MARKET ANCILLARY SERVICE SPECIFICATION

PREPARED BY: AEMO Systems Performance and Commercial
DOCUMENT REF: ESOPP_12
VERSION: 5.0
EFFECTIVE DATE: 30 July 2017
STATUS: FINAL

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APPROVED BY: Damien Stanford
TITLE: Acting Executive General Manager - Operations

DATE: 30 / 06 / 2017
## VERSION RELEASE HISTORY

<table>
<thead>
<tr>
<th>Version</th>
<th>Effective Date</th>
<th>Summary of Changes</th>
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<tbody>
<tr>
<td>1.0</td>
<td>Sep 2001</td>
<td>Initial document issued at the commencement of the market ancillary services</td>
</tr>
<tr>
<td>1.5</td>
<td>27 Feb 2004</td>
<td>Revised to include the Tasmania region</td>
</tr>
<tr>
<td>2.0</td>
<td>5 May 2009</td>
<td>Revised to align with the revised Tasmania frequency operating standards</td>
</tr>
<tr>
<td>2.0</td>
<td>1 Jul 2009</td>
<td>Updated to reflect NEMMCO’s transition to AEMO</td>
</tr>
<tr>
<td>3.0</td>
<td>1 Jul 2010</td>
<td>Revised after consultation</td>
</tr>
<tr>
<td>3.01</td>
<td>1 Jul 2010</td>
<td>Typographical error in Table 4 corrected. The entry in level 3, column 3 was previously an incorrect value of 51.875 and is corrected to 50.875. This is the only change to this version.</td>
</tr>
<tr>
<td>3.02</td>
<td>23 Sep 2011</td>
<td>This draft version is prepared for the first stage consultation. The proposed changes are intended to address the matters raised in the Issues Paper issued as part of the first stage consultation.</td>
</tr>
<tr>
<td>3.03</td>
<td>25 Jan 2012</td>
<td>Revisions made as a part of the draft determination report and the notice of second stage. The proposed changes are intended to address the matters raised in the submissions and meetings with consulted parties in response to the first stage notice</td>
</tr>
<tr>
<td>4.0</td>
<td>30 Mar 2012</td>
<td>Revised after consultation</td>
</tr>
<tr>
<td>5.0</td>
<td>30 Jun 2017</td>
<td>Revised after consultation</td>
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</table>
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1. INTRODUCTION

1.1. Purpose and scope

This is the market ancillary service specification (MASS) made under Rule 3.11.2(b) of the National Electricity Rules (NER).

The MASS has effect only for the purposes set out in the NER. The NER and the National Electricity Law prevail over the MASS to the extent of any inconsistency.

The MASS must contain:

1. a detailed description of each kind of market ancillary service; and
2. the performance parameters and requirements which must be satisfied in order for a service to qualify as the relevant market ancillary service and also when a Market Participant provides the relevant kind of market ancillary service.

For more information about market ancillary services, please contact the Australian Energy Market Operator (AEMO) Information & Support Hub (Support.Hub@aemo.com.au) or call AEMO on 1300 236 600.

1.2. Definitions and interpretation

1.2.1. Glossary

The words, phrases and abbreviations set out below have the meanings set out opposite them when used in the MASS.

Terms defined in the National Electricity Law or the NER have the same meanings in the MASS unless otherwise specified in this clause. Those terms/defined terms are intended to be identified in the MASS by italicising them, but failure to italicise a defined term does not affect its meaning.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregated Ancillary Service Facility</td>
<td>The relevant plant which ancillary service generating units and/or ancillary service loads have aggregated to provide the relevant market ancillary service</td>
</tr>
<tr>
<td>Aggregated Generation Amount</td>
<td>means the amount of power flow through one or more connection points of an aggregated ancillary service generating unit, measured in megawatts (MW), with flow from the ancillary service generating unit being positive</td>
</tr>
<tr>
<td>Aggregated Load Amount</td>
<td>means the amount of power flow through one or more connection points of an aggregated ancillary service load, measured in MW, with flow towards the ancillary service load being negative</td>
</tr>
<tr>
<td>Ancillary Service Facility</td>
<td>The ancillary service generating unit and/or ancillary service load used to provide the relevant market ancillary service</td>
</tr>
<tr>
<td>Contingency Services</td>
<td>means the (1) the fast raise service; (2) the fast lower service; (3) the slow raise service; (4) the slow lower service; (5) the delayed raise service; and (6) the delayed lower service</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>---------------------------------------------------------------------</td>
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<tr>
<td>Controlled Quantity</td>
<td>means a measured quantity of generation or load that is: (a) controlled by the action of Raise Signals and Lower Signals; (b) measured and transmitted to AEMO’s control centre; and (c) unless otherwise agreed between AEMO and the relevant Market Participant, the same quantity specified in a dispatch bid or dispatch offer of the Ancillary Service Facility</td>
</tr>
<tr>
<td>Frequency Control Ancillary Services (FCAS)</td>
<td>means those ancillary services concerned with balancing, over short intervals (shorter than the dispatch interval), the power supplied by generating units and the power consumed by loads. Procured as market ancillary services</td>
</tr>
<tr>
<td>Frequency Control Ancillary Service Verification Tool (FCASVT)</td>
<td>means the Frequency Control Ancillary Service Ancillary Service Verification Tool; an excel spreadsheet designed to verify the performance of Contingency Services</td>
</tr>
<tr>
<td>Frequency Dead-Band</td>
<td>means the range of Local Frequency through which a Variable Controller will not operate</td>
</tr>
<tr>
<td>Frequency Deviation Setting(s)</td>
<td>means the setting or settings allocated to the Ancillary Service Facility by AEMO within the range shown in Table 3 for regions other than Tasmania and Table 4 for the Tasmania region</td>
</tr>
<tr>
<td>Frequency Disturbance</td>
<td>means an occasion when the frequency of the power system moves outside the normal operating frequency band</td>
</tr>
<tr>
<td>Frequency Disturbance Time</td>
<td>means the time at which Local Frequency falls or rises outside the normal operating frequency band during a Frequency Disturbance, referenced to Australian Eastern Standard Time</td>
</tr>
<tr>
<td>Frequency Operating Standards</td>
<td>has the meaning given in the NER, as applicable to the region in which the relevant Ancillary Service Facility is located</td>
</tr>
<tr>
<td>Frequency Ramp Rate</td>
<td>Means 0.125 hertz (Hz) per second for regions other than Tasmania or 0.4 Hz per second for the Tasmanian region</td>
</tr>
<tr>
<td>Frequency Rate of Change Multiplier</td>
<td>means a value in Table 3 for regions other than Tasmania, or Table 4 for the Tasmanian region, which corresponds to the allocated Frequency Setting</td>
</tr>
<tr>
<td>Frequency Recovery</td>
<td>means the first change in Local Frequency from above 50.15 Hz to below 50.1 Hz, or below 49.85 Hz to above 49.9 Hz, to occur after a Frequency Disturbance</td>
</tr>
<tr>
<td>Frequency Setting(s)</td>
<td>means the level(s) of frequency or a combined level(s) of frequency and frequency rate of change determined by AEMO in accordance with the procedure set out in clause 7.2 of the MASS and notified in writing to the Market Participant for use by a Switching Controller or a combined Switching Controller for a particular Ancillary Service Facility when providing a particular market ancillary service</td>
</tr>
<tr>
<td>Generation Amount</td>
<td>means the amount of power flow through a connection point of an ancillary service generating unit, measured in MW, with flow from the ancillary service generating unit being positive</td>
</tr>
<tr>
<td>Generation Event</td>
<td>has the meaning given or implied in the relevant Frequency Operating Standards</td>
</tr>
</tbody>
</table>

1 The Frequency Disturbance Time is referred to in the equations in the MASS as occurring at t = 0.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inertial Response</td>
<td>means the change in Generation Amount or Load Amount due to the effect of the inertia of the Ancillary Service Facility</td>
</tr>
<tr>
<td>Initial Value</td>
<td>means the Generation Amount or Load Amount just prior to the Frequency Disturbance Time of a Frequency Disturbance</td>
</tr>
<tr>
<td>Load Amount</td>
<td>means the amount of power flow through a connection point of an ancillary service load, measured in MW, with flow towards the ancillary service load being negative</td>
</tr>
<tr>
<td>Load Event</td>
<td>has the meaning given or implied in the relevant Frequency Operating Standards</td>
</tr>
<tr>
<td>Local Frequency</td>
<td>means the frequency of the electricity measured by an ancillary service generating unit or consumed by an ancillary service load, measured in Hz</td>
</tr>
<tr>
<td>Lower Control Limit</td>
<td>means the lowest level to which a Controlled Quantity may be controlled in response to Lower Signals, as transmitted to AEMO's control centre</td>
</tr>
<tr>
<td>Lower Rate Limit</td>
<td>means the highest rate at which a Controlled Quantity may be controlled in response to Lower Signals, as transmitted to AEMO's control centre</td>
</tr>
<tr>
<td>Lower Reference Frequency</td>
<td>means the containment frequency above 50 Hz for Load Events, as given in the relevant Frequency Operating Standards</td>
</tr>
<tr>
<td>Lower Response</td>
<td>means the decrease in Generation Amount or increase in Load Amount with respect to the corresponding Initial Value</td>
</tr>
<tr>
<td>Lower Signal</td>
<td>means a control signal sent by or on behalf of AEMO in a form agreed between AEMO and the relevant Market Participant in order to request delivery of Regulating Lower Response</td>
</tr>
<tr>
<td>Operational Frequency Tolerance Band</td>
<td>has the meaning given in the NER and the value given in the relevant frequency operating standard</td>
</tr>
<tr>
<td>Raise Control Limit</td>
<td>means the highest level to which a Controlled Quantity may be controlled in response to Raise Signals, as transmitted to AEMO's control centre</td>
</tr>
<tr>
<td>Raise Rate Limit</td>
<td>means the highest rate at which a Controlled Quantity may be controlled in response to Raise Signals, as transmitted to AEMO's control centre</td>
</tr>
<tr>
<td>Raise Reference Frequency</td>
<td>means the containment frequency below 50 Hz for Generation Events, as given in the relevant Frequency Operating Standards</td>
</tr>
<tr>
<td>Raise Response</td>
<td>means the increase in Generation Amount or decrease in Load Amount with respect to the corresponding Initial Value</td>
</tr>
<tr>
<td>Raise Signal</td>
<td>means a control signal sent by or on behalf of AEMO in a form agreed between AEMO and the relevant Market Participant in order to request delivery of Regulating Raise Response</td>
</tr>
<tr>
<td>Regulating Lower Response</td>
<td>means the decrease in Generation Amount or increase in Load Amount delivered in response to one or more Lower Signals</td>
</tr>
<tr>
<td>Regulating Raise Response</td>
<td>means the increase in Generation Amount or decrease in Load Amount delivered in response to one or more Raise Signals</td>
</tr>
</tbody>
</table>
### Table 1

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Frequency Ramp</td>
<td>means a linear change of Local Frequency from one level to another at the applicable Frequency Ramp Rate and then sustained, as shown in Appendix A</td>
</tr>
<tr>
<td>Switching Controller</td>
<td>means a control system that delivers a specific amount of service when one or more specified conditions are met</td>
</tr>
<tr>
<td>System Frequency</td>
<td>means a frequency measured by or for AEMO that represents the frequency of the power system to which the Ancillary Service Facility is connected</td>
</tr>
<tr>
<td>Time Average</td>
<td>means, in respect of a Raise Response or Lower Response and a time interval, the average value of that Raise Response or Lower Response over that time interval, determined as the integral of the Raise Response or Lower Response over the time interval divided by the time interval duration</td>
</tr>
<tr>
<td>Trigger Range</td>
<td>means the contiguous range comprising the upper 40% of the range between 50 Hz and the Raise Reference Frequency and the lower 40% of the range between 50 Hz and the Lower Reference Frequency</td>
</tr>
<tr>
<td>Trigger Rate</td>
<td>means 0.05 Hz per second for regions other than Tasmania and 0.15 Hz per second for the Tasmanian region</td>
</tr>
<tr>
<td>Variable Controller</td>
<td>means a control system that delivers a variable amount of market ancillary service commensurate with the size of the Frequency Disturbance</td>
</tr>
</tbody>
</table>

### 1.2.2. Interpretation

The following principles of interpretation apply to the MASS unless otherwise expressly indicated:

- (a) The MASS is subject to the principles of interpretation set out in Schedule 2 of the National Electricity Law.
- (b) References to time are references to Australian Eastern Standard Time.

### 1.3. Related documents

#### Table 2  
Title and location of related documents

<table>
<thead>
<tr>
<th>Title</th>
<th>Location</th>
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</table>

### 2. MARKET ANCILLARY SERVICES PRINCIPLES

#### 2.1. Principles

As defined in clause 3.11.1 of the NER, ancillary services are services that are essential to the management of power system security, facilitate orderly trading in electricity, and ensure that electricity
supplies are of acceptable quality. Frequency Control Ancillary Services (FCAS) are acquired by AEMO as market ancillary services as part of the spot market in accordance with Chapter 3 of the NER to maintain the System Frequency within the operating limits specified in the frequency operation standards.

The MASS sets out the more detailed specification of the market ancillary services and how Market Participants’ performance when providing these market ancillary services is measured and verified.

The MASS is designed to:

- Avoid any special treatment in respect of different technologies used by Market Participants.
- Treat Ancillary Service Facilities with the same performance equally.
- Provide for equal access to the market for existing and prospective Market Participants.

The definitions and requirements of the market ancillary services detailed in the MASS are designed to allow AEMO to manage System Frequency in accordance with the Frequency Operating Standards.

AEMO employs two types of market ancillary services to manage System Frequency during normal operational conditions and following contingency events:

- Contingency Services, which are enabled to correct material frequency deviations that might arise from larger supply-demand imbalances.
- Regulation services, which are enabled to manage minor frequency deviations within the five minute dispatch interval.

2.1.1. Contingency Services

The purpose of the Contingency Services is to manage Frequency Recovery after an under- or over-frequency event to arrest the frequency fall or raise, and recover the frequency as required by the Frequency Operating Standards. As such, Contingency Services, while always enabled to cover contingency events, are only occasionally used.

Contingency Services are locally controlled and triggered by the frequency deviation that follows a contingency event.

Contingency Services are provided by technologies that can locally detect the frequency deviation and respond in a manner that corrects the frequency. Some examples of these technologies include:

- Generating unit governor response – where the generating unit governor on a steam turbine reacts to the frequency deviation by opening or closing the turbine steam valve and altering the megawatt (MW) output of the generating unit accordingly.
- Load reduction – where a load can be quickly disconnected from the electrical system (can act to correct a low frequency only).
- Rapid generating unit loading – where a frequency relay will detect a low frequency and correspondingly start a fast generating unit (can act to correct a low frequency only).
- Rapid generating unit unloading – where a frequency relay will detect a high frequency and correspondingly reduce a generating unit output (can act to correct a high frequency only).
- Potential rapid change in consumption/generation from batteries.

By contrast, the actions from the inertia of plant connected to the power system are not considered a supply of Contingency Services.
There are six Contingency Services:

- fast raise service;
- fast lower service;
- slow raise service;
- slow lower service;
- delayed raise service; and
- delayed lower service.

It is possible for a registered Ancillary Service Facility to be enabled to provide any or all of these Contingency Services.

2.1.2. Regulation services

Regulation services are enabled to manage minor changes to System Frequency within the normal operating frequency band following small deviations in the demand/generation balance within the five minute dispatch interval. There are two regulation services:

- Regulating raise – to increase System Frequency
- Regulating lower – to reduce System Frequency.

Regulation services are centrally controlled by AEMO. AEMO’s Automatic Generation Control (AGC) system allows AEMO to continually monitor the frequency and time error. It also sends control signals through the supervisory control and data acquisition (SCADA) systems to Ancillary Service Facilities enabled to provide regulation services so frequency is maintained within the normal operating frequency band of 49.85 hertz (Hz) to 50.15 Hz.

These control signals alter the MW output of generating units or the consumption of loads to correct the demand/generation imbalance. In contrast to the occasional use of Contingency Services, enabled regulation services are normally utilised by AEMO in each dispatch interval.

It is possible for a registered Ancillary Service Facility to be enabled to provide either or both regulation services.

2.2. Contracting

Nothing in this MASS is intended to prevent a Market Participant procuring a third party to provide equipment or recording service, or perform any other action required or contemplated by this MASS.

2.3. Accuracy of Market Ancillary Service bids

Market Participants must ensure that market ancillary service offers reflect the physical availability and capability of the market ancillary service as per Rule 3.8.7A of the NER. Where there is a condition that results in changed availability and capability of the market ancillary service, the Market Participant must rebid to reflect changes to the market ancillary service availability and capability in the central dispatch process. This includes services that are aggregated across multiple connection points.

2.4. Aggregation of Ancillary Service Facilities

Market Participants who wish to aggregate their generating units, or Market Ancillary Service Providers or Market Customers who wish to aggregate their loads as ancillary service loads for the purpose of central dispatch, may apply to do so in accordance with Rule 3.8.3 of the NER.

Unless otherwise agreed with AEMO, a market ancillary service offer for ancillary services in respect of a generating unit or load that is aggregated for central dispatch of energy must apply to the whole aggregated generating unit or load.

In relation to regulating services, AEMO’s AGC system may support the aggregated dispatch of regulating raise service or regulating lower service. In this situation, AEMO’s AGC system will send a single signal to the aggregated unit, and the operator of that aggregated unit is responsible for ensuring that the relevant plant that form the Aggregated Ancillary Service Facilities responds such that, in total, the aggregated unit provides the required response in an accurate and timely manner.
For the purposes of Rule 3.11.2(f) of the NER, the equipment required to monitor and record aggregated responses of Ancillary Service Facilities must have the following characteristics:

i. The power flow representing the amount of generation or load of each relevant plant of the Aggregated Ancillary Service Facility must be measured at or close to each of the relevant connection points and summed to calculate the Aggregated Generation Amount or Aggregated Load Amount. Where a relevant plant that forms part of an Aggregated Ancillary Service Facility shares a connection point with a variable load or generating unit, it is the gross power flow to or from the relevant plant that forms the aggregated response, and must be directly measured.

ii. For Contingency Services, the Local Frequency must be measured at or close to each relevant connection point or, if otherwise agreed with AEMO, an alternative measurement may be provided that closely represents the frequency of each Aggregated Ancillary Service Facility.

iii. Subject to clause 2.4(iv), the measurements of power flow and Local Frequency of aggregated Ancillary Service Facilities must be made at an interval specified under clauses 3.6, (e)4.6 and 5.6. Sufficient information should be provided to compare the Local Frequency and power flow data in a common time scale.

iv. If agreed with AEMO, where a Switching Controller is used, the measurement of power flow representing the Aggregated Generation Amount or Aggregated Load Amount may be made at intervals of up to four seconds, provided that another measurement of power flow at an interval of 50 milliseconds or less is provided sufficient to determine the timing of the market ancillary service provision relative to Local Frequency.

v. The clocks associated with the meters of relevant plant that form an Aggregated Ancillary Service Facility may record slightly differing times. To correct for this, Market Participants must time-align the data logged by each meter to the actual time the Frequency Disturbance was detected, being the time the System Frequency measurement first falls outside the normal operating frequency band.

A request issued by AEMO to a Market Participant under Rule 3.11.2 (h) of the NER may include a request for the Market Participant with an Aggregated Ancillary Service Facility to provide a report detailing the response of each unit that constitutes the Aggregated Ancillary Service Facility to a particular change or changes in the frequency of the power system. For Contingency Services, this may include the response as determined by the Frequency Control Ancillary Services Tool (FCASVT), or the Market Participant may propose an alternate method of demonstrating the response of the relevant plant that form the Aggregated Ancillary Services Facility which AEMO, at its discretion, may accept. A Market Participant must provide a report promptly but, in any event, no more than 20 business days after notice is given.

2.5. The Frequency Control Ancillary Services Verification Tool (FCASVT)

The FCASVT\(^2\) has been made available to Market Participants to help calculate the Contingency Services delivered by their plant.

The FCASVT will calculate the quantities of fast raise, slow raise, delayed raise, fast lower, slow lower, and delayed lower service delivered by the Ancillary Service Facility in accordance with the principles contained in the MASS.

The FCASVT contains detailed algorithms that implement the principles listed in the MASS. These algorithms are used by AEMO to verify Contingency Services delivered by market ancillary service facilities.

The FCASVT is currently implemented as an excel spreadsheet. AEMO may update the algorithms and its form from time to time.

If there is any inconsistency between the FCASVT and the MASS, the MASS will prevail to the extent of that inconsistency.

To avoid doubt, the FCASVT does not constitute a part of the MASS.

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3. FAST RAISE AND FAST LOWER SERVICES

3.1. Principles

The purpose of fast raise and fast lower services is to arrest the fall or rise in System Frequency following a contingency event that results in System Frequency being outside the normal operating frequency band.

3.2. Definitions

AEMO will issue dispatch instructions through its market systems to registered providers of fast raise and fast lower services to enable the required quantities of fast raise and fast lower services based on the bids and offers received. Once enabled, the provider of fast raise or fast lower services must respond to Local Frequency without further instruction from AEMO during the period of enablement.

Fast raise service is the service to either increase generation or decrease load rapidly in response to decreases in Local Frequency. It has traditionally been provided by governor systems on generating units and by under-frequency load reduction.

Fast lower service is the service to either decrease generation or increase load rapidly in response to increases in Local Frequency. It has traditionally been provided by governor systems on generating units.

These fast services are valued by their ability to arrest a rapid change in System Frequency within the first six seconds of a Frequency Disturbance, then provide an orderly transition to the slow raise service or slow lower service.

3.3. Amount of Fast Raise Service for Dispatch Purposes

For the purposes of a market ancillary service offer for dispatch, the amount of fast raise service in a price band and all cheaper price bands is the lesser of:

(a) twice the Time Average of the Raise Response between zero and six seconds from the Frequency Disturbance Time, excluding any Inertial Response; and

(b) twice the Time Average of the Raise Response between six and 60 seconds from the Frequency Disturbance Time, excluding any Inertial Response,

that the person making the market ancillary service offer expects would be delivered at the relevant connection point or points in response to a Standard Frequency Ramp from 50 Hz to the Raise Reference Frequency while this price band is enabled.

3.4. Amount of Fast Lower Service for Dispatch Purposes

For the purposes of a market ancillary service offer for dispatch, the amount of fast lower service in a price band and all cheaper price bands is the lesser of:

(a) twice the Time Average of the Lower Response between zero and six seconds from the Frequency Disturbance Time, excluding any Inertial Response; and

(b) twice the Time Average of the Lower Response between six and sixty seconds from the Frequency Disturbance Time, excluding any Inertial Response,

that the person making the market ancillary service offer expects would be delivered at the relevant connection point or points in response to a Standard Frequency Ramp from 50 Hz to the Lower Reference Frequency while this price band is enabled.

3.5. Control Facilities for Fast Raise Service and Fast Lower Service

For the purposes of Rule 3.11.2(b) of the NER:

(a) The Ancillary Service Facility must have a control system to automatically initiate:
(i) a fast Raise Response when Local Frequency changes are below the lower limit of the normal operating frequency band; or

(ii) a fast Lower Response when Local Frequency changes are above the upper limit of the normal operating frequency band,

in accordance with the control system requirements of paragraphs (b) and (c) below, whenever the respective market ancillary service is enabled.

(b) The control system for a fast Raise Response may be either a Variable Controller or a Switching Controller or a discrete combination of both, and must operate so that the amount of Raise Response is either:

(i) for a Variable Controller, a variable amount of market ancillary service commensurate with the difference between Local Frequency and controller’s Frequency Dead-Band for a range of Local Frequency between the normal operating frequency band and the lower limit of the Operational Frequency Tolerance Band; or

(ii) for a Switching Controller, one or more step changes if the Local Frequency falls through its Frequency Setting; or

(iii) for a discrete combination of both, responses in accordance with clauses 3.5(b)(i) and (ii) with each metered separately in accordance with metering requirements specified in clause 3.6(b).

(c) The control system for a fast Lower Response may be either a Variable Controller or a Switching Controller or a discrete combination of both, and must operate so that the amount of Lower Response is either:

(i) for a Variable Controller, a variable amount of market ancillary service commensurate with the difference between Local Frequency and controller’s Frequency Dead-Band for a range of Local Frequency between the normal operating frequency band and the upper limit of the Operational Frequency Tolerance Band; or

(ii) for a Switching Controller, one or more step changes if the Local Frequency rises through its Frequency Setting; or

(iii) for a discrete combination of both, responses in accordance with clauses 3.5(c)(i) and (ii), with each metered separately in accordance with metering requirements specified in clause 3.6(b).

(d) The Market Participant must inform AEMO of the details of the control system described by paragraphs (a), (b) and (c) above, as reasonably required by AEMO for central dispatch or for determining Frequency Settings.

(e) A Switching Controller for a fast raise service or fast lower service must be capable of adjusting its Frequency Setting to the setting provided by AEMO within the ranges shown in Table 3 for regions other than Tasmania or Table 4 for the Tasmanian region. The error needs to be no greater than 0.05 Hz for absolute Frequency Settings and 0.05 seconds for Frequency Rate of Change Multiplier.

(f) A Switching Controller must not operate if the Local Frequency is within the normal operating frequency band.


(a) For the purposes of Rule 3.11.2(f) of the NER, the equipment required to monitor and record the Raise Response in respect of a fast raise service or the Lower Response in respect of a fast lower service, including both the source transducer(s) and the data recorder, must have the following characteristics:

(i) The power flow representing the Generation Amount or Load Amount must be measured at or close to the relevant connection point or, if otherwise agreed with AEMO, sufficient measurements may be provided to calculate the Generation Amount or Load Amount.
(ii) The Local Frequency must be measured at or close to the relevant connection point or, if otherwise agreed with AEMO, an alternate measurement may be provided that closely represents the frequency at the connection point.

(iii) Subject to clause 3.6(a)(iv), the measurements of power flow and Local Frequency must be made at intervals of 50 milliseconds or less. Sufficient information should be provided to compare the Local Frequency and power flow data in a common time scale.

(iv) If agreed with AEMO, where a Switching Controller is used, the measurement of power flow representing the Generation Amount or Load Amount may be made at intervals of up to four seconds. This is provided that another measurement of power flow at an interval of 50 milliseconds or less is provided sufficient to determine the timing of the market ancillary service provision relative to Local Frequency.

(v) Measurements of power flow must have a measurement range appropriate to the Ancillary Service Facility, error of less than or equal to 2% of the measurement range, and resolution of less than or equal to 0.2% of the measurement range.

(vi) Measurements of Local Frequency must have a measurement range of at least the range defined by the Operational Frequency Tolerance Band, error of less than or equal to 0.01 Hz, and resolution of less than or equal to 0.0025 Hz.

(vii) The measurements must have a settling time (to 99% of final value after a step change from zero) of less than 50 milliseconds.

(viii) The equipment must record the Frequency Disturbance Time to within ten seconds.

(ix) The equipment must trigger recording at least whenever Local Frequency changes at a rate of at least the Trigger Rate and exceeds the Trigger Range.

(x) The equipment must record its power and frequency measurements for a period of at least five seconds before the Frequency Disturbance Time and at least 60 seconds after the Frequency Disturbance Time, making a total duration of at least 65 seconds.

(xi) The recordings must be made digitally and stored in a computer file format that is reasonably acceptable to AEMO for analysis using commercial spreadsheet software.

(xii) The recordings must be provided to AEMO on request (or as otherwise agreed) and retained by the Market Participant for at least 12 calendar months from the Frequency Disturbance Time.

(xiii) If a Market Participant is of the view that the information provided by the four second measurements can be provided more simply and with adequate accuracy by other means, they should present their case to AEMO for determination. A proposal that does not align with the requirements of clauses 3.6(i)(a)(i) to (xii) must ensure that the provision of the market ancillary service can be verified.

(xiv) Refer also to clause 2.4 in relation to aggregation of ancillary service generating units and ancillary service loads.

(b) If the control system is a discrete combination of a Variable Controller and a switched controller, there must be a process in place, agreed to by AEMO, to determine the separate amounts of Raise Response or Lower Response supplied by the Variable Controller and the Switching Controller. This can be through separate metering or from control system data logged at the time of the Frequency Disturbance or application of appropriate control system models.

3.7 Verification of performance for Fast Raise Service and Fast Lower Service

3.7.1 Principles

(a) To verify the amount of fast raise service or fast lower service delivered in response to a change in Local Frequency, the amount of service delivered must be determined using the recordings made under clause 3.6 above and is compared with the amount of the relevant market ancillary service offer enabled as follows:
(i) FCAS assessment commences at the Frequency Disturbance Time and ends at Frequency Recovery or, in the event that Frequency Recovery does not occur within 60 seconds of the Frequency Disturbance Time, 60 seconds from the Frequency Disturbance Time.

(ii) If the Ancillary Service Facility or Aggregated Ancillary Service Facility is scheduled or semi-scheduled, determine the reference generation or consumption energy trajectory for the facility that the generating unit(s) or load(s) would be expected to have followed had the frequency event not occurred.

(iii) Commencing from the Frequency Disturbance Time, use this reference trajectory to adjust the measure power flows to reverse any impact of an Ancillary Service Facility being scheduled in a direction that would hinder the Frequency Recovery. For an Ancillary Service Facility that is neither scheduled nor semi-scheduled, no such adjustment is required.

(iv) Remove the impact of the Inertial Response from (ii) above, to the extent that an Inertial Response exists.

(v) The basic response is the difference between the value calculated in (iv) and a measure of the operating point of the facility just prior to the Frequency Disturbance.

(vi) For a Variable Controller, the basic response is compensated to take into account the difference between the Local Frequency and the Standard Frequency Ramp. For a Switching Controller, the basic response is compensated to take into account the timing difference for the Local Frequency to reach the Frequency Setting, compared to the Standard Frequency Ramp.

If a discrete combination of Switching Controller and Variable Controller is used, then the compensated basic response is the sum of the compensated basic responses in (v).

(vii) The definition in clauses 3.3 and 3.4 is applied to calculate the fast raise service or fast lower service delivered.

(viii) If slow raise service or slow lower service is also enabled for the Ancillary Service Facility, then the Facility’s response should exceed the required response, such that the slow raise service or slow lower service can be provided.

(b) The amount of fast raise service or fast lower service delivered in response to a change in Local Frequency must be at least equal to the dispatched quantity of the relevant fast service.

4. SLOW SERVICES

4.1. Principles

The purpose of slow raise and slow lower services is to stabilise System Frequency following a contingency event that results in System Frequency being outside the normal operating frequency band.

4.2. Definitions

AEMO will issue dispatch instructions through its market systems to registered providers of slow raise and slow lower services to enable the required quantities of slow raise and slow lower services based on the bids and offers received. Once enabled, the provider of slow raise or slow lower services must respond to Local Frequency without further instruction from AEMO during the period of enablement.

Slow raise service is the service to either increase generation or decrease load rapidly in response to decreases in Local Frequency. It has traditionally been provided by governor systems on generating units.

Slow lower service is the service to either decrease generation or increase load rapidly in response to increases in Local Frequency. It has traditionally been provided by governing systems on generating units.
These slow services are valued by their ability to stabilise System Frequency within the first 60 seconds of a Frequency Disturbance, then provide an orderly transition to delayed raise service or delayed lower service.

Ancillary Service Facilities should not provide Contingency Services once the Local Frequency has recovered, for example:

- If frequency recovers above 49.9 Hz within six seconds from the Frequency Disturbance Time, there should be no slow Raise Response or delayed Raise Response.
- If frequency recovers below 50.1 Hz within six seconds from the Frequency Disturbance Time, there should be no slow Lower Response or delayed Lower Response.

### 4.3. Amount of Slow Raise Service for Dispatch Purposes

For the purposes of a market ancillary service offer for dispatch, the amount of slow raise service in a price band and all cheaper price bands is the lesser of:

(a) twice the Time Average of the Raise Response between six and 60 seconds from the Frequency Disturbance Time, excluding any Inertial Response and fast raise service provided; and

(b) twice the Time Average of the Raise Response between 60 seconds and five minutes from the Frequency Disturbance Time,

that the person making the market ancillary service offer expects would be delivered at the relevant connection point or points in response to a Standard Frequency Ramp from 50 Hz to the Raise Reference Frequency while this price band is enabled.

### 4.4. Amount of Slow Lower Service for Dispatch Purposes

For the purposes of a market ancillary service offer for dispatch, the amount of slow lower service in a price band and all cheaper price bands is the lesser of:

(a) twice the Time Average of the Lower Response between six and 60 seconds from the Frequency Disturbance Time, excluding any Inertial Response and fast lower service provided; and

(b) twice the Time Average of the Lower Response between 60 seconds and five minutes from the Frequency Disturbance Time,

that the person making the market ancillary service offer expects would be delivered at the relevant connection point or points in response to a Standard Frequency Ramp from 50 Hz to the Lower Reference Frequency while this price band is enabled.

### 4.5. Control Facilities for Slow Raise Service and Slow Lower Service

For the purposes of Rule 3.11.2(b) of the NER:

(a) The Ancillary Service Facility must have a control system to automatically initiate:
   
   (i) a slow Raise Response when Local Frequency changes are below the lower limit of the normal operating frequency band; or
   
   (ii) a slow Lower Response when Local Frequency changes are above the upper limit of the normal operating frequency band,

   in accordance with the control system requirements of paragraphs (b) and (c) below, whenever the respective market ancillary service is enabled.

(b) The control system for a slow Raise Response may be either a Variable Controller or a Switching Controller or a discrete combination of both, and must operate so that the amount of Raise Response is either:

   (i) for a Variable Controller, a variable amount of market ancillary service commensurate with the difference between Local Frequency and controller's Frequency Dead-Band for a range of Local Frequency between the normal operating frequency band and the lower limit of the Operational Frequency Tolerance Band; or
(ii) for a Switching Controller, one or more step changes, if the Local Frequency falls through its Frequency Setting; or

(iii) for a discrete combination of both, responses in accordance with clauses 4.5(b)(i) and (ii), with each metered separately in accordance with metering requirements specified in clause (e)(b).

(c) The control system for a slow Lower Response may be either a Variable Controller or a Switching Controller or a discrete combination of both, and must operate so that the amount of Lower Response is either:

(i) for a Variable Controller, a variable amount of market ancillary service commensurate with the difference between Local Frequency and a controller’s Frequency Dead-Band for a range of Local Frequency between the normal operating frequency band and the upper limit of the Operational Frequency Tolerance Band; or

(ii) for a Switching Controller, one or more step changes if the Local Frequency rises through its Frequency Setting; or

(iii) for a discrete combination of both, responses in accordance with clauses 4.5(c)(i) and (ii), with each metered separately in accordance with metering requirements specified in clause (e)(b).

(d) The Market Participant must inform AEMO of the details of the control system described by paragraphs (a), (b) and (c) above, as reasonably required by AEMO for central dispatch or for determining Frequency Settings.

(e) A Switching Controller for a slow raise service or slow lower service must be capable of adjusting its Frequency Setting to the setting provided by AEMO within the ranges shown in Table 3 for regions other than Tasmania or Table 4 for the Tasmanian region. The error needs to be no greater than 0.05 Hz for the absolute Frequency Settings and 0.05 seconds for Frequency Rate of Change Multiplier.

4.6. Measurement Facilities for Slow Raise Service and Slow Lower Service

(a) For the purposes of Rule 3.11.2(f) of the NER, the equipment required to monitor and record the Raise Response in respect of a slow raise service or Lower Response in respect of a slow lower service, including both the source transducer(s) and the data recorder, must have the following characteristics:

(i) The power flow representing the Generation Amount or Load Amount must be measured at or close to the relevant connection point or, if otherwise agreed with AEMO, sufficient measurements may be provided to calculate the Generation Amount or Load Amount.

(ii) The Local Frequency must be measured at or close to the relevant connection point or, if otherwise agreed with AEMO, an alternative measurement may be provided that closely represents the frequency at the connection point.

(iii) The measurements of power flow and Local Frequency must be made at intervals of four seconds or less.

(iv) The measurements of power flow must have a measurement range appropriate to the ancillary service non-conforming, error of less than or equal to 2% of the measurement range, resolution of less than or equal to 0.2% of the measurement range.

(v) The measurements of Local Frequency must have a measurement range of at least the range defined by the Operational Frequency Tolerance Band, error of less than or equal to 0.02 Hz, and resolution of less than or equal to 0.01 Hz.

(vi) Any analogue measurements prior to sampling must have a settling time (to 99% of final value) of less than four seconds.

(vii) The equipment must record the Frequency Disturbance Time to within 10 seconds.

(viii) The equipment must trigger recording at least whenever Local Frequency changes at a rate of at least the Trigger Rate and exceeds the Trigger Range.
(ix) The equipment must record its power and frequency measurements for a period of at least 20 seconds before the Frequency Disturbance Time and five minutes after the Frequency Disturbance Time.

(x) The recordings must be made digitally and stored in a computer file format that is reasonably acceptable to AEMO for analysis using commercial spreadsheet software.

(xi) The recordings must be provided to AEMO on request (or as otherwise agreed) and retained by the Market Participant for at least 12 calendar months from the Frequency Disturbance Time.

(xii) If a Market Participant is of the view that the information provided by the four second measurements can be provided more simply and with adequate accuracy by other means, they should present their case to AEMO for determination. A proposal that does not align with the requirements of clauses (e)(a)(i) to (xi) must ensure that the provision of the market ancillary service can be verified.

(xiii) Refer also to clause 2.4 in relation to aggregation of Ancillary Service Facilities.

(b) If the control system is a discrete combination of a Variable Controller and a Switching Controller, there must be a process in place to determine the amount of Raise Response or Lower Response supplied by the Variable Controller and Switching Controller. This can be through separate metering or from control system data logged at the time of the Frequency Disturbance or application of appropriate control system models.

4.7. Verification of Performance for Slow Raise Service and Slow Lower Service

4.7.1. Principles

(a) To verify the amount of slow raise service or slow lower service delivered in response to a change in Local Frequency, the amount of service delivered must be determined using the recordings made under clause 4.6 above and is compared with the amount of the relevant market ancillary service offer enabled as follows:

(i) FCAS assessment commences at the Frequency Disturbance Time and ends at Frequency Recovery or, in the event that Frequency Recovery does not occur within 300 seconds of the Frequency Disturbance Time, 300 seconds from the Frequency Disturbance Time.

(ii) If the Ancillary Service Facility or Aggregated Ancillary Service Facility is scheduled or semi-scheduled, determine the reference generation or consumption energy trajectory for the facility that the generating unit or load would be expected to have followed had the frequency event not occurred.

(iii) Commencing from the Frequency Disturbance Time, use this reference trajectory to adjust the measure power flows to reverse any impact of an Ancillary Service Facility being scheduled in a direction that would hinder the Frequency Recovery. For an Ancillary Service Facility that is neither scheduled nor semi-scheduled, no such adjustment is required.

(iv) The basic response is the difference between the value calculated in (iii) and a measure of the operating point of the facility just prior to the Frequency Disturbance.

(v) For a Variable Controller, the basic response is compensated to take into account the difference between the Local Frequency and the Standard Frequency Ramp.

If a discrete combination of Switching Controller and Variable Controller is used, the compensated basic response is the sum of the compensated basic responses in (iv).

(vi) The definition in clauses 4.3 and 4.4 is applied to calculate the slow raise service or slow lower service delivered.
(vii) If delayed raise service or delayed lower service is also enabled for the Ancillary Service Facility, its response should exceed the required response such that the delayed raise service or delayed lower service can be provided.

(b) The amount of slow raise service or slow lower service delivered in response to a change in Local Frequency must be at least equal to the dispatched quantity of the relevant delayed service.

5. DELAYED SERVICES

5.1. Principles

The purpose of delayed raise and delayed lower services is to return System Frequency to 50 Hz within the first five minutes of a Frequency Disturbance that resulted in System Frequency being outside the normal operating frequency band.

5.2. Definitions

Delayed raise service is the service to either increase generation or decrease load in response to decreases in Local Frequency. It has traditionally been provided by manual load reduction and starting up hydroelectric or gas generating units.

Delayed lower service is the service to either decrease generation or increase load in response to increases in Local Frequency. It has traditionally been provided by reducing the output of generating units.

These delayed services are valued by their ability to restore System Frequency to 50 Hz within the first five minutes of a Frequency Disturbance, and to sustain their response until central dispatch can take the generation requirement into account.

Ancillary Service Facilities should not provide Contingency Services once the Local Frequency has recovered, for example:

- If the frequency recovers above 49.9 Hz between six seconds and 60 seconds from the Frequency Disturbance time, there would be no delayed Raise Response.
- If the frequency recovers below 50.1 Hz between six seconds and 60 seconds from the Frequency Disturbance Time, there would be no delayed Lower Response.

5.3. Amount of Delayed Raise Service for dispatch purposes

For the purposes of a market ancillary service offer for dispatch, the amount of delayed raise service in a price band and all cheaper price bands is the lesser of:

(a) twice the Time Average of the Raise Response between one and five minutes from the Frequency Disturbance Time and slow raise service provided; and

(b) the Time Average of the Raise Response between five and ten minutes from the Frequency Disturbance Time,

that the person making the market ancillary service offer expects would be delivered at the relevant connection point in response to a Standard Frequency Ramp from 50 Hz to the Raise Reference Frequency while this price band is enabled.

5.4. Amount of Delayed Lower Service for dispatch purposes

For the purposes of a market ancillary service offer for dispatch, the amount of delayed lower service in a price band is the lesser of:

(a) twice the Time Average of the Lower Response between one and five minutes from the Frequency Disturbance Time and slow lower service provided; and

(b) the Time Average of the Lower Response between five and ten minutes from the Frequency Disturbance Time,
that the person making the *market ancillary service* offer expects would be delivered at the relevant *connection point*. This is in addition to the amounts in all cheaper *price bands* in response to a Standard Frequency Ramp from 50 Hz to the Lower Reference Frequency while this *price band* is *enabled*.

### 5.5. Control facilities required for Delayed Raise Service and Delayed Lower Service

For the purposes of Rule 3.11.2(b) of the NER:

(a) The Ancillary Service Facility must have a *control system* to automatically initiate:

(i) a delayed Raise Response when Local Frequency changes are below the lower limit of the *normal operating frequency band*; or

(ii) a delayed Lower Response when Local Frequency changes are above the upper limit of the *normal operating frequency band*,

in accordance with the *control system* requirements of paragraphs (b) and (c) below, whenever the respective *market ancillary service* is *enabled*.

(b) The *control system* for a delayed Raise Response may be either a Variable Controller or a Switching Controller or a discrete combination of both, and must operate so that the amount of Raise Response is either:

(i) for a Variable Controller, a variable amount of *market ancillary service* commensurate with the difference between Local Frequency and controller’s Frequency Dead-Band for a range of Local Frequency between the *normal operating frequency band* and the lower limit of the Operational Frequency Tolerance Band; or

(ii) for a Switching Controller, one or more step changes if the Local Frequency falls through its Frequency Setting; or

(iii) for a discrete combination of both, responses in accordance with clauses 5.5(b)(i) and (ii), with each metered separately in accordance with metering requirements specified in clause 5.6.

(c) The *control system* for a delayed Lower Response may be either a Variable Controller or a Switching Controller or a discrete combination of both, and must operate so that the amount of Lower Response is either:

(i) for a Variable Controller, a variable amount of *market ancillary service* commensurate with the difference between Local Frequency and controller’s Frequency Dead-Band for a range of Local Frequency between the *normal operating frequency band* and the upper limit of the Operational Frequency Tolerance Band; or

(ii) for a Switching Controller, one or more step changes if the Local Frequency rises through its Frequency Setting; or

(iii) for a discrete combination of both, responses in accordance with clauses 5.5(c)(i) and (ii), with each metered separately in accordance with metering requirements specified in clause 5.6.

(d) The *Market Participant* must inform *AEMO* of the details of the *control system* described by paragraphs (a), (b) and (c) above, as reasonably required by *AEMO* for *central dispatch* or for determining Frequency Settings.

(e) A Switching Controller for a *delayed raise service or delayed lower service* must be capable of adjusting its Frequency Setting to the setting provided by *AEMO* within the ranges shown in Table 3 for *regions* other than Tasmania or Table 4 for the Tasmanian *region*. The error needs to be no greater than 0.05 Hz for absolute Frequency Settings and 0.05 seconds for Frequency Rate of Change Multiplier.
5.6. Measurement facilities required for Delayed Raise Service and Delayed Lower Service

(a) For the purposes of Rule 3.11.2(f) of the NER, the equipment required to monitor and record the Raise Response in respect of a delayed raise service or Lower Response in respect of a delayed lower service, including both the source transducer(s) and the data recorder, must have the following characteristics:

(i) The power flow representing the Generation Amount or Load Amount must be measured at or close to the relevant connection point or, if otherwise agreed with AEMO, sufficient measurements may be provided to calculate the Generation Amount or Load Amount.

(ii) The Local Frequency must be measured at or close to the relevant connection point or, if otherwise agreed with AEMO, an alternative measurement may be provided that closely represent the frequency at the connection point.

(iii) The measurements of power flow and Local Frequency must be made at intervals of four seconds or less.

(iv) The measurements of power flow must have a measurement range appropriate to the Ancillary Service Facility, error of less than or equal to 2% of the measurement range, and resolution of less than or equal to 0.2% of the measurement range.

(v) The measurements of Local Frequency must have a measurement range of at least the range defined by the Operational Frequency Tolerance Band, error of less than or equal to 0.02 Hz, and resolution of less than or equal to 0.01 Hz.

(vi) The equipment must record the Frequency Disturbance Time to within ten seconds.

(vii) The equipment must trigger recording at least Local Frequency to change at a rate of at least the Trigger Rate and exceeding the Trigger Range.

(viii) The equipment must record its power and frequency measurements for a period of at least 20 seconds before the Frequency Disturbance Time and 10 minutes after the Frequency Disturbance Time.

(ix) The recordings must be made digitally and stored in a computer file format that is reasonably acceptable to AEMO for analysis using commercial spreadsheet software.

(x) The recordings must be provided to AEMO on request (or as otherwise agreed) and retained by the Market Participant for at least 12 calendar months from the Frequency Disturbance Time.

(xi) If a Market Participant is of the view that the information provided by the four second measurements can be provided more simply and with adequate accuracy by other means, they should present their case to AEMO for determination. A proposal that does not align with the requirements of clauses 5.6(a)(i) to (x) must ensure that provision of the market ancillary service can be verified.

(xii) Refer also to clause 2.4 in relation to aggregation of Ancillary Service Facilities.

(b) If the control system is a discrete combination of a Variable Controller and a Switching Controller, there must be a process in place to determine the amount of Raise Response or Lower Response supplied by the Variable Controller and Switching Controller. This can be through separate metering or from control system data logged at the time of the Frequency Disturbance or application of appropriate control system models.

5.7. Verification of Delayed Raise Service and Delayed Lower Service

5.7.1. Principles

(a) To verify the amount of delayed raise service or delayed lower service delivered in response to a change in Local Frequency, the amount of service delivered must be determined using
the recordings made under clause 5.6 above and is compared with the amount of the relevant market ancillary service offer enabled as follows:

(i) FCAS assessment commences at the Frequency Disturbance Time and ends at Frequency Recovery or, in the event that Frequency Recovery does not occur within 600 seconds of the Frequency Disturbance Time, 600 seconds from the Frequency Disturbance Time.

(ii) If the Ancillary Service Facility or Aggregated Ancillary Service Facility is scheduled or semi-scheduled, determine the reference generation or consumption energy trajectory for the facility that the generating unit or load would be expected to have followed had the frequency event not occurred.

(iii) Commencing from the Frequency Disturbance Time, use this reference trajectory to adjust the measure power flows to reverse any impact of an Ancillary Service Facility being scheduled in a direction that would hinder the Frequency Recovery. For an Ancillary Service Facility that is neither scheduled nor semi-scheduled, no such adjustment is required.

(iv) The basic response is the difference between the value calculated in (iii) and a measure of the operating point of the facility just prior to the Frequency Disturbance.

(v) The definition in clauses 5.3 and 5.4 is applied to calculate the delayed raise service or delayed lower service delivered.

(b) The amount of delayed raise service or delayed lower service delivered in response to a change in Local Frequency, must be at least equal to the dispatched quantity of the relevant delayed service.

6. REGULATION SERVICES

6.1. Overview

Regulation services are enabled to manage changes in frequency within the normal operating frequency band following small deviations in the demand/generation balance within the five minute dispatch interval. These are controlled centrally by AEMO. AEMO monitors power System Frequency and time error, and instructs generating units or loads enabled to provide regulation services through the AGC system.

The AGC system allows AEMO to continually monitor System Frequency and send control signals to Ancillary Service Facilities providing regulation services so frequency is maintained within the normal operating frequency band of 49.85 Hz to 50.15 Hz. These control signals alter the megawatt (MW) output of the generating units or the consumption (MW) of the loads to correct the demand/generation imbalance.

6.2. Definitions

Regulating raise service is the service of either increasing generation or decreasing load in response to electronic Raise Signals from AEMO. It has traditionally been provided by generation setpoint controllers on generating units.

Regulating lower service is the service of either decreasing generation or increasing load in response to electronic Lower Signals from AEMO. It has traditionally been provided by generation setpoint controllers on generating units.

These regulation services are valued by their ability to control System Frequency and time error in response to variations of system demand within a dispatch interval.

A market ancillary service offer to provide regulating raise service or regulating lower service in respect of an Ancillary Service Facility that is aggregated for central dispatch of energy, must apply to the whole aggregated generating unit or load.

The AGC system sends signals through the SCADA system to all enabled plant that are required to respond to the signals in an accurate and timely manner.
6.3. **Amount of Regulating Raise Service for dispatch purposes**

For the purposes of a *market ancillary service offer* for dispatch, the amount of *regulating raise service* in a *price band* is the amount of Regulating Raise Response that the person making the *market ancillary service offer* expects would be delivered:

(a) at the relevant *connection point*;
(b) progressively over a five minute period;
(c) in addition to the amounts in all cheaper *price bands*; and
(d) in response to Raise Signals sent to request the maximum possible Regulating Raise Response while this *price band* is enabled.

6.4. **Amount of Regulating Lower Service for dispatch purposes**

For the purposes of a *market ancillary service offer* for dispatch, the amount of *regulating lower service* in a *price band* is the amount of Regulating Lower Response that the person making the *market ancillary service offer* expects would be delivered:

(a) at the relevant *connection point*;
(b) progressively over a five minute period;
(c) in addition to the amounts in all cheaper *price bands*; and
(d) in response to Lower Signals sent to request the maximum possible Regulating Lower Response while this *price band* is enabled.

6.5. **Performance parameters and requirements for Regulating Raise Service and Regulating Lower Service**

*AEMO* needs to be assured that that *generating units and loads enabled* to provide regulation services respond in accurate and timely manner.

*AEMO* will monitor the performance of registered *generating units and loads* to determine if acceptable performance is being maintained.

As described in 3.8.23(g) of the NER, if, in *AEMO's* reasonable opinion, an Ancillary Service Facility is *enabled* to provide *regulating raise service* or *regulating lower service* and fails to respond in an accurate and timely manner, the Ancillary Service Facility will be declared as non-conforming.

*AEMO* may impose a fixed constraint with respect to the Ancillary Service Facility until *AEMO* is reasonably satisfied (as a result of a test or otherwise) that the Ancillary Service Facility is capable of responding in the manner contemplated by the MASS.

6.6. **Control facilities required for Regulating Raise Service and Regulating Lower Service**

For the purposes of Rule 3.11.2(b) of the NER, the Ancillary Service Facility must have a *control system* to:

(a) transmit values of the Controlled Quantity, Raise Control Limit, Lower Control Limit, * Raise Rate Limit and*, if different from the Raise Rate Limit, the Lower Rate Limit every four seconds;
(b) receive Raise Signals and Lower Signals;
(c) when *enabled* for the respective service, automatically deliver a Regulating Raise Response or a Regulating Lower Response corresponding to those Raise Signals or Lower Signals; and
(d) not suspend the service for more than 60 seconds during a Frequency Disturbance, and only if Local Frequency has exceeded the Raise Reference Frequency or Lower Reference Frequency.

A *control system for regulating raise service or regulating lower service* with respect to a *generating unit or load* aggregated for *central dispatch of energy*, must only apply to the whole aggregated *generating unit or load*. 
6.7. Measurement facilities required for Regulating Raise Service and Regulating Lower Service

For the purposes of Rule 3.11.2(f) of the NER, the equipment required to monitor and record the Regulating Raise Response in respect of a regulating raise service, or Regulating Lower Response in respect of a regulating lower service, including both the source transducer(s) and the data recorder, must have the following characteristics:

(a) The power flow representing the Generation Amount or Load Amount must be measured at or close to the relevant connection point or, if otherwise agreed with AEMO, sufficient measurements may be provided to calculate the Generation Amount or Load Amount.

(b) The measurements of power flow must be made at intervals of four seconds or less.

(c) The measurements of power flow must have a measurement range appropriate to the Ancillary Service Facility, error of less than or equal to 2% of the measurement range, and resolution of less than or equal to 0.2% of the measurement range.

(d) The recordings must be made digitally and stored in a computer file format reasonably acceptable to AEMO for analysis using commercial spreadsheet software.

(e) The recordings must be provided to AEMO on request (or as otherwise agreed) and retained by the Market Participant for at least six calendar months from the Frequency Disturbance Time.

6.8. Verification of Regulating Raise Service and Regulating Lower Service

For the purpose of verifying the amount of regulating raise service or regulating lower service that can be delivered in response to a Raise Signal or a Lower Signal, the amount of service to be compared with the enabled price bands of the relevant market ancillary service offer must be determined using the recordings made under clause 6.7 above as follows:

(a) If AEMO or the Market Participant wishes to verify performance, AEMO must:
   (i) transmit no Raise Signals or Lower Signals to the relevant Ancillary Service Facility for a period of at least 60 seconds; and then immediately
   (ii) transmit Raise Signals or Lower Signals to the relevant Ancillary Service Facility that would produce either a Regulating Raise Response or Regulating Lower Response equal to the lesser of the sum of the enabled price bands of the relevant market ancillary services offer and the corresponding Raise Rate Limit or Lower Rate Limit. This would last for at least five minutes such that the Controlled Quantity remains at all times between the Raise Control Limit and the Lower Control Limit.

(b) The following procedure must be used:
   (i) fit a linear function of time (of the form $P = P_1 + R_1 \times t$) to the power measurements made during the sixty seconds to which paragraph (a)(i) refers;
   (ii) fit a linear function of time (of the form $P = P_2 + R_2 \times t$) to the earliest power measurements made over the following five minutes that are all greater than (for Regulating Raise Response) or less than (for Regulating Lower Response) the function to which paragraph (b)(i) refers; and
   (iii) determine the Regulating Raise Response or Regulating Lower Response as the slope of the function to which paragraph (b)(ii) refers (in MW per minute) multiplied by five minutes.

6.9. Response to AGC instructions during and after a contingency event

Should a contingency event occur at a time when a generating unit or load is enabled to provide both regulation services and Contingency Services, the generating unit or load should give priority to providing the Contingency Services and not respond to AGC instructions while responding to Contingency Service actions until such time as the Local Frequency has returned to the normal operating frequency band.
7. COMMON PROCEDURES

7.1. Enablement

The provider of a market ancillary service must promptly operate its equipment to deliver the relevant service as soon as reasonably practicable following enablement of it by AEMO.

7.2. Allocation of the Frequency Settings of Switching Controllers

(a) AEMO will allocate Frequency Settings to particular Ancillary Service Facilities for each market ancillary service other than regulating raise service and regulating lower service, separately for Tasmania region and for all other regions combined.

(b) In allocating the frequencies, AEMO may consider one or more of the following principles as appropriate:

(i) Ancillary Service Facilities registering for multiple services will be allocated the same settings for each raise service and lower service.

(ii) Ancillary Service Facilities with larger switched blocks of generation or load will be allocated to frequencies closer to normal operating frequency bands.

(iii) Ancillary Service Facilities with higher availability will be allocated to frequencies closer to normal operating frequency bands.

(iv) Where possible, for aggregated Ancillary Service Facilities AEMO will negotiate with the Market Participant to allocate multiple Frequencies Settings across the relevant plant of the Facility to simulate the behaviour of Variable Controllers and so minimise the potential for over-delivery of the services.

(v) AEMO will consider any physically-appropriate characteristics of the Ancillary Service Facilities.

(c) If there is a technical reason why a particular Ancillary Service Facility will be unable to provide market ancillary services due to its allocated Frequency Setting, the relevant Market Participant may request AEMO to change the allocated Frequency Setting. AEMO will have sole discretion in accepting the request for change. If one or more Frequency Settings have been changed, AEMO may elect to re-allocate the remaining Frequency Settings as per clause 7.2(b).

(d) AEMO must not request a change to an existing Frequency Setting unless:

(i) the procedure for determining Frequency Settings, as shown in paragraph (b) above has been amended; or

(ii) an Ancillary Service Facility that uses a Switching Controller to provide the service has been registered or deregistered, or its registration has materially changed since the last change to existing settings; or

(iii) at least six months has elapsed since Frequency Settings were changed and one or more Ancillary Service Facility has changed its maximum response capability; or

(iv) a Frequency Disturbance has occurred that involved loss of load or generation and AEMO has determined that the relevant Frequency Setting was not adequate under that circumstance.

(e) Until an Ancillary Service Facility that uses a Switching Controller to provide the service is allocated a Frequency Setting under clause 7.2(b), the Market Participant may apply the relevant default Frequency Deviation Setting shown in Table 3 for regions other than Tasmania and Table 4 for the Tasmania region.

(f) For the purposes of clauses 3.5(b)(ii) and 3.5(c)(ii) a Frequency Setting may be a Frequency Deviation Setting or a combination of both Frequency Deviation Setting allocated and Frequency Rate of Change Multiplier shown in Table 3 for regions other than Tasmania and Table 4 for the Tasmania region.
For the purposes of clauses 4.5(b)(ii), 4.5(c)(ii), 5.5(b)(ii) and 5.5(c)(ii) a Frequency Setting is based on allocated Frequency Deviation Setting alone.

The criteria for a combined Switching Controller to initiate delivery of a fast raise service based on a combination of both Frequency Deviation Setting and Frequency Rate of Change Multiplier is to occur if the both of the following conditions are satisfied:

if Local Frequency < 49.85 and
Local Frequency < Frequency Deviation Setting + Frequency Rate of Change Multiplier * Local Frequency rate of change

where:

Frequency Deviation Setting is setting allocated within the range shown in Table 3 for regions other than Tasmania and Table 4 for the Tasmania region;
Frequency Rate of Change Multiplier is equal to the value in Table 3 for regions other than Tasmania and Table 4 for the Tasmania region;
Local Frequency rate of change is the measured rate of change of Local Frequency;

The criteria for a combined Switching Controller to initiate delivery of a fast lower service based on a combination of both Frequency Deviation Setting and Frequency Rate of Change Multiplier is to occur if the both of the following conditions are satisfied:

if Local Frequency > 50.15 and
Local Frequency > Frequency Deviation Setting - Frequency Rate of Change Multiplier * Local Frequency rate of change

where:

Frequency Deviation Setting is setting allocated within the range shown in Table 3 for regions other than Tasmania and Table 4 for the Tasmania region;
Frequency Rate of Change Multiplier is equal to the value in Table 3 for regions other than Tasmania and Table 4 for the Tasmania region;
Local Frequency rate of change is the measured rate of change of Local Frequency;

<table>
<thead>
<tr>
<th>Table 3 Frequency Settings for regions other than Tasmania</th>
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<tbody>
<tr>
<td>Level</td>
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<tr>
<td>Frequency Deviation Setting range</td>
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<tr>
<td>Default Frequency Deviation Setting</td>
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<tr>
<th>Table 4 Frequency Settings for the Tasmania region</th>
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<tr>
<td>Level</td>
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<td>-------</td>
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<tr>
<td>Frequency Deviation Setting range</td>
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<tr>
<td>Default Frequency Deviation Setting</td>
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</tbody>
</table>
7.3. Trials of new technologies

*EMO*, at its absolute discretion, may allow an Ancillary Service Facility to participate in a trial to test the performance of new technologies.

It is envisaged that any trial will:

- Be for a limited period,
- Be for a limited measurable quantity of the service, and
- Be subject to the conditions that the party conducting the trial:
  - Withdraw from the market if directed by *EMO*.
  - Use best endeavours to meet the full requirements of the MASS.
  - Meet any other requirements *EMO*, at its discretion, requests.
APPENDIX A. STANDARD FREQUENCY RAMP

Figure 1  Standard Frequency Ramp for regions other than Tasmania

**Mainland Frequency (Hz)**

- At least 4s for Fast services
- At least 20s for other

**Time**

At most 10 minutes

**Contingency**

Contingency FCAS begins here. i.e. \( t = 0 \) s

**Mainland Frequency (Hz)**

- At least 4s for Fast services
- At least 20s for other

**Time**

At most 10 minutes

**Contingency**

FCAS assessment begins here. i.e. \( t = 0 \) s

Contingency FCAS begins here. i.e. \( t = 0 \) s
**Figure 2  Standard Frequency Ramp for Tasmania**

- **Tasmania Frequency (Hz)**
  - At least 4s for Fast services
  - At least 20s for other

- **Time**
  - At most 10 minutes

**Standard frequency ramp for Raise services**

- Contingency FCAS begins here, i.e. \( t = 0 \) s

**Standard frequency ramp for Lower services**

- FCAS assessment begins here, i.e. \( t = 0 \) s

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