator seeks a variation from the requirement to operate an Affected GS in *frequency response mode* in accordance with one or more of the PFRP, it must submit an application for variation to AEMO in the form in Appendix B ~~to at the same time as it submits the Affected GS' Results,~~ detailing the Affected GS' limitations, with reasons and supporting evidence.

For the avoidance of doubt, Affected Generators do not need to submit an application for variation where one or more of the conditions specified in section 6.6 may affect the Affected GS' ability to provide PFR.

~~7.4.~~6.4. Application process

~~7.4.1.~~6.4.1. Insufficient information

If AEMO considers that an Affected Generator has not provided enough information for AEMO to assess an Affected Generator's application for exemption or variation, a request specifying

the further information required will be forwarded to the Affected Generator within ~~10~~30 *business days* of receiving the Affected Generator's application for exemption.

The Affected Generator must provide the further information requested within ~~10~~30 *business days* of receiving AEMO's request.

6.4.2. Extension of time

~~7.4.2. Extension of time~~

In its absolute discretion, if AEMO is satisfied that an Affected Generator cannot reasonably provide ~~the Results, or~~such further information~~,~~ within the required time, AEMO may grant the Affected Generator additional time to provide the further information requested under section 6.4.1~~76.4.1~~.

~~7.4.3.~~6.4.3. AEMO response to application

AEMO will determine whether to grant an exemption or variation within ~~20~~60 *business days* of receiving an Affected Generator's application, or provision of any further information requested under section 6.4.1, whichever is the later, in the form in Appendix C~~.~~.

If AEMO rejects an application for exemption, AEMO may grant the Affected Generator a variation from one or more of the PFRP, instead.

AEMO may grant an exemption or variation with or without conditions, as appropriate.

~~7.5.~~6.5. Standing exemptions

~~7.5.1.~~6.5.1. Steam stage of combined cycle gas turbines

The steam turbine component of a combined cycle gas generator does not need to be frequency responsive.

~~7.6.~~6.6. Standing variations

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 ~~for the duration of~~to the extent that its ability to do so is impacted by the relevant factor or cause:

(a) to manage the safety or stability of the Affected GS;

(b) to maintain operation between the Affected GS' Maximum Operating Level and Minimum Operating Level;

(c) to effect the start-up or shutdown of the Affected GS, including following *plant* disturbances;

(d) to manage *self-commitment*, *synchronisation*, *decommitment* or *de-synchronisation* of the Affected GS;

(e) to manage *plant* within pressure limits, operating temperature limits, or limits due to ambient ~~temperature;~~environmental conditions;

(f) to avoid rough running ranges associated with the Affected GS;

(g) while the Affected GS is *inflexible*;

(h) to respond to primary energy availability, such as the availability of fuel or stored pressure for thermal *generation*, wind for wind *generation*, irradiance for solar *generation*, head level for hydro *generation* or number of in-service coal mills for coal *generation*;

(i) where the Affected GS is comprised of one or more hydro *generating units*, while they are being operated in tail-water depression mode;

(j) to maintain operation within the limit of ~~an~~the Affected GS' obligations and capabilities, as expressed in its *performance standards* under ~~clauses~~NER S5.2.5.7 and S5.2.5.8 ~~of the NER; or~~;

~~(k)~~ to conduct tests on the Affected GS~~.~~

~~A.6 Subsequent applications for exemption or variation~~

~~7.6.1. Exemption~~

~~An~~ provided that the Affected Generator ~~who has received an Affected GS' PFR Settings from~~ notifies AEMO ~~under section or , as applicable, may subsequently apply for exemption in the form in , detailing the Affected GS' limitations with reasons~~[4] of the expected start and ~~supporting evidence.~~

~~(a)~~(k) ~~The process in section applies~~ end times of testing where it is expected to ~~the application and AEMO will respond to the application in the form in .~~ take one hour or longer and confirms when testing is complete and normal *frequency* response has resumed. For the avoidance of doubt, no notification is required if the test is expected to take less than one hour; or

~~7.6.2. Variation~~

(l) to comply with a request by the LNSP to change or limit the *frequency* response of the Affected GS, provided that the Affected Generator notifies AEMO[5] of the expected duration of the change or limit where it is expected to take one hour or longer and confirms when the change or limit no longer applies and normal *frequency* response has resumed. For the avoidance of doubt, no notification is required if the change or limit is expected to be in effect for less than one hour.

6.7. Changes to Affected GS after exemption or variation

The approval of an application for exemption or variation is granted using information on the status of the Affected GS at the relevant time. If, after the grant of an exemption or variation, an Affected Generator is proposing substantive changes to the configuration of an Affected GS, the Affected Generator must either:

[4] Notifications must be made to AEMO's control room by telephone or email to the appropriate OPS mailbox.

[5] Notifications must be made to AEMO's control room by telephone or email to the appropriate OPS mailbox.

~~Once an Affected Generator has received an Affected GS' PFR Settings from AEMO under section or , as applicable, the Affected Generator must not adjust the PFR Settings of the Affected GS in a manner that would no longer meet those PFR Settings or the terms of the variation.~~

(a) ~~If an Affected Generator wishes to vary the PFR Settings,~~ the Affected Generator considers the Affected GS is capable of meeting the PFRP without variation, advise AEMO of the proposed PFR Settings and how the Affected Generator proposes to demonstrate *plant* stability; or

(b) re-apply for exemption or variation (as applicable) in accordance with sections 6.2 to 6.4~~must apply to~~ .

6.8. AEMO-initiated variation for power system security

6.8.1. Initiation by AEMO

If AEMO considers that ~~using the form in and follow the process for~~ a variation~~, as detailed in section .~~ from the requirement to operate an Affected GS in *frequency response mode* in accordance with one or more of the PFRP is likely to assist in improving *power system security*, AEMO may request the relevant Affected Generator to consider and discuss the feasibility of proposed variations, either on a temporary (trial) or ongoing basis.

6.8.2. Finalisation of AEMO-initiated variation

If ~~The process in~~AEMO and an Affected Generator agree on a variation following AEMO's contact under section 6.8.1 ~~applies to the application,~~ AEMO will ~~respond to~~confirm its approval of the ~~application~~variation in the form in Appendix D~~.~~.

~~8.~~7. Demonstration of stability

~~8.1.~~7.1. General

Plant stability needs to be demonstrated following changes to a *control system* or primary plant to meet the PFRP. Section 7.2~~7.2~~ outlines how this may be demonstrated.

Where material changes are made to governor or *plant* load controller deadbands or load limiters, or to the DCS only, modelling and testing beyond that described in section 7.2 will not be required by AEMO until expiry of the testing cycle detailed in an Affected GS' compliance program under ~~clause~~NER 4.15(b~~) of the NER.~~).

Material changes beyond DCS, governor or *plant* load controller deadbands, or load limiters will require the Affected Generator to test its Affected GS when these changes are made in

accordance with the requirements of the GPS Compliance Assessment and R2 Model Validation Test Plan Templates[6].

~~8.2.~~7.2. Options for demonstrating stability

Once an Affected GS meets the PFRP, its stability must be demonstrated.

It is preferred that Affected Generators conduct a *frequency* step response stability test as described in section 7.2.1. Other possible methods of demonstrating *plant* stability are detailed in the remainder of section 7.2~~87.2~~.

Testing should confirm the ability of the Affected GS to simultaneously respond to changes in *power system frequency* and changes in *dispatch level*, including both small ongoing changes in *frequency* and larger *frequency* disturbances.

~~8.2.1.~~7.2.1. Step response stability test

A test plan for a step response stability test must be submitted to AEMO a minimum of 10 *business days* prior to the proposed date for testing[7]. AEMO may agree to a shorter notice period in its absolute discretion.

A positive frequency step signal equivalent to create 5%, or greater, change in *active power* must be injected into the frequency controller summing junction. The response is to be recorded allowing at least 10 seconds pre-triggered recording and at least 60 seconds recording time after the response has settled at its steady-state value.

The tester must assess whether the recorded response is *adequately damped*, and if so, repeat the test with a negative frequency step signal of the same size.

The test is to be undertaken from a loading that will allow a full positive and negative 5% *active power* change to be achieved.

The *active power, reactive power* and RMS *voltage* must be recorded during the test. Values are to be provided to AEMO at a sample rate of no less than one sample per cycle, unless agreed otherwise by AEMO. Where practicable, the injected frequency signal is to be recorded while synchronised with the other measurements. Where available, existing recorders of the Affected GS's LNSP may be used.

~~8.2.2.~~7.2.2. Actual response to power system disturbance

Where an Affected Generator cannot carry out the test described in section 7.2.1, for example, where it uses a mechanical governor, or where the injection to a sub-part of the overall control will not present a picture of the full response, and the Affected GS is operating in accordance

[6] GPS Compliance Assessment And R2 Model Validation Test Plan Template For Conventional Synchronous Machines. AEMO, May 2016. Available at: https://www.aemo.com.au/-/media/Files/Electricity/NEM/Network_Connections/Transmission-and-Distribution/Generating-System-Test-Plan-Template-for-Conventional-Synchronous-Machines.pdf and GPS Compliance Assessment And R2 Model Validation Test Plan Template For Power Electronic Interfaced Nonsynchronous Generation Technologies. AEMO, September 2016. Available at: https://aemo.com.au/-/media/files/electricity/nem/network_connections/transmission-and-distribution/generating-system-test-template-for-non-synchronous-generation.docx.

[7] See SO_OP_3715 section 6 - ~~https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/power_system_ops/procedures/so_op_3715-power-system-security-guidelines.pdf~~https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/system-operations/power-system-operation/power-system-operating-procedures.

with its PFR Settings, the Affected Generator may submit records of the Affected GS' performance following one or more *power system* disturbances to demonstrate stability.

The records required include *frequency*, *active power, reactive power* and RMS *voltage*. Values are to be provided to AEMO at a sample rate of no less than one sample per cycle, unless agreed by AEMO that a different rate is acceptable. Where available, existing recorders of the Affected GS's LNSP may be used.

~~8.2.3.~~7.2.3. Recent tests

Where an Affected Generator has completed tests in the last few years on its Affected GS and those tests are substantially similar to the tests contemplated by section 7.2.1, the results of those tests may be submitted to AEMO as evidence of stability provided that no changes to the Affected GS have been made since then that would reasonably be expected to have a material adverse effect on the test results.

~~8.2.4.~~7.2.4. Identical generating units within an Affected GS

Where multiple identical *generating units* that form an Affected GS have identical settings applied, the Affected Generator is only required to test or otherwise demonstrate stable response from one of these identical *generating units.*

~~8.2.5.~~7.2.5. Recent operation with similar settings

Where:

(a) an Affected GS has been operated in the last few years with settings substantially similar to the Affected GS' PFR Settings; and

(b) no other changes to the Affected GS in the intervening period would reasonably be expected to have a material adverse effect on its operation with those settings,

the Affected Generator may submit evidence of stable operation during the period of prior operation with those settings.

~~A.7 Timing of tests~~

~~Affected Generators are not required to conduct tests of the type contemplated in section prior to, or to support preparation of, its Results submitted under section , however, they may do so to increase their confidence in the Results.~~

~~9.~~8. Compliance

~~9.1.~~8.1. No new compliance monitoring

There are no additional compliance monitoring requirements, beyond those in the NER, required from Affected Generators to demonstrate compliance with an Affected GS' PFR Settings.

~~9.2.~~8.2. Non-compliance

Where AEMO considers an Affected GS is being operated contrary to its PFR Settings, or there is an unusually high number of instances where it is subject to one or more of the operating conditions specified in section 6.6, AEMO may require further information and data from the Affected Generator to assess the Affected GS' compliance.

~~10.~~9. Publication of Primary Frequency Response outcomes

AEMO will publish and maintain on its website a list of Affected GSs and an indication of whether each Affected GS is:

(a) required to maintain its PFR Settings;

(b) exempt from the requirements of this PFRR; or

(c) subject to a variation of one or more PFRP described in section 3, and if so, which parameters are varied[8].

~~11. IMPLEMENTATION TIMETABLE~~

~~Clause 11.122.2(c)(3) of the NER requires AEMO to set out the process for the coordinated activation of changes to Affected GS, which may be by type.~~

~~contains an indicative timetable, which shows that many of the milestones to be achieved are heavily dependent on timely submission of information and responses to requests for information by Affected Generators. Implementation issues and uncertainty with testing times will also have a significant impact on the timetable.~~

~~The timetable does not include the estimated time to review applications for exemption or variation, as these are expected to be submitted at the same time as the Self-Assessment. Subsequent exemption or variation applications may be made if, after AEMO's review, an Affected Generator considers it necessary.~~

~~AEMO will publish an updated version of this timetable on its website at after reviewing the Self-Assessments due on 28 August 2020. The timetable will be reviewed and updated at regular intervals after publication.~~

[8] The varied PFRP will only be published by an Affected Generator's consent.

~~Appendix A. PRIMARY FREQUENCY RESPONSE REQUIREMENTS~~

~~Existing Generation – Results of Self-Assessment~~

~~Section 1: Applicant~~

~~Applicant~~	
~~ABN~~	

~~Where the Applicant represents a number of related parties who are Affected Generators[9], a document showing the relationships between the Applicant and those Affected Generators should also be provided.~~

~~Section 2: Affected GS[6] & Local Network Service Provider (LNSP)[10]~~

~~[9] As defined in the Interim Primary Frequency Response Requirements.~~

~~[10] Copy and paste for each Affected GS.~~

Appendix A. Primary frequency response requirements Application for Exemption

Section 1: Affected Generator/Connection Applicant (Applicant)

Name	
~~DUID~~ABN	
~~Connection Point~~	
~~Registered Capacity~~	
~~Technology~~	
~~LNSP~~	

~~Section 3: Results of self-assessment and proposed PFR settings~~[7]

~~The following are the results of the Applicant's self-assessment of the Affected GS' ability to meet each of the PFRP outlined in section and the Proposed PFR Settings for the Affected GS:~~

~~Name of Affected GS:~~		
~~DUID:~~		
~~Deadband at the Connection Point:~~	~~One change to ±0.015Hz~~	~~Yes/No~~
~~(indicate preference)~~	~~Two changes:~~ ~~1. ±0.05Hz~~ ~~2. ±0.015Hz~~	~~Yes/No~~
~~Droop (% of Maximum Operating Level)~~		
~~Response Time (seconds to achieve a 5% change in output)~~	~~(provide evidence of inherent delays in plant response or any physical, environmental, temperature or other limits that could impact response time, include its range and continuity – see additional performance requirements referred to in section 4.)~~	
~~Earliest date(s) that Proposed PFR Settings can be made:~~		

~~Section 4: Supporting information~~

~~Documents to be submitted to support this Self-Assessment, where necessary, include:~~

- ~~Control block diagrams, simulations, reports of previous physical tests, past commissioning test results or OEM specifications, as relevant to PFR.~~
- ~~Information on limits to range of response, or the ability of the Affected GS to sustain response, including how they may relate to underlying plant capability, stability or safety.~~
- ~~Information on any limitations on the Affected GS' ability to meet the PFRP.~~
- ~~Information describing how the Affected GS is operated to provide Regulation FCAS or Contingency FCAS.~~

~~Please list each supporting document provided:~~

1.

Section 5: Demonstration of stability – the following applies to each Affected GS[11]:

Name of Affected GS:	
DUID:	
Are tests of the type contemplated by section 8.2.1 proposed?	Yes/No (If yes, please describe the proposed tests)
Are tests of the type contemplated by section 8.2.2 proposed?	Yes/No (If yes, please describe the proposed tests)
Does the Applicant wish to use previous test results as evidence for stable operation with the PFRP?	Yes/No (If yes, please describe the previous tests, and how they indicate stable operation will be achieved with the PFRP)
Has the Affected GS previously operated with settings similar to or consistent with the PFRP within the last few years?	Yes/No (if yes, provide evidence of previous operation date/time and outcomes)
If tests are proposed, please provide date(s) for the tests.	

Section 6: Applicant contacts for queries[12]

Name	
Title	
Phone	
Email	

Section 7: Certification and signature

I, _____ (insert name)

_____ (insert title)

DECLARE that I am authorised by the Applicant to submit this Self-Assessment on the Applicant's behalf and CERTIFY that the contents of this Self-Assessment and any attachments are true and correct.

Signature	……/……/20…… Date

[11] Copy and paste table for each Affected GS.

[12] Copy and paste table to insert more names if more than one contact.

~~This form should be submitted to:~~

~~Enquiries about this form should be submitted to:~~

~~Appendix B. PRIMARY FREQUENCY RESPONSE REQUIREMENTS~~
~~New Connections – Proposed PFR settings~~

~~Section 1: Connection applicant~~

Applicant	
~~ABN~~	

~~Section 2: Proposed Affected GS[13] & Local Network Service Provider (LNSP)[14]~~

~~Name~~	
~~DUID~~	
~~Connection Point~~	
~~Proposed Capacity~~	
~~Technology~~	
~~LNSP~~	

~~Section 3: Proposed PFR settings[14]~~

~~Name of Affected GS:~~	
~~DUID:~~	
~~Deadband at the Connection Point~~	
~~Droop (% of Maximum Operating Level)~~	
~~Response Time (seconds to achieve a 5% change in output))~~	

~~Section 4: Supporting documents~~

~~Documents that may be submitted to support this Self-Assessment include:~~

- ~~Control block diagrams, simulations, as relevant to PFR.~~
- ~~Information on any limitations on the Affected GS' ability to meet the PFRP.~~

~~[13] As defined in the Interim Primary Frequency Response Requirements.~~

~~[14] Copy and paste table for each Affected GS.~~

- Information on any proposed limits to range of response, or the ability of the Affected GS to sustain response, including how they may relate to underlying plant capability, stability or safety.
- Information describing how the Affected GS is operated to provide Regulation or Contingency FCAS.

Please list each supporting document provided:

1.

Section 5: Connection applicant contacts for queries[15]

Name	
Title	
Phone	
Email	

Section 6: Certification and signature

I, _____ (insert name)

_____(insert title)

DECLARE that I am authorised by the Applicant to submit this Self-Assessment on the Applicant's behalf and CERTIFY that the contents of this Self-Assessment and any attachments are true and correct.

Signature	……/……/20…… Date

This form should be submitted to:

Enquiries about this form should be submitted to:

[15] Copy and paste table to insert more names if more than one contact.

Appendix C. PRIMARY FREQUENCY RESPONSE REQUIREMENTS AEMO Response to Affected Generator

[on AEMO letterhead]

[Name and address of Affected Generator]

Dear [insert as appropriate],

Interim Primary Frequency Response Requirements – Notice of PFR Settings

Further to your recent self-assessment, AEMO has assessed the information provided by you and confirms that the PFR Settings[16] for each Affected GS you own/operate and the date from which provision of PFR must commence in accordance with those PFR Settings is as detailed in Attachment 1 [if only one or a few, delete Attachment 1 and insert table here].

[Where testing is proposed, include next paragraph]

We confirm that you will be testing [insert name of plant or vary if more than one]. The agreed arrangements are as follows:

[Insert testing details, especially when and how]

AEMO's usual control room procedures will apply prior to, during, and immediately after, testing.

Please ensure you understand the performance requirements as they apply to each Affected GS, as specified in the IPFRR and note your obligations to advise AEMO of any non-compliance.

Should you wish to vary any of these PFR Settings, please refer to the IPFRR for the variation application process.

Any queries should be addressed to [insert particulars].

Yours sincerely,

[insert name and title]

[16] Capitalised terms are defined in the Interim Primary Frequency Response Requirements (IPFRR).

Attachment 1 – PFR settings

Generating System DUID	Progressive narrowing of deadband?	Affected GS' Deadband	Commencement Date	Droop	Response Time	Conditions[17]
	Yes/No	[If staged] 1. ±0.050 Hz 2. ±0.015 Hz	1. [date] 2. [date]			
		[If not staged] ±0.015 Hz				

[17] You may insert attachments if lengthy.

~~Appendix D. PRIMARY FREQUENCY RESPONSE REQUIREMENTS Application for Exemption~~

Section ~~1: Applicant~~

~~Applicant~~	
~~ABN~~	

~~Section~~ 2: Affected GS[19] & Local Network Service Provider (LNSP)[20]

Name	
DUID	
Connection Point	
LNSP	

The Applicant seeks exemption from the requirement to operating the Affected GS in accordance with all PFRP on the following grounds:

Section 3: Grounds for exemption~~:~~

Provide details of basis for exemption and attach any relevant evidence. See Section 6.1 for details.

Section 4: Supporting information

Attach supporting information. See Section 6.1 of the ~~Interim~~ Primary Frequency Response Requirements and ~~clause~~NER 4.4.2B ~~of the NER~~ for the relevant grounds and details of the type of information to be provided.

Section 5: ~~Applicant~~ Contacts for queries[21]

Name	
Title	
Phone	
Email	

[19] As defined in the ~~Interim~~ Primary Frequency Response Requirements.

[20] If more than one Affected GS affected by the same issues, you may copy and paste table for each Affected GS.

[21] Copy and paste table to insert more names if more than one contact.

Section 6: Acknowledgment and consent to publication

By submitting this application, the Applicant acknowledges that AEMO will publish a list of *generating systems* that are exempt from the Primary Frequency Response Requirements, as required by the National Electricity Rules.

If exemption is granted, the published exemption list may include a brief reason for the exemption, with the Applicant's consent. The Applicant consents/does not consent to the publication of the reason for which any exemption was granted.

Section 7: Certification and signature

I,

_____(_____(insert name)

_____(_____(insert title)

DECLARE that I am authorised by the Applicant to submit this Application on the Applicant's behalf and CERTIFY that the contents of this Application and any attachments are true and correct.

Signature	……/……/20…….
	Date

This form should be submitted to PFR@aemo.com.au.

Enquiries about this form should be submitted to PFR@aemo.com.au.

~~Appendix E.~~Appendix B. Primary frequency response requirements Application For Variation

Section 1: Affected Generator/Connection Applicant (Applicant)

Applicant	
ABN	

~~Applicant~~	
~~ABN~~	

Section 2: Affected GS[22] & Local Network Service Provider (LNSP)[23]

Name	
DUID	
Connection Point	
LNSP	

The Applicant seeks a variation from one or more of the PFRP.

Section 3: Variations ~~requested[22]~~requested

Indicate which PFRP the Affected Generator seeks AEMO to vary for each Affected GS and on what basis.

PFRP	Reason
Deadband	
Droop	
Speed of Response	

Section 4: Supporting information

Attach supporting information for each variation requested. See section 6.1~~7.1~~ of the ~~Interim~~ Primary Frequency Response Requirements and ~~clause~~NER 4.4.2B of the NER for the relevant grounds and details of the type of information to be provided.

[22] As defined in the ~~Interim~~ Primary Frequency Response Requirements.

[23] If more than one Affected GS affected by the same issues, you may copy and paste table for each Affected GS.

Section 5: Applicant contacts for queries[24]

Name	
Title	
Phone	
Email	

Section 6: Acknowledgment of publication of variation and reasons:

By submitting this application, the Applicant acknowledges that AEMO will publish a list of *generating systems* that have been granted variations of one or more PFRP, as required by the National Electricity Rules. The published list will specify which parameters are varied for each relevant *generating system*.

If a variation is granted, the published list may include the varied PFR Settings as approved by AEMO, with the Applicant's consent. The Applicant consents/does not consent to the publication of the approved PFR Settings for the Affected GS and the reasons for the variation.

Section 7: Certification and signature

I,

_____

_____(_____(insert name)

-

_____

_____(-

_____(insert title)

DECLARE that I am authorised by the Applicant to submit this Application on the Applicant's behalf and CERTIFY that the contents of this Application and any attachments are true and correct.

Signature	……/……/20…….
	Date

This form should be submitted to PFR@aemo.com.au.

Enquiries about this form should be submitted to PFR@aemo.com.au.

[24] Copy and paste table to insert more names if more than one contact.

~~Appendix F.~~Appendix C. Primary frequency response requirements
AEMO Response to Application for Exemption/Variation

[on AEMO letterhead]

[Name and address of Affected Generator]

Dear [insert as appropriate],

~~Interim~~ Primary Frequency Response Requirements – Exemption/Variation [delete whichever is inapplicable] of [insert name of Affected GS]

Further to your recent application for exemption/variation [delete as applicable] of [insert name of Affected GS] from the requirements of the ~~Interim~~ Primary Frequency Response Requirements (~~IPFRR~~) PFRR)[25], AEMO has assessed the information provided by you and decided to grant/not grant [delete as applicable] your application for exemption/variation [delete as applicable] on the following grounds/conditions [delete as applicable]:

[insert grounds/conditions – adjust as necessary if no conditions]

[If granting variation to requirements, confirm PFR Settings as follows]

Therefore, the PFR Settings for [insert name of Affected GS] are as follows:

PFRR		
Affected GS Deadband		
Droop	Under-Frequency Response	
	Over-Frequency Response	
Response Time		

[Next ~~two paragraphs~~paragraph not needed for exemptions]

~~Please ensure you understand the performance requirements as they apply to each Affected GS, as specified in the PFRR and note your obligations to advise AEMO of any non-compliance.~~

Should you subsequently wish to vary any of these PFR Settings, please refer to the PFRR for the application process.

[If granting variation, confirm tests]

AEMO also wishes to confirm that you will be carrying out tests as follows:

[insert]

AEMO's usual control room procedures will apply prior to, during, and immediately after, testing.

[25] Capitalised terms are defined in the ~~IPFRR~~PFRR.

Please ensure you understand the performance requirements as they apply to each Affected GS, as specified in the ~~I~~PFRRPFRR, and note your obligations to advise AEMO of any non-compliance.

Any queries should be addressed to [insert particulars].

Yours sincerely,

[insert name and title]

Appendix D. Primary frequency response requirements Agreed variation for power system security

[on AEMO letterhead]

[Name and address of Affected Generator]

Dear [insert as appropriate],

Primary Frequency Response Requirements – Agreed Variation of [insert name of Affected GS]

Further to our recent discussions concerning a proposed variation of [insert name of Affected GS] from the requirements of the Primary Frequency Response Requirements (**PFRR**), AEMO confirms its approval of the application of the following PFR Settings for [insert name of Affected GS] for the purpose of improving power system security:

PFRP		
Affected GS Deadband		
Droop	Under-Frequency Response	
	Over-Frequency Response	
Response Time		
Period of Variation	[Specify if temporary or permanent. If temporary, specify the period for which, or conditions under which, the variation applies, and the process for either reverting or retaining the PFR Settings at the end of the period.]	

Should you subsequently wish to vary any of these PFR Settings, please refer to the PFRR for the application process.

[If testing will be required, confirm tests]

AEMO also wishes to confirm that you will be carrying out tests as follows:

[insert]

AEMO's usual control room procedures will apply prior to, during, and immediately after, testing.

Please ensure you understand the performance requirements as they apply to each Affected GS, as specified in the PFRR, and note your obligations to advise AEMO of any non-compliance.

Any queries should be addressed to [insert particulars].

Yours sincerely,

[insert name and title]

~~Appendix G. Indicative TRANCHE 1 implementation timeline~~

~~As at 4 June 2020 – updated versions will be published on AEMO's website as available.~~

Appendix E. Version release history

Version	Effective date	Summary of changes
2.0	8 May 2023	Final requirements under NER 11.152.2.
1.0	4 June 2020	First version under NER 4.4.2A(a) and interim requirements under NER 11.112.2.

~~**CODE:** A = Self-Assessment received. B = AEMO response provided. I = Interim deadband applied before complying with PFR Settings. C = Commencement of the provision of PFR in accordance with the PFR Settings.~~