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31 October 2019

Mr John Pierce
Chair
Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

On-line submission: AEMC **ERC0274**

Dear Mr Pierce

Primary frequency response rule changes – AEMO submission to AEMC's Consultation Paper

AEMO welcomes the opportunity to contribute to the Commission's consultation paper that addresses issues raised in three rule change requests relating to primary frequency response.

AEMO's submission reiterates our proposed solution that near-universal provision of primary frequency response (PFR) outside a narrow deadband is the only effective means of regaining control of frequency within the normal operating frequency band (NOFB), and re-establishing prudent electricity practice. We continue to strongly support that this proposal addresses the urgent need for mandatory PFR and should be implemented as soon as possible.

Once the mandatory PFR rule is made and implemented, AEMO would work with the AEMC and industry on options for incentivising a market mechanism for PFR. This process is expected to take a significant amount of time and therefore must not be used as a delay tactic for implementing AEMO's rule change proposal.

AEMO acknowledges the proposal of a voluntary trial by larger generating systems to increase their provision of PFR with narrower settings. While we will work with these generators to address any issues to allow setting changes, we continue to advise that partial participation cannot reliably and securely address the immediate needs of the power system or meet the other objectives of the proposed rule.

Our submission also comments on the Commission's proposal that the delivery of PFR could be limited to a minimum level considered likely to achieve an acceptable frequency distribution within the NOFB in normal operating conditions. AEMO notes that this is not an effective or sustainable solution to the identified issue, particularly as the characteristics and complexities of the National Electricity Market (NEM) continue to change. Further, the Commission's proposal will not achieve the objective of minimising individual ongoing costs. Consistent with expert recommendations and industry practice in many international power grids, the objective should be to achieve the highest technically and economically feasible participation from generation in the NEM.

AEMO also proposes further drafting to some parts of the generator access standard to mitigate the risk of misinterpretation between that and our PFR Requirements document.

We look forward to continuing to work with the AEMC on this rule change. Should you have any further queries on our proposal or on the matters raised in this submission please contact Kevin Ly – Group Manager Regulation at kevin.ly@aemo.com.au.

Yours sincerely

Peter Geers
Chief Strategy and Markets Officer

Attachments: Response to AEMC consultation paper – Primary frequency response rule changes

Response to AEMC Consultation Paper

October 2019

Primary Frequency Response Rule Changes

Executive summary

AEMO welcomes the opportunity to comment on the Australian Energy Market Commission's (**AEMC**) Consultation Paper on Primary Frequency Response Rule Changes (**Consultation Paper**). As the proponent of two of the rule change requests, AEMO continues to support its proposed solution to increase the amount of primary frequency response (**PFR**) in the National Electricity Market (**NEM**).

This submission reiterates AEMO's key proposition that near-universal provision of PFR outside a narrow deadband is the only effective means of achieving all objectives of the proposed rule change. Beyond regaining control of frequency within the normal operating frequency band (**NOFB**), these objectives include re-establishing prudent electricity industry standards for power system operability, predictability and resilience.

To be effective as a solution to the physical problem currently being experienced in the NEM, any contract or market incentive mechanism for PFR must operate in parallel with a widespread PFR requirement or be designed to achieve the same outcome.

A key focus of AEMO's submission is the proposition in the Consultation Paper that the delivery of PFR could be limited to a minimum level considered likely to achieve an acceptable frequency distribution within the NOFB in normal operating conditions. AEMO does not consider that this approach could deliver a robust and sustainable solution in a power system with the changing characteristics and the complexity of the NEM. Consistent with expert recommendations and industry practice in many international power grids, the aim should be to achieve the highest technically and economically feasible participation from generation in the NEM.

While a reduced PFR requirement may reduce the overall upfront implementation costs, a widespread obligation would reduce the ongoing individual burden on generating systems and, therefore, the ongoing cost for all affected generators. If reducing upfront costs is a key concern, AEMO suggests it may be more efficient to consider options for managing these upfront costs through additional scrutiny or feasibility criteria, rather than reducing the application of the requirement.

Contents

1. A necessary physical requirement

AEMO submitted rule change requests ERC0263 - Removal of Disincentives to Primary Frequency Response (**ERC0263**) and ERC0274 - Mandatory Primary Frequency Response (**ERC0274**) because the deterioration in power system frequency performance needs to be addressed at the earliest feasible time.

The objectives of AEMO's rule change requests were articulated in the proposals submitted, but can be summarised as:

- Re-establish stable control of power system frequency, especially within the normal operating frequency band (**NOFB**).
- Increase power system resilience to disturbances, especially those that are more complex, or larger than expected.
- Increase predictability in generating system performance, supporting the analysis of power system performance, and the design of control and protection systems.
- Align frequency control practices in the NEM with best practice in comparable jurisdictions.
- Minimise the ongoing operational impact on each generating system.
- Reduce the risk of load shedding or generation shedding following power system frequency events.

On 25 August 2018, the loss of an interconnector transferring 870 MW resulted in the separation of the Queensland and South Australia regions from the rest of the NEM, large frequency deviations in all regions, significant delay in re-establishing sufficiently stable frequency for islanded regions to be re-synchronised, uncoordinated disconnection of generation, and material interruption of customer load. This occurred in relatively benign power system conditions.

AEMO's investigation of this event highlighted the importance of a fundamental physical problem facing the power system - the erosion of effective frequency control as the amount of primary frequency response (**PFR**) provided by capable generation had declined.

AEMO welcomes the priority indicated in the AEMC's Consultation Paper on Primary Frequency Response Rules Changes (**Consultation Paper**) for addressing the risks to power system security associated with the degradation of frequency control. At the same time, the Consultation Paper also explores the potential for contract or market mechanisms to procure a new form of PFR service.

AEMO emphasises that the only robust and sustainable solution to address all objectives of AEMO's rule change requests is a near-universal obligation on capable generation to provide PFR. While AEMO is supportive of economically efficient market or incentive mechanisms to maintain and improve power system performance and resilience, it is vital that the physical requirements of the power system are not compromised in the process.

2. No minimum level of PFR

In ERC0274, AEMO explained that the most efficient and effective way to re-establish stable control of frequency under normal operating conditions was to reverse the trend of limiting, defeating or disabling automated generator frequency response, and require the near-universal provision of PFR outside of a narrowly specified frequency deadband.

AEMO's proposal recognised that there might be physical issues precluding the participation of all generation in the provision of PFR, and that some might not be able to participate without incurring significant costs. AEMO accounted for both by allowing for exceptions under its proposed Primary Frequency Response Requirements (**PFRR**).

Subject to these exceptions, AEMO proposed that all scheduled and semi-scheduled generating systems (typically 30 MW and above) be subject to the PFRR. This is seen as an appropriate mechanism to ensure the widest possible participation, including all capable generation technologies.

Section 6.2.3 of the Consultation Paper states that 'there is likely to be a minimum set of technical requirements and a corresponding proportion of responsive generation where the operational needs of the power system are met'. AEMO understands that, in seeking to specify these, the AEMC's objective is to balance the benefits of a requirement for PFR against both the upfront and ongoing costs of generator compliance with an obligation to provide PFR.

AEMO notes the series of studies of PFR carried out by the Lawrence Berkeley National Laboratory for the Federal Energy Regulatory Commission[1] might suggest that a minimum requirement is capable of calculation. Certainly, these papers detail the authors'[2] analysis of the impact of several variables on the provision of PFR in a simulated environment, however, one of their key recommendations was that, to enhance reliability and minimise the risk of unforeseen shortages, all generators, to the extent feasible, should be capable of providing sustained PFR[3].

AEMO emphasises that ERC0274 seeks to meet all the power system objectives outlined in Section 1. A limited, or 'minimum level' provision of PFR from only a sub-set of capable generation focuses on improving a narrower distribution of frequency under normal operating conditions, but would not, by itself, achieve the other objectives. A widespread obligation:

- diminishes the operational burden on any individual generator to the lowest practicable level and in an equitable as possible manner, thus reducing the longer term operating impacts for all generating systems;
- ensures broad-based contribution to the public good of stable and resilient control of power system frequency; and
- provides greater resilience and facilitates adequate control where a need for PFR arises, particularly where this need may initially be unforeseen.

Compartmentalising the individual power system objectives and trying to manage them in isolation to a minimum level is unlikely to be successful.

The approach AEMO proposes is widely used worldwide and has been proven to work over many decades. Similar technical requirements for PFR are mandated as a condition of operation in both smaller and larger power systems than the NEM, both in broadly conventional power systems and those with high proportions of variable renewable generation.

Implementing this approach would bring the NEM into closer alignment with operating practices in many other power systems worldwide, allowing increased opportunity to learn from and share information with the operators of those other systems as the NEM continues to transform.

3. Comparison with Great Britain

3.1 Description of Great Britain grid mandatory frequency response

Appendix F of the Consultation Paper provides a description of the mandatory PFR arrangements used in the national grid in Great Britain. Similar to the NEM, there is a specified target operating frequency band (±0.2 Hz), and a target for how often frequency should depart this band (less than 1500 excursions per annum).

[1] See https://certs.lbl.gov/project/interconnection-frequency-response.

[2] AEMO also notes that one of the key authors of the published papers is Dr John Undrill.

[3] See pages xxiii and 82 of Eto, Joseph H., John Undrill, Ciaran Roberts, Peter Mackin, and Jeffrey Ellis. Frequency Control Requirements for Reliable Interconnection Frequency Response. LBNL-2001103.

National Grid ESO procures a level of PFR within this normal operating band to ensure this outcome is met. In comparison, AEMO only procures a level of secondary frequency control reserves to permit centralised AGC control of frequency under normal operating conditions, with no corresponding level of PFR.

PFR must be delivered with certain response characteristics, including certain droop and sustain time requirements, and a maximum deadband requirement of ±0.015 Hz, a deadband set well within the target operating frequency band.

Capability to deliver this PFR is mandatory for generation above a certain size, however, actual enablement is determined and compensated in real-time, with enablement sufficient only to meet the minimum frequency control standard under normal conditions. Separate 'Firm Frequency Response' arrangements are used to manage reserve requirements for responding to contingency events.

As shown in Figure 7 of ERC0274, these arrangements result in the British national grid experiencing a relatively wide variation of frequency, second only to the NEM amongst the international power systems shown in that figure.

While the introduction of similar arrangements in the NEM may provide some improvement to the stability of frequency under normal operating conditions, it would not meet all objectives of AEMO's rule change proposal, as listed in Section 1.

Great Britain has a much smaller power system geographically, without the attendant multiple separation risks present in a sparse, long system such as the NEM. Consequently, it does not require the degree of dispersion of frequency response that would be ensured by the proposed broad-based mandatory requirements for the NEM.

3.2 Recent power system incident

The Great Britain grid recently experienced under-frequency load shedding following a single fault event under relatively benign power system conditions due to several unexpected generation responses[4]. The loss of generation exceeded the minimum specified levels of reserves that had been procured, requiring under-frequency load shedding to prevent collapse of the system.

In its interim report into this event, the Energy Emergencies Executive Committee[5] has recommended a review into both the reserve holding, and the response holding policies of National Grid ESO, and whether they are fit for purpose[6].

3.3 Appropriateness of Great Britain's model for the NEM

Events such as this highlight the reliance on emergency responses such as under-frequency load shedding that result from deliberately enabling only sufficient frequency response to meet a minimum standard, without also targeting improved resilience against larger than expected events.

AEMO considers that it is appropriate to implement a PFR requirement that corresponds with Dr Undrill's recommendation for the most widespread possible application. This is a reasonable and prudent approach, given the level of uncertainty that accompanies the NEM's world-leading penetration of power electronic technology connected to the grid.

[4] See report at: https://www.nationalgrideso.com/information-about-great-britains-energy-system-and-electricity-system-operator-eso

[5] Commissioned by the UK Secretary of State for Business, Energy and Industrial Strategy.

[6] See interim report at: https://www.gov.uk/government/publications/great-britain-power-system-disruption-review.

4. Relationship between clause S5.2.5.11 and Primary Frequency Response Requirements

The Consultation Paper refers to the generator performance standards (**GPS**) dealing with frequency performance, primarily clause S5.2.5.11 of the NER.

A query has arisen as to whether the PFRR give rise to an inconsistency with clause S5.2.5.11.

Table 1 compares the requirements in clause S5.2.5.11 with the PFRR:

Table 1 Comparison of requirements in clause S5.2.5.11 and PFRR

Requirement		S5.2.5.11	Reference	PFRR	Reference
Minimum Access Standard					
Power transfer must not increase in response to rise in power system frequency		✓	(c)(1)(i)	✓	4.1
Power transfer must not decrease more than 2% per Hz in response to fall in power system frequency		✓	(c)(1)(ii)	✓	4.1
Subject to energy source availability, generating system must be capable of operating in frequency response mode so that change in power transfer in response to changes in power system frequency is either proportional or as agreed with AEMO and NSP.		✓	(c)(2)	✓	4.7 & 4.1
General Requirements					
Each control system must be adequately damped.		✓	(g)	✓	4.5
Automatic Access Standard & Negotiated Access Standard	Delay in response	No delay beyond that required for stable operation, or inherent in the plant controls, once the power system frequency leaves a deadband around 50Hz.	(i)(1)	No delay beyond that limited by plant stability or capability. Capable of achieving 5% change within 10 seconds	4.5
	Deadband	Capable between 0 to ± 1.0 Hz	(i)(2)(i)	± 0.015 Hz	4.3
	Different rise/fall deadbands	✓	(i)(2)(i)	Permissible	4.3
	Droop	Capable between 2% to 10%	(i)(2)(ii)	Not greater than 5% but could be different for rise/fall as long as not more than 5%	4.4
	No operation below minimum operating level or above maximum operating level	✓	(i)(3)	✓	4.7

Requirement		S5.2.5.11	Reference	PFRR	Reference
	Operation in frequency response mode	Interpreted by some generators as permitting no PFR outside of FCAS	(4)	✓	4.1

While the requirements are not identical, AEMO considers that the capabilities required under the PFRR are not more onerous than the access standards in clause S5.2.5.11, or in other existing minimum access standards in clause S5.2.5.

Nevertheless, AEMO recognises that two sets of requirements for frequency response could give rise to unintended interpretations.

A proposal to amend clause S5.2.5.11 to remove any potential ambiguity is shown in Appendix 1. The amended clause explicitly refers to the need for generation to meet the requirements of the PFRR and removes the requirements in relation to the capability to set droop and deadband settings.

5. Primary Frequency Response Requirements

A draft of the proposed PFRR was released with ERC0274 to give generators an opportunity to assess its impact on their operations and to advise where there might be risk of unintended outcomes.

Various issues have been raised by generators, both with AEMO and the AEMC, to which AEMO responds as follows:

5.1 Technical requirements

In response to the technical issues raised, AEMO has proposed changes to the PFRR, and has provided the AEMC with an updated draft showing those changes prior to providing this submission. These changes are broadly intended to clarify and provide further information on the proposed requirements.

Specifically, they:

- Clarify requirements around headroom.
- Clarify requirements around sustaining response
- Provide alternative options for testing where control changes are made.
- Amend the description of requirements in relation to speed of response.
- Note that partial exemptions may be necessary to avoid adverse impacts on power system security.

5.2 Application to generating systems or units

It has been suggested that the PFRR should be directed at generating units, as opposed to each generating system. AEMO is concerned that the collective response of operational generating units within a generating system meets the PFRR, and not necessarily each generating unit at all times.

Moreover, the frequency control access standards in clause S5.2.5.11 are also expressed as being applicable to generating systems, and so the PFRR are consistent with those standards.

5.3 Application to scheduled loads

There have been some enquiries as to how the PFRR will apply to battery energy storage systems, which operate as scheduled loads as well as scheduled generators.

The current market arrangements treat batteries as separate market entities (namely, they have separate DUIDs in AEMO's market systems) when discharging (as a Scheduled Generator) and charging (as Market Customer with scheduled load). Hence, the operation of a battery energy storage system as a generating system is covered.

To meet the objectives of these rule change requests, 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.

AEMO understands, however, that most existing scheduled loads in the NEM, other than batteries, are not technically capable of meeting the requirements of the PFRR and, for the foreseeable future, does not intend that the PFRR extend to scheduled loads.

5.4 Upfront costs associated with PFR

When AEMO conceived the technical requirements, it was considered that the most onerous change that most generators might have to undertake would be a change in control system settings[7].

AEMO are aware that some generating systems can make control system changes to become compliant with the PFRR at near zero cost, and at very short notice. AEMO are also aware that more significant, time consuming, complex and costly changes may be required for other generating systems.

In light of the full range of technologies in operation, and in the absence of specific information for each generating system, AEMO do not wish to speculate on the unique costs associated with becoming PFRR-compliant for every affected generating system.

5.5 Assessment and payment of upfront costs

The underlying principle of AEMO's assessment of claims for recovery of upfront costs is that generators should be able to recover costs they would not otherwise have incurred, were it not for the requirement to comply with the PFRR.

In doing so, AEMO must also determine whether the costs claimed are fair and reasonable. As there is potential for some claims to be high, AEMO has proposed an assessment process and, depending on the quantum of claims, may engage an independent expert to assist in that assessment to advise whether the costs claimed are fair and reasonable.

Beyond these principles, AEMO considers it premature to speculate on materiality thresholds.

Finally, if AEMO considers any upfront costs to be unreasonable, AEMO may grant an exemption or partial exemption from one or more requirements, if that would result in the costs being more reasonable, without adversely impacting power system security.

AEMO is keen to ensure that uncertainty about the level of upfront costs does not pre-emptively limit the objective of achieving the participation of the greatest feasible proportion of capable generation in providing PFR, as discussed earlier in this submission. AEMO suggests that cost concerns may be better addressed though a claims assessment and approval process that provides confidence both that the amount claimed reflects reasonable costs that are not so high as to be uneconomic relative to the PFR contribution. If AEMO's proposed framework is not considered sufficient, alternative options could be explored, including additional criteria or involvement of other bodies, while preserving the objective of achieving PFR that is as widespread as technically and economically feasible without undue delay.

[7] See section 6.1 of the PFRR.

5.6 Ongoing costs of PFR provision

The ongoing costs are likely to include fuel and opportunity costs. Generators have also indicated concerns over the impact of the proposals on their relative competitive positioning.

As noted in section 13.2.2 of ERC0274, if there is a near-universal provision of PFR, the incremental ongoing costs incurred by each generator will be kept to a minimum, which should reduce the impact on their relative competitive positioning as far as possible.

5.7 Exemptions

AEMO notes that section 6.4 of the PFRR details two standing exemptions. Beyond these, applications for exemption will be treated on a case-by-case basis.

AEMO's focus will be on either a physical inability of the plant to comply with the frequency response requirements, or on the impact that any setting changes might have on power system security. Relevant information from the generators will be required in each case.

6. NEM-wide PFR trial

AEMO understands that an option of voluntary PFR trials, as proposed by AEMO prior to the 25 August 2018 system event, has been suggested by some generators.

AEMO welcomes any voluntary changes by generators to increase their provision of PFR, particularly within the NOFB, at any time. As contemplated in ERC0263, AEMO is keen to encourage and facilitate favourable changes in frequency response settings. Any material change is likely to result in some improvement in stable frequency control and in power system resilience to major disturbances, both of which are key objectives of AEMO's proposed rule changes. AEMO is happy to work with generators to remove any impediments to making control system changes and manage any transitional issues, ahead of a rule change taking effect.

The voluntary provision of PFR might also be helpful in identifying the actual impact on individual generating units/systems of changes to their control systems, however, volunteer generating plant is likely to experience an increase in the operating impact above what would be expected with broader system-wide PFR provision, due to the greater individual burden placed on the limited, volunteered plant.

AEMO emphasises that a voluntary trial of increased provision of PFR from a limited group of generating systems cannot be a durable substitute for the broad requirement proposed in the rule change requests. Among other reasons, it would be dependent on voluntary participation which, in theory, could be withdrawn at any time. Such an arrangement would only serve as a stop-gap mechanism at best, and would not fully or reliably achieve the objectives of the rule change requests.

7. Alternative solutions

In section 4.4 of the Consultation Paper, the AEMC presents seven policy options previously identified through the Frequency Control Frameworks Review, which are summarised in Table 4.1. All options other than option C (mandatory provision of PFR) rely solely on incentive-based mechanisms to ensure adequate control of power system frequency. In most cases, this section notes AEMO's previously provided views.

AEMO would support any incentive-based or market mechanism for the provision of PFR if it acted to support the achievement of the full range of objectives AEMO seeks, as outlined in Section 1, however, AEMO does not believe that the purely incentive-based or market mechanisms presented in the Consultation Paper would be able to do so.

AEMO notes that beyond the minimum mandatory technical requirements proposed in ERC0274, existing long-standing commercial arrangements for the management of frequency control reserves will continue via the existing Contingency and Regulation FCAS markets. Generators will continue to be able to offer reserves into these markets, and AEMO is working to remove disincentives to doing so, particularly via a review of the Market Ancillary Service Specification (**MASS**).

As noted in AEMO's rule change requests, while existing market and incentive arrangements could be adjusted over time to meet the needs of a changing power system, these are fundamentally unsuited, by themselves, to deliver all the objectives AEMO is trying to achieve.

There is little experience beyond the NEM with incentives as the sole mechanism for managing the provision of PFR by relying on a small fraction of potentially capable generation. AEMO suggests the experience of the NEM to date makes the disadvantages of this reliance increasingly clear.

AEMO supports the development of new mechanisms to incentivise better performance than what is required by the PFRR only if they operate in parallel to a near-universal PFR obligation. AEMO does not believe an incentive mechanism alone could achieve all objectives of its rule change requests without ensuring a broad level of participation.

8. Dr Sokolowski's proposal

AEMO was pleased to see that the rule change request from Dr Sokolowski seeks to achieve similar outcomes as ERC0274 and recognises that there is more than one way the NER could be amended to achieve the outcomes AEMO seeks.

AEMO wishes to address two questions that relate to Dr Sokolowski's request.

8.1 Enhancement of AEMO's power system security responsibilities

AEMO does not consider the proposed change to clause 4.3.1 of the NER to be necessary.

As with the other functions listed in section 49 of the *National Electricity Law*, they are high-level, and the detail around each function is in the NER. One of the issues raised in ERC0274 was the need to address the tools that facilitate AEMO's achievement of the function expressed in section 49(1)(e), namely, to maintain and improve power system security. Replicating that function in clause 4.3.1 of the NER will not achieve the desired outcome.

8.2 Relationship with inertia

An inertia framework has recently been created, with mechanisms for inertia management. AEMO does not consider that any changes to the inertia framework are necessary for determining these PFR rule change proposals.

Glossary

This document uses many terms that have meanings defined in the National Electricity Rules (**NER**). The NER meanings are adopted unless otherwise specified.

Term	Definition
AEMC	Australian Energy Market Commission
Consultation Paper	AEMC, Primary frequency response rule changes, Consultation paper, 19 September 2019
DUID	Dispatchable unit identifier
ERC0263	Rule change request ERC0263 - Removal of Disincentives to Primary Frequency Response
ERC0274	Rule change request ERC0274 - Mandatory Primary Frequency Response
FCAS	Frequency control ancillary services. A form of market ancillary services.
Generator	The owner/operator of a generating system.
GPS	Generator performance standards
MASS	Market Ancillary Service Specification
NEM	National Electricity Market
NER	National Electricity Rules
NOFB	The 'normal operating frequency band' specified in the Frequency Operating Standard, published by the Reliability Panel.
NSP	Network Service Provider
PFR	Primary frequency response.
PFRR	Primary Frequency Response Requirements, the document AEMO proposes to publish with proposed new clause 4.4.2A of the NER.

Appendix 1 – Proposed amendments to clause S5.2.5.11

S5.2.5.11 Frequency control

(a) For the purpose of this clause S5.2.5.11:

droop means, in relation to *frequency response mode*, the percentage change in *power system frequency* as measured at the *connection point*, divided by the percentage change in *power transfer* of the *generating system* expressed as a percentage of the maximum operating level of the *generating system*. Droop must be measured at *frequencies* that are outside the deadband and within the limits of *power transfer*.

maximum operating level means in relation to:

(1) a *non-scheduled generating unit*, the maximum *sent out generation* consistent with its *nameplate rating*;

(2) a *scheduled generating unit* or *semi-scheduled generating unit*, the maximum *generation* to which it may be *dispatched* and as provided to *AEMO* in the most recent *bid and offer validation data*;

(3) a *non-scheduled generating system*, the combined maximum *sent out generation* consistent with the *nameplate ratings* of its in-service *generating units*; and

(4) a *scheduled generating system* or *semi-scheduled generating system*, the combined maximum *generation* to which its in-service *generating units* may be *dispatched* and as provided to *AEMO* in the most recent *bid and offer validation data*.

minimum operating level means in relation to:

(1) a *non-scheduled generating unit*, its minimum *sent out generation* for continuous stable operation;

(2) a *scheduled generating unit* or *semi-scheduled generating unit*, its minimum *sent out generation* for continuous stable operation;

(3) a *non-scheduled generating system*, the combined *minimum operating level* of its in-service *generating units*; and

(4) a *scheduled generating system* or *semi-scheduled generating system*, the combined minimum *sent out generation* of its in-service *generating units*.

Automatic access standard

(b) The *automatic access standard* is:

(1) a *generating system's power transfer* to the *power system* must not:

(i) increase in response to a rise in the *frequency* of the *power system* as measured at the *connection point*; or

(ii) decrease in response to a fall in the *frequency* of the *power system*

as measured at the *connection point*; and

(2) subject to the *primary frequency response requirements,* a *generating system* must be capable of operating in *frequency response mode* such that it automatically provides a proportional:

(i) decrease in *power transfer* to the *power system* in response to a rise in the *frequency* of the *power system* as measured at the *connection point*; and

(ii) increase in *power transfer* to the *power system* in response to a fall in the *frequency* of the *power system* as measured at the *connection point*,

sufficiently rapidly and sustained for a sufficient period for the *Generator* to be in a position to offer measurable amounts of all *market ancillary services* for the provision of *power system frequency* control.

Minimum access standard

(c) The *minimum access standard* is:

(1) for a *generating system* under relatively stable input energy, *power transfer* to the *power system* must not:

(i) increase in response to a rise in the *frequency* of the *power system* as measured at the *connection point*; and

(ii) decrease more than 2% per Hz in response to a fall in the *frequency* of the *power system* as measured at the *connection point*; and

(2) subject to the *primary frequency response requirements*, a *generating system* must be capable of operating in *frequency response mode* such that, subject to energy source availability, it automatically provides:

(i) a decrease in *power transfer* to the *power system* in response to a rise in the *frequency* of the *power system* as measured at the *connection point*; or

(ii) an increase in *power transfer* to the *power system* in response to a fall in the *frequency* of the *power system* as measured at the *connection point*,

where the change in *active power* is either proportional or otherwise as agreed with *AEMO* and the *Network Service Provider*.

[Deleted]

(d) [**Deleted**]

(e) [**Deleted**]

(f) [**Deleted**]

General requirements

(g) Each *control system* used to satisfy this clause S5.2.5.11 must be *adequately damped*.

(h) The amount of a relevant *market ancillary service* for which the *plant* may be registered must not exceed the amount that would be consistent with the *performance standard* registered in respect of this requirement.

(i) For the purposes of subparagraph (b)(2), and with respect to a *negotiated access standard* proposed for the technical requirements relevant to this clause S5.2.5.11:

(1) the change in *power transfer* to the *power system* must occur with no delay beyond that required for stable operation, or inherent in the *plant* controls, once the *frequency* of the *power system* as measured at the *connection point* leaves a deadband;

~~(2) a *generating system* must be capable of setting the deadband and droop within the following ranges:~~

~~(i) the deadband referred to in subparagraph (1) must be set within the range of 0 to ± 1.0 Hz. Different deadband settings may be applied for a rise or fall in the *frequency* of the *power system* as measured at the *connection point*; and~~

~~(ii) the droop must be set within the range of 2% to 10%, or such other settings as agreed with the *Network Service Provider* and *AEMO*;~~

(3) nothing in subparagraph (b)(2) is taken to require a *generating system* to operate below its minimum operating level in response to a rise in the *frequency* of the *power system* as measured at the *connection point*, or above its maximum operating level in response to a fall in the *frequency* of the *power system* as measured at the *connection point*;

~~(4) a *generating system* is required to operate in *frequency response mode* only when it is enabled for the provision of a relevant *market ancillary service*; and~~

(5) the *performance standards* must record:

(i) agreed values for maximum operating level and minimum operating level, and where relevant the method of determining the values, and the values for a *generating system* must take into account its in-service *generating units*; and

(ii) for the purpose of subparagraph (b)(2), or a *negotiated access standard* offering measureable amounts of *market ancillary services* under this clause S5.2.5.11, the *market ancillary services*, including the performance parameters and requirements that apply to each such *market ancillary service*.