Market Ancillary Service Specification

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Current version release details

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7.1	9 Oct 2023 (TBC)	Revised following consultation on the creation of Very Fast FCAS markets.

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

1. Introduction

1.1. Purpose and scope

This is the *market ancillary service specification* (**MASS**) made under clause 3.11.2(b) of the National Electricity Rules (**NER**). It includes the monitoring and recording standards referred to in clause 3.11.2(g).

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.

1.2. Definitions and interpretation

1.2.1. Glossary

Terms defined in the *National Electricity Law* or the NER have the same meanings in the MASS unless otherwise specified in this section 1.2.1. NER 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.

The words, phrases and abbreviations in Table 1 have the meanings set out opposite them when used in the MASS.

Table 1 Definitions

Term	Definition
AGC	AEMO's automatic generation control system.
Aggregated ~~Ancillary Service~~FCAS Facility	The *ancillary service generating units* or *ancillary service loads* aggregated by an FCAS Provider under clause 3.8.3 of the NER for the purpose of providing FCAS.
Aggregated Generation Amount	The aggregate Generation Amounts through one or more *connection points* of an Aggregated ~~Ancillary Service~~FCAS Facility.
Aggregated Load Amount	The aggregate Load Amounts through one or more *connection points* of an Aggregated FCAS ~~Ancillary Service~~ Facility.
~~Ancillary Service Facility~~	~~An *ancillary service generating unit* or *ancillary service load* used to deliver FCAS, and includes an Aggregated Ancillary Service Facility unless the context otherwise requires.~~
~~Contingency Event Time~~	~~The time at which a *contingency event* occurred, which is determined as follows:~~ ~~a) Where the initial *frequency* change that led to a Frequency Disturbance is clear, there was a single rapid and significant change in *frequency*, the Contingency Event Time is the starting point of that *frequency* change.~~ ~~b) If there was a series of step changes in *frequency* or a slow ramp in *frequency*, the Contingency Event Time will be at the start of the greatest rate of change of *frequency*, as measured by AEMO.~~ ~~If neither paragraph (a), nor (b), applies, AEMO will take into account the circumstances of the *contingency event* and select a time that, in AEMO's opinion, represents the start time of the Frequency Disturbance, against which the FCAS response to it can reasonably be measured.~~
Contingency FCAS	A term used to refer to *very fast raise service*, *very fast lower services*, *fast raise service*, *fast lower service*, *slow raise service*, *slow lower service*, *delayed raise service* and *delayed lower service* collectively.

Term	Definition
Control Response Delay or CRD	Applies to Regulation FCAS Providers: defines the maximum end-to-end time in seconds an FCAS~~Ancillary Service~~ Facility takes to achieve at least 63.2%[1] of a step change in output following instructions via AGC.
Control Request Feedback	Applies to Regulation FCAS Providers: the latest AGC-issued control signal request (in MW) as known by an FCAS~~Ancillary Service~~ Facility. This value excludes any change in output from frequency controller action, including PFR. • For ~~Setpoint Control~~ FCAS~~Ancillary Service~~ Facilities with Setpoint Control, this is simply an echo ~~back~~ of the AGC control signal request. • For ~~Raise/Lower~~ FCAS~~Controlled Ancillary Service~~ Facilities with Raise/Lower Controls, this is the MW value of the stream of Raise~~/~~ Control Limits or Lower Control Limits as accumulated internal to the Plant Controller or equivalent.
Controlled Quantity	A quantity of *generation* or *load* that is: a) controlled by Raise Signals and Lower Signals; and b) measured at the relevant *connection point*.
Delayed FCAS	*delayed raise services* and *delayed lower services*.
Fast FCAS	*fast raise services* and *fast lower services*.
Fast Frequency Ramp	1 Hz/s.
FCAS	*market ancillary services*, commonly referred to as "frequency control ancillary services".
FCAS Facility	An *ancillary service generating unit* or *ancillary service load* used to deliver FCAS, and includes an Aggregated FCAS Facility unless the context otherwise requires.
FCAS Provider	An *Ancillary Service Provider*. The term can be combined with 'Regulation', 'Delayed', 'Raise', 'Lower', 'Very Fast', 'Fast', 'Slow' or 'Contingency' or a combination of these to indicate an FCAS Provider providing a particular type of FCAS.
FCASVT	Frequency Control Ancillary Service Ancillary Service Verification Tool: An Excel spreadsheet used to verify the delivery of Contingency FCAS.
FDT[2]	Frequency disturbance time: The time[3] when Local Frequency is outside the NOFB following a Frequency Disturbance, as determined by AEMO.
FOS	*frequency operating standard*.
Frequency Deadband	The range of Local Frequency through which a Variable Controller will not operate.
Frequency Deviation Setting	The setting allocated to an FCAS~~Ancillary Service~~ Facility by AEMO within the range shown in ~~Table 5~~Table 7 for the Mainland and ~~Table 6~~ Table 8 for the Tasmania *region*.
Frequency Disturbance	An occasion when System Frequency is outside the NOFB.
~~Frequency Disturbance Time or FDT[4]~~	~~The time[5] when Local Frequency is outside the NOFB following a Frequency Disturbance, as determined by AEMO.~~
Frequency Ramp Rate	0.125 Hz/s for the Mainland or 0.4 Hz/s for Tasmania.
~~Frequency Rate of Change Multiplier~~	~~See Table 5 for the Mainland, and Table 6 for Tasmania.~~
Frequency Recovery	The first change in Local Frequency to occur after a Frequency Disturbance from above 50.15 Hz to below 50.1 Hz, or below 49.85 Hz to above 49.9 Hz.
Frequency Setting	The level of *frequency* ~~or a combined level of *frequency* and *frequency* rate of change~~ determined by AEMO in accordance with section 6 for use by an FCAS~~Ancillary Service~~ Facility's Switching Controller.

[1] This value is specific to AGC.

[2] Referred to as occurring at t=0 in the equations used in the MASS.

[3] *Australian Eastern Standard Time.*

Term	Definition
Generation Amount	The amount of *active power* flow through the *connection point* of an FCASAncillary Service Facility into the *transmission network* or *distribution network* to which it is *connected*, expressed as a positive value in MW. In respect of an Aggregated FCASAncillary Service Facility, a reference to the Generation Amount means the Aggregated Generation Amount.
Generation Event	As defined in the FOS.
IANZ	International Accreditation New Zealand
ILAC MRA	International Laboratory Accreditation Cooperation Mutual Recognition Arrangements
Inertial Response	The change in Generation Amount or Load Amount due to the impact of an FCASAncillary Service Facility's *inertia*.
Initial Value	The Generation Amount or Load Amount immediately prior to a Contingency Event Time.an FDT.
Intrinsic Uncertainty	The uncertainty of a measuring instrument for the nominated measurement range.
Load Amount	The amount of *active power* flow through the *connection point* of an FCASAncillary Service Facility from the *transmission network* or *distribution network* to which it is *connected*, expressed as a negative value in MW. In respect of an Aggregated FCASAncillary Service Facility, a reference to the Load Amount means the Aggregated Load Amount.
Load Event	As defined in the FOS.
Load Reference	An AGC term that refers to the target power output of an FCASAncillary Service Facility when System Frequency is at its nominal value (50 Hz). Other commonly used terminology to refer to this is 'speed-load reference' or 'basepoint'.
Local Frequency	The *frequency* measured by an FCAS Provider at the *connection point* of the FCAS Provider's FCASAncillary Service Facility or at each *connection point* in an Aggregated FCASAncillary Service Facility, in Hz.
Lower Control Limit	The lowest level to which a Controlled Quantity can be controlled in response to Lower Signals, subject to the *enablement* amount.
Lower Rate Limit	The highest rate at which a Controlled Quantity can be controlled in response to Lower Signals, subject to the *enablement* amount.
Lower Reference Frequency	The upper value in the 'containment band' for Generation Events and Load Events, as specified in Table A.3 of the FOS for the Mainland and (Table A.6 for Tasmania).
Lower Response	The decrease in Generation Amount or increase in Load Amount as compared with its Initial Value.
Lower Signal	An AGC control signal sent by or on behalf of AEMO to request delivery of a Regulating Lower Response.
Mainland	All *regions* other than Tasmania.
MASS	This document, namely, the *market ancillary service specification*.
NATA	National Association of Testing Authorities
NER	National Electricity Rules.
NOFB	The relevant *normal operating frequency band* corresponding to 'normal' conditions, being the values specified in Column 2 of Table A.1 in the FOS.
OFTB	The relevant *operational frequency tolerance band* corresponding to 'normal' conditions, specified in Column 2 of Table A.1 in the FOS.
Online/Offline Status	Applies to Regulation FCAS Providers: a binary status flag indicating whether their FCASAncillary Service Facility is *connected* and ready to implement AGC-issued control requests.
PFR	*primary frequency response*.
Plant Controller	The system within an FCASAncillary Service Facility that controls the overall behaviour of the FCASAncillary Service Facility and is responsible for a variety of duties, including actioning AGC control requests and co-ordinating the behaviour of all *plant* within the FCASAncillary Service Facility.

Term	Definition
Raise Control Limit	The highest level to which a Controlled Quantity can be controlled in response to Raise Signals, subject to the *enablement* amount.
Raise/Lower Control	An AGC term that refers to a method of AGC control where Load Reference controls are issued as relative MW values (e.g. an AGC request to set an FCAS~~Ancillary Service~~ Facility's Load Reference to 100 MW would be sent as a value of +2 MW if the machine was currently at 98 MW). Raise/Lower Control is also sometimes referred to as 'pulse control'. See also Setpoint Control.
Raise Rate Limit	The highest rate at which a Controlled Quantity can be controlled in response to Raise Signals, subject to the *enablement* amount.
Raise Reference Frequency	The lower value in the 'containment band' for Generation Events and Load Events, as specified in Table A.3 of the FOS for the Mainland and~~(~~ Table A.6 for Tasmania~~)~~.
Raise Response	The increase in Generation Amount or decrease in Load Amount as compared with its Initial Value.
Raise Signal	An AGC control signal sent by or on behalf of AEMO to request the delivery of a Regulating Raise Response.
Reference Trajectory	A linear trajectory between two consecutive *energy market dispatch* targets.
Regulating Lower Response	The decrease in Generation Amount or increase in Load Amount delivered in response to one or more Lower Signals.
Regulating Raise Response	The increase in Generation Amount or decrease in Load Amount delivered in response to one or more Raise Signals.
Remote/Local Status	Applies to Regulation FCAS Providers: a binary status flag. 'Remote' indicates ~~the~~ an FCAS~~Ancillary Service~~ Facility's ~~-~~Plant Controller, or equivalent for Aggregated FCAS~~Ancillary Service~~ Facilities, is ready to receive AGC control signal requests.
SCADA	Supervisory control and data acquisition system.
Setpoint Change Deadband	A value set parameter assigned to each FCAS~~Ancillary Service~~ Facility in AGC that indicates the minimum change in MW output AGC may request from that FCAS~~Ancillary Service~~ Facility.
Setpoint Control	An AGC term that refers to a method of AGC control where Load Reference controls are issued as absolute MW values (e.g. an AGC request to set an FCAS~~Ancillary Service~~ Facility's Load Reference to 100 MW would be sent as a value of 100 MW). See also Raise/Lower Control.
Slow FCAS	*Slow raise services* and *slow lower services*.
Standard Frequency Ramp	A linear change in Local Frequency from one level to another at the applicable Frequency Ramp Rate and then sustained, as ~~per~~ described in Appendix A.
Switching Controller	A *control system* that automatically delivers a specific amount of FCAS by either switching *generation* or *load* on or off (as applicable) or rapidly altering an FCAS~~Ancillary Service~~ Facility's output when its Frequency Settings are detected.
System Frequency	The *frequency* of the *power system*, as measured by AEMO.
Time Average	For 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 duration of the time interval.
Trigger Range	The *frequency* range for which an Ancillary Services Facility with one or more Switching Controllers must record and store data regarding its performance, commencing 0.2 Hz either side of 50 Hz for the Mainland, and 0.8 Hz for Tasmania.
~~Trigger Rate~~	~~0.05 Hz/s for the Mainland and 0.15 Hz/s for Tasmania.~~
Variable Controller	A *control system* that is used by an FCAS~~Ancillary Service~~ Facility to deliver FCAS upon the commencement of a Frequency Disturbance in proportion to the size of the *frequency* excursion.
Very Fast FCAS	*very fast raise services* and *very fast lower services*.

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

1.3. Related documents

Table 2 Title and location of related documents

Title	Location
Application for Registration as a Customer in the NEM	https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/participate-in-the-market/registration/register-as-a-customer-in-the-nem
Application for Registration as a Generator in the NEM	https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/participate-in-the-market/registration/register-as-a-generator-in-the-nem
Application for Registration as a as a Demand Response Service Provider	https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/participate-in-the-market/registration/register-as-a-drsp
Dispatch Procedure SO_OP_3705	https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/power-system-operation/power-system-operating-procedures
Frequency Control Ancillary Service Ancillary Service Verification Tool	https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/ancillary-services/market-ancillary-services-specification-and-fcas-verification-tool
FCAS Verification Tool User Guide	http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Ancillary-services/Market-ancillary-services-specifications-and-FCAS-verification
Generator Exemption and Classification Guide	http://aemo.com.au/-/media/Files/Electricity/NEM/Participant_Information/New-Participants/Generator-Exemption-and-Classification-Guide.pdf
Generator Registration Guide	https://aemo.com.au/-/media/files/electricity/nem/participant_information/registration/generator/nem-generator-registration-guide.pdf?la=en
Guide to Ancillary Services in the National Electricity Market	http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Ancillary-services
~~MASS 4.0 FCAS Verification Tool_v2.08~~	~~https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/ancillary-services/market-ancillary-services-specification-and-fcas-verification-tool~~
Guide for Demand Response Service Providers – NEM – change or classify new Ancillary Service Load	https://aemo.com.au/-/media/files/electricity/nem/participant_information/registration/demand-response-service-provider/application-guide-nem-demand-response-service-provider-asl.pdf?la=en
Pre-Dispatch Procedure SO_OP_3704	http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Power-system-operation/Power-system-operating-procedures
Interim Primary Frequency Response Requirements	https://aemo.com.au/-/media/files/initiatives/primary-frequency-response/2020/interim-pfrr.pdf

2. MASS principles

2.1. Open access

When specifying the requirements for participation, the MASS is designed to permit open access to the FCAS *spot markets*.

2.2. No priority in delivery of different FCAS types

If an FCAS~~Ancillary Service~~ Facility is *enabled* for Regulation FCAS and Contingency FCAS, it should be able to deliver both types of FCAS together in a co-ordinated manner. Section ~~10.3~~ 11.3 provides guidance on how controls may be co-ordinated, including examples. Unless directed by AEMO to do otherwise[6], subject to clause 4.9.4 of the NER, an FCAS~~Ancillary Service~~ Facility providing Regulation FCAS should follow AGC instructions at all times, noting that AGC instructions are subject to Local Frequency as outlined in section 11.3~~10.3~~.

2.3. Contracting

Nothing prevents an FCAS Provider from procuring a third party to provide equipment or a monitoring or recording service to the FCAS Provider under contract, or perform any other action required or contemplated by the MASS on behalf of that FCAS Provider.

The FCAS Provider remains responsible for compliance with its NER obligations regardless of whether it provides *market ancillary services* itself or outsources part or all of their delivery.

2.4. Inertia

FCAS does not include the impact of *inertia*.[7]

2.5. Delivery of FCAS by FCAS~~Ancillary Service~~ Facilities

An FCAS~~Ancillary Service~~ Facility can be *enabled* to deliver any combination of FCAS it is capable of delivering and must deliver all types of FCAS for which it is *enabled*.

3. Description of each type of FCAS

FCAS are essential to the management of *power system security*, facilitation of orderly trading in electricity, and ensuring that electricity supplies are of acceptable quality. They are, effectively, reserves procured through the FCAS *spot markets* operated by AEMO and the *central dispatch* process in accordance with clause 3.8.1 of the NER.

AEMO procures FCAS to manage System Frequency during normal operating conditions and following *contingency events*. FCAS usually takes the form of an increase or decrease in *active power* output or consumption by an FCAS~~Ancillary Service~~ Facility to address the impact of

[6] Aside from reasons of safety or in a situation where a risk to unit stability exists.

[7] See also the definition of ~~Frequency Disturbance Time~~FDT.

supply/demand imbalances on System Frequency at any given point within a *trading~~dispatch~~ interval*. Each type of FCAS is delivered to different specifications to address different needs.

Clause 3.11.2(a) of the NER specifies that there are ~~eight~~ ten different types of FCAS. Table 3 details these, provides their common names, differentiates between Contingency FCAS and Regulation FCAS, and provides a brief description of how they are usually provided.

Table 3 Description of each FCAS

Type	NER Term	Commonly Referred to as…	Group	Description	Key Purpose	Usually Facilitated by…
Contingency FCAS	Very fast raise service	1-Second Raise FCAS or R1	Very Fast FCAS	A very rapid increase in *generation* or a decrease in *load* in response to decreases in Local Frequency.	To arrest a change in System Frequency following a *contingency event* that takes it outside the NOFB within the first 1 s of a Frequency Disturbance and then provide an orderly transition to a Fast FCAS.	• Frequency relay detecting a *frequency* deviation and increasing a *generating unit's* output or disconnecting a *load or* reducing consumption by a *load*. • Rapid change in charging or discharging from batteries.
	Very fast lower service	1-Second Lower FCAS or L1		A very rapid decrease in *generation* or an increase in *load* in response to increases in Local Frequency.		• Frequency relay detecting a *frequency* deviation and reducing a *generating unit's* output or increasing consumption by a *load*. • Rapid change in charging or discharging from batteries.
	Fast raise service	6-Second Raise FCAS or R6	Fast FCAS	A rapid increase in *generation* or a decrease in *load* in response to decreases in Local Frequency.	To arrest a change in System Frequency following a *contingency event* that takes it outside the NOFB within the first 6 s of a Frequency Disturbance and then provide an orderly transition to a Slow FCAS.	• Governor or governor-like *control systems*. • Frequency relay detecting a *frequency* deviation and starting a fast *generating unit* or disconnecting a *load* or reducing *load* consumption. • Rapid change in charging or discharging from batteries.
	Fast lower service	6-Second Lower FCAS or L6		A rapid decrease in *generation* or an increase in *load* in response to increases in Local Frequency.		Governor or governor-like *control systems.* • Frequency relay detecting a *frequency* deviation and reducing a *generating unit's* output or increasing consumption by a *load*.
	Slow raise service	60-Second Raise FCAS or R60	Slow FCAS	An increase in *generation* or a decrease in *load* in response to decreases in Local Frequency.	To stabilise System Frequency following a *contingency event* within the first 60 s of a Frequency Disturbance, and then provide an orderly transition to a Delayed FCAS.	• Governor or governor-like *control systems*. • Frequency relay detecting a *frequency* deviation and reducing consumption by a *load* or *disconnecting* a *load*.
	Slow lower service	60-Second Lower FCAS or L60		A decrease in *generation* or an increase *load* in response to increases in Local Frequency.		Governor systems on *generating units.*
	Delayed raise service	5-Minute Raise FCAS or R5	Delayed FCAS	An increase in *generation* or a decrease in *load* in response to decreases in Local Frequency.	To return System Frequency to 50 Hz within the first 5 min of a Frequency Disturbance, and to sustain that response until *central dispatch* can re-schedule	*Frequency* relay detecting a *frequency* deviation starting up *generating units* or reducing consumption by a *load* or *disconnecting* a *load*..
	Delayed lower service	5-Minute Lower FCAS or L5		A decrease in *generation* or an increase in *load* in response to increases in Local Frequency.		*Frequency* relay detecting a *frequency* deviation and reducing *generating unit* output or increasing consumption by a *load*~~s~~.

Type	NER Term	Commonly Referred to as…	Group	Description	Key Purpose	Usually Facilitated by…
					generation and *load* to balance the *power system*.	
Regulation FCAS	Regulating raise service	Raise Regulation FCAS or RREG	Regulation FCAS	Increasing *generation* or decreasing *load* relative to the FCAS~~Ancillary Service~~ Facility's Reference Trajectory in response to Raise Signals to increase System Frequency.	To support control of System Frequency and time error in tandem with *primary frequency response* (PFR) in response to variations of demand and *generation* within a *trading~~dispatch~~ interval*.	Setpoint controllers on *generating units*.
	Regulating lower service	Lower Regulation FCAS or LREG		Decreasing *generation* or increasing consumption by a *load* relative to the FCAS~~Ancillary Service~~ Facility's Reference Trajectory in response to Lower Signals to reduce System Frequency.		

3.1. Contingency FCAS

Contingency FCAS manages Frequency Recovery after an under-*frequency* or over-*frequency* event to arrest a fall or rise in System Frequency (as applicable), then stabilise and assist to restore System Frequency so that AEMO can meet the conditions specified in the FOS. This means that, while always *enabled* for delivery following a *contingency event*, Contingency FCAS are only required to be delivered if a *contingency event* occurs.

Contingency FCAS are provided by technologies that can detect a Local Frequency deviation and respond in a manner that corrects System Frequency following a *contingency event*.

FCAS~~Ancillary Service~~ Facilities may cease to provide Contingency FCAS once Frequency Recovery has occurred. ~~For example:~~In other words, if Local Frequency recovers following a *contingency event* within the parameters specified in the first two columns of Table 4, the FCAS Facility is not required to deliver the types of FCAS listed in column 3.

Table 4 Delivery requirements for different Contingency FCAS

Frequency Recovery	Time from FDT	FCAS not required
Above 49.9 Hz within…	1 s	Fast Raise FCAS, Slow Raise FCAS, Delayed Raise FCAS.
	6 s	Slow Raise FCAS, Delayed Raise FCAS.
	60 s	Delayed Raise FCAS.
Below 50.1 Hz within…	1 s	Fast Raise FCAS, Slow Raise FCAS, Delayed Raise FCAS.
	6 s	Slow Raise FCAS, Delayed Raise FCAS.
	60 s	Delayed Raise FCAS.

- ~~If Local Frequency recovers above 49.9 Hz within 6 s from the FDT, the Ancillary Service Facility is not required to deliver any Slow Raise FCAS or Delayed Raise FCAS.~~
- ~~If Local Frequency recovers below 50.1 Hz within 6 s from the FDT, the Ancillary Service Facility is not required to deliver any Slow Lower FCAS or Delayed Lower FCAS.~~
- ~~If Local Frequency recovers above 49.9 Hz between 6 s and 60 s from the FDT, the Ancillary Service Facility is not required to deliver any Delayed Raise FCAS.~~
- ~~If Local Frequency recovers below 50.1 Hz between 6 s and 60 s from the FDT, the Ancillary Service Facility is not required to deliver any Delayed Lower FCAS.~~

3.1.1. Relationship with PFR

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

3.2. Regulation FCAS

Regulation FCAS are centrally controlled by AGC, which allows AEMO to monitor System Frequency, time error and FCAS~~Ancillary Service~~ Facility output at all times. AGC sends control signals through SCADA (on a regular cycle, such as every 4 s) to ~~Ancillary Service~~FCAS Facilities *enabled* to deliver Regulation FCAS to alter the controlled MW output of *generating units* or electricity consumption of *loads* to assist with correcting the demand/supply

imbalance. Adjustments to MW output are from an FCAS~~Ancillary Service~~ Facility's Load Reference; the *enabled* Regulation Raise and Regulation Lower quantities form a band around the FCAS~~Ancillary Service~~ Facility's Load Reference within which AGC may control it. An FCAS~~Ancillary Service~~ Facility must be a *scheduled generating unit*, *scheduled load* or *semi-scheduled generating unit* to provide Regulation FCAS as it is required to have a centrally controlled MW output or consumption level visible to AGC.

Regulation FCAS are normally delivered during each *trading~~dispatch~~ interval*.

3.2.1. Relationship with PFR

Regulation FCAS works in tandem with *primary frequency response* (**PFR**) to help control *frequency* and *power system* imbalance within and outside the NOFB[8], however, it is distinguished from PFR in two key ways:

(a) Headroom, footroom and stored energy – Regulation FCAS is provided by the reserved headroom, footroom and stored energy, as specified in a *market ancillary service offer.* PFR is a response based on a *scheduled generating unit* or *semi-scheduled generating unit's* available capacity and energy at the time; there is no requirement to reserve capacity or energy.

(b) AGC – Regulation FCAS need only be provided in response to an AGC control signal request from AEMO to do so, whereas PFR is an ongoing *power system security* requirement every time a *Scheduled Generator* or *Semi-Scheduled Generator* receives a *dispatch instruction* to generate a volume greater than zero MW, as required by clause 4.4.2(c1) of the NER.

4. Aggregation of ~~Ancillary Service~~FCAS Facilities

4.1. Requests for aggregation

4.1.1. Generally

FCAS Providers may apply to AEMO under clause 3.8.3 of the NER to aggregate their *ancillary service generating units* or *ancillary service loads* for the purposes of *central dispatch*. Where aggregation has been approved, *market ancillary service offers* must only be made in respect of the Aggregated FCAS~~Ancillary Service~~ Facility.

4.1.2. Regulation FCAS

With Regulation FCAS, AEMO will approve aggregation if an FCAS Provider's AGC can support the aggregated *dispatch* of Regulation FCAS, namely it will respond to a single AGC signal from AEMO to deliver the requested Regulation FCAS.

The FCAS Provider must ensure that its Aggregated FCAS~~Ancillary Service~~ Facility provides the requested Regulation FCAS in an accurate and timely manner.

[8] Refer to guidance on co-ordination of PFR and Contingency FCAS controls with AGC controls in section 11.3~~10.3~~.

4.2. Requests for reports on Aggregated FCASAncillary Service Facilities

4.2.1. Generally

A request from AEMO to an FCAS Provider for a report detailing how an FCASAncillary Service Facility responded to changes in System Frequency under clause 3.11.2(h) of the NER may also be made in respect of an Aggregated FCASAncillary Service Facility, in which case the FCAS Provider must detail in its report the response of each FCASAncillary Service Facility within the Aggregated FCASAncillary Service Facility.

An FCAS Provider must provide a report promptly but, in any event, no more than 20 *business days* after AEMO's request.

4.2.2. Contingency FCAS

Where the report requested concerns the delivery of Contingency FCAS, this may include the response as determined by the FCASVT, or the FCAS Provider may propose an alternative method of demonstrating the response of the relevant FCASAncillary Service Facility within the Aggregated FCASAncillary Service Facility. AEMO, in its absolute discretion, may accept an FCAS Provider's alternative method.

5. Common requirements

5.1. Market ancillary service offers

FCAS Providers must ensure their *market ancillary service offers* reflect the physical availability and capability of their FCASAncillary Service Facility to deliver the relevant FCAS, as required by clause 3.8.7A of the NER.

FCAS Providers must rebid in accordance with clause 3.8.22 to reflect changes to FCAS availability and capability.

5.2. Enablement

FCAS Providers must operate their equipment in accordance with clause 4.9.3A(c) of the NER to deliver FCAS in response to a *dispatch instruction* immediately following enablement by AEMO.

5.3. Measurement

5.3.1. Connection point

All measurements of Local Frequency, Generation Amount and Load Amount must be taken at or close to a relevant *connection point*.

If an FCAS Provider considers that an alternative measurement methodology can provide AEMO the required data more simply and accurately, the FCAS Provider must request AEMO's approval prior to using it. AEMO may approve any alternative measurement methodology on such conditions as AEMO considers appropriate.

5.3.2. Measurement requirements ~~for all Ancillary Service Facilities~~

The equipment ~~required~~ used to measure and record the ~~delivery of~~ FCAS delivered~~, including both the source transducer and data recorder,~~ must have the characteristics detailed in ~~Table 4~~ Table 5.

~~Table 4~~Table 5 Measurement requirements for FCAS

Requirement	Applicable to…	Very Fast FCAS	Fast FCAS	Slow FCAS	Delayed FCAS	Regulation FCAS
~~Frequency~~ Sampling rate of Local Frequency measurements	Aggregated FCAS~~Ancillary Service~~ Facilities comprised of ≥25 FCAS~~Ancillary Service~~ Facilities with **no** Inertial Response and with an initiation delay of ≤500 ms	≤100 ms	≤200 ms	≤4 s	≤4 s	NR
	Aggregated FCAS Facilities comprised of ≥25 FCAS Facilities with **no** Inertial Response and with an initiation delay of >500 ms	≤50 ms	≤200 ms	≤4 s	≤4 s	NR
	Aggregated FCAS~~Ancillary Service~~ Facilities with Inertial Response and those comprised of <25 FCAS~~Ancillary Service~~ Facilities with **no** Inertial Response	≤50 ms	≤50 ms[9]	≤4 s	≤4 s	NR
	All other FCAS~~Ancillary Service~~ Facilities	≤50 ms	≤50 ms	≤4 s	≤4 s	NR
~~Frequency~~ Sampling rate of Generation Amount and Load Amount measurements	Aggregated FCAS~~Ancillary Service~~ Facilities comprised of ≥25 FCAS~~Ancillary Service~~ Facilities with **no** Inertial Response and with an initiation delay of ≤500ms	≤100 ms	≤200 ms	≤4 s	≤4 s	≤4 s
	Aggregated FCAS Facilities comprised of ≥25 FCAS Facilities with **no** Inertial Response and with an initiation delay of >500ms	≤50 ms	≤200 ms	≤4 s	≤4 s	≤4 s
	Aggregated FCAS~~Ancillary Service~~ Facilities with Inertial Response and those comprised of <25 FCAS~~Ancillary Service~~ Facilities with **no** Inertial Response.	≤50 ms	≤50 ms[10]	≤4 s	≤4 s	≤4 s
	All other FCAS~~Ancillary Service~~ Facilities	≤50 ms	≤50 ms	≤4 s	≤4 s	≤4 s
Measurement Range of Power Flow Measurements	As appropriate to the FCAS~~Ancillary Service~~ Facility with an Intrinsic Uncertainty ~~margin of error~~ of ≤2%, and resolution of ≤0.2%					
~~Settling Time~~	~~The time required for the measurement to remain within 99% of final value after a step change from pre-contingency conditions:~~					

[9] If another measurement at ≤50 ms is sufficient to determine the timing of the delivery of the Fast FCAS where a Switching Controller is used, the measurement may be at 4-s intervals. Information should be provided to AEMO's reasonable satisfaction to compare the Local Frequency and power flow data in a common time scale.

[10] If another measurement at ≤50 ms is sufficient to determine the timing of the delivery of the Fast FCAS where a Switching Controller is used, the measurement may be at 4-s intervals. Information should be provided to AEMO's reasonable satisfaction to compare the Local Frequency and power flow data in a common time scale.

Requirement	Applicable to…	Very Fast FCAS	Fast FCAS	Slow FCAS	Delayed FCAS	Regulation FCAS
	~~Aggregated Ancillary Service Facilities comprised of ≥25 Ancillary Service Facilities with no Inertial Response~~		~~≤200 ms~~	~~≤4 s~~	~~≤4 s~~	~~NR~~ ~~NR~~ ~~NR~~
	~~Aggregated Ancillary Service Facilities with Inertial Response and those comprised of <25 Ancillary Service Facilities with no Inertial Response.~~		~~≤50 ms[11]~~	~~≤4 ms[12]~~	~~≤4 s~~	
	~~All other Ancillary Service Facilities~~		~~≤50 ms~~	~~≤4 ms~~	~~≤4 s~~	
Local Frequency Measurement Range	At least the range specified in the OFTB, with:					NR
	Intrinsic Uncertainty~~margin of error~~	≤0.01 Hz		≤0.02 Hz		
	Resolution	≤0.0025 Hz		≤0.01 Hz		
~~Frequency Disturbance Time~~FDT	< 10 s					NR
Recording Period for Power & System Frequency Measurements	≥5 s before ~~the~~ FDT and ≥60 s after it			≥20 s before ~~the~~ FDT and 5 min after it	≥20 s before ~~the~~ FDT and 10 min after it	NR
Trigger for Recording Measurements	At least whenever Local Frequency changes ≥ Trigger Range.					NR

~~[12] If another measurement at ≤50 ms is sufficient to determine the timing of the delivery of the Fast FCAS where a Switching Controller is used, the measurement may be at 4-s intervals. Information should be provided to AEMO's reasonable satisfaction to compare the Local Frequency and power flow data in a common time scale.~~

5.3.3. Additional requirements for Aggregated FCAS~~Ancillary Service~~ Facilities

If an Aggregated FCAS~~Ancillary Service~~ Facility is used for the delivery of FCAS, measurements must meet these **additional** requirements:

(a) The Generation Amount or Load Amount must be measured at, or close to, each relevant *connection point* and summed to calculate the Aggregated Generation Amount or Aggregated Load Amount. Where any part of an Aggregated FCAS~~Ancillary Service~~ Facility shares a *connection point* with a variable *load* or *generating unit*, it is the gross *active power* flow to or from the relevant *plant* that forms the aggregated response by the Aggregated FCAS~~Ancillary Service~~ Facility and must be measured directly.

(b) To correct for any discrepancy in the time measurement by Aggregated FCAS~~Ancillary Service~~ Facility meter clocks, FCAS Providers must time-align the data logged by each meter to the actual time a Frequency Disturbance was detected.

5.4. Discounting Very Fast FCAS from Aggregated FCAS Facilities in certain circumstances

If an FCAS Provider provides Very Fast FCAS using an Aggregated FCAS Facility for which the measurements of *power flow* and Local Frequency are captured with a sampling rate >50 ms but ≤100ms, AEMO will apply a discount of 5% to the combined quantity of Very Fast FCAS measured at or close to the *connection points* of the Aggregated FCAS Facility if the *control system* is a Variable Controller, or 10% if the *control system* is a Switching Controller or a discrete combination of both.

The discount is applied during registration. The Aggregated FCAS Facility must be able to deliver up to the maximum registered capacity for Very Fast FCAS after factoring in the discount, as the quantity of Very Fast FCAS delivered in response to a *contingency event* must be greater than the *enabled* quantity by at least 5% for a Variable Controller, and 10% for a Switching Controller or a discrete combination of both.

~~5.4.~~5.5. Discounting Fast FCAS from Aggregated FCAS~~Ancillary Service~~ Facilities in certain circumstances

If an FCAS Provider provides Fast FCAS using an Aggregated FCAS~~Ancillary Service~~ Facility for which:

(a) the number of FCAS~~Ancillary Service~~ Facilities aggregated by the FCAS Provider is ≥25 but <500; and

(b) the measurements of *power flow* and Local Frequency are captured with a sampling rate >50 ms but ≤200ms,

AEMO will apply a discount of 5% to the combined quantity of Fast FCAS measured at or close to the *connection points* of the Aggregated FCAS~~Ancillary Service~~ Facility.

The discount is applied during the ~~process of registering Ancillary Service Facilities when their Fast FCAS capability is assessed~~registration. The Aggregated FCAS~~Ancillary Service~~ Facility must be able to deliver up to the maximum registered ~~Fast FCAS~~ capacity for Fast FCAS after

factoring in the discount, as the quantity of Fast FCAS delivered in response to a Contingency Event must be at least 5% greater than the *enabled* quantity.

~~5.5.~~5.6. Data retention

Measurement and other data recordings must be digital and stored in a format that is reasonably acceptable to AEMO for analysis using commercial spreadsheet software.

Each FCAS Provider must retain recordings of data and other measurements for at least 12 months from the FDT and provide them to AEMO on request.

5.7. Certification of FCAS metering equipment type

The type of equipment capturing measurements of power and *frequency* must be:

(a) certified to the sections of the IEC 61557-12[13] standard specified in Table 6 for an FCAS facility providing Contingency FCAS;

Table 6 Application of IEC 61557-12 type tests

Measurement Parameters	Requirements Section	Description	Type Test Section	Comment
Power and Frequency			6.2.1 6.2.2 6.2.3 6.2.4	General test and acceptance requirements, temperature influence.
Power only	4.8.2	Specifies the limits of uncertainty, over the rated measuring range, under reference conditions and influence quantities, environmental and electromagnetic. Sample rate, measurement range and uncertainty as specified in Table 5	6.2.5 6.2.16	Specific tests for active power measurement and EMC test.
Frequency only	4.8.5	Specifies the limits of uncertainty, over the rated measuring range, under reference conditions and influence quantities, environmental and electromagnetic. Sample rate, measurement range and uncertainty as specified in Table 5	6.2.9	Specific test for frequency measurement.

(b) tested by a facility accredited by either:

(i) The Australian National Association of Testing Authorities (NATA), or

(ii) The International Accreditation New Zealand (IANZ); or

(iii) By accreditation bodies that are signatories to the International Laboratory Accreditation Cooperation Mutual Recognition Arrangements (ILAC MRA); and

[13] IEC 61557-12 edition 2.1-2021-05 is adopted for MASS performance and test requirements. These are not affected by subsequent revisions of the IEC standard, unless the MASS is subsequently amended to incorporate them.

(c) compliant with the respective clause in Annex H of the IEC61557-12 standard which applies where the meter is embedded in another device (e.g. an inverter or a protection relay).

5.8. Reporting requirements

5.8.1. Request for Report

AEMO may require an FCAS Provider to submit one or more reports to AEMO demonstrating compliance with any aspect of the MASS. At the time when AEMO requests the report, AEMO will specify:

(d) the content of the required report;

(e) whether the report is required once only, or on a regular basis;

(f) if AEMO requires regular reports, the frequency of the reports; and

(g) the due date(s) for the report(s).

For example, AEMO may require an FCAS Provider to demonstrate that adequate headroom and footroom (where appropriate) have been reserved for the delivery of FCAS whenever the FCAS Facility was *enabled*.

5.8.2. How Report to be Submitted

Reports requested under section 5.8.1 must be forwarded to Freq_Event.Data@aemo.com.au by the relevant due date, and where applicable must cover the performance of the FCAS Provider's FCAS Facilities for the specified reporting period.

5.8.3. Requests for Extension

FCAS Providers who cannot provide the requested report by the due date specified by AEMO must apply to AEMO before that due date for an extension, explaining why the FCAS Provider cannot reasonably meet the due date and proposing an extension period. AEMO may grant an extension in its sole discretion.

6. Contingency FCAS Requirements

6.1. Frequency Deviation Settings provided by Switching Controllers

6.1.1. Default Frequency Deviation Setting

Until an FCAS~~Ancillary Service~~ Facility that uses a Switching Controller to deliver Contingency FCAS is allocated one or more Frequency Deviation Settings under section 6.1.2, the FCAS Provider must apply the default Frequency Deviation Setting shown in Table 7 if the FCAS~~Ancillary Service~~ Facility is on the Mainland or Table 8 if the FCAS~~Ancillary Service~~ Facility is in Tasmania.

~~Table 5~~Table 7 Frequency Settings for the Mainland

Level	Raise FCAS Frequency Deviation Setting (Hz)	Lower FCAS Frequency Deviation Setting (Hz)	~~Frequency Rate of Change Multiplier (FRCM)~~
Frequency Deviation Setting range	49.80 Hz to 49.60 Hz	50.20 Hz to 50.4 Hz	~~0.4~~
Default Frequency Deviation Setting	49.8 Hz	50.2 Hz	~~0.4~~

~~Table 6~~Table 8 Frequency Settings for Tasmania

Level	Raise FCAS Frequency Deviation Setting (Hz)	Lower FCAS Frequency Deviation Setting (Hz)	~~Frequency Rate of Change Multiplier (FRCM)~~
Frequency Deviation Setting range	49.50 Hz to 48.75 Hz	50.50 Hz to 51.25 Hz	~~0.875~~
Default Frequency Deviation Setting	49.125 Hz	50.875 Hz	~~0.875~~

6.1.2. Allocation of Frequency Settings

When allocating Frequency Settings to FCAS~~Ancillary Service~~ Facilities for each Contingency FCAS, AEMO will take into account the following principles, as appropriate:

(a) Where an FCAS~~Ancillary Service~~ Facility is used to deliver more than one type of Contingency FCAS, it will be allocated the same Frequency Settings for each.

(b) FCAS~~Ancillary Service~~ Facilities with larger switched blocks of *generation* or *load* will be allocated Frequency Settings closer to the NOFB.

(c) FCAS~~Ancillary Service~~ Facilities with higher availability will be allocated Frequency Settings closer to the NOFB.

(d) For Aggregated FCAS~~Ancillary Service~~ Facilities, where possible, AEMO will negotiate with the FCAS Provider to allocate a series of Frequency Settings to minimise the potential for over-delivery of Contingency FCAS.

(e) AEMO will consider the physical characteristics of the FCAS~~Ancillary Service~~ Facilities.

~~(f)~~ A Frequency Setting ~~:~~

~~(g)~~ for Very Fast FCAS, Fast FCAS, ~~may be a Frequency Deviation Setting or a combination of both the Frequency Deviation Setting and Frequency Rate of Change Multiplier shown in for the Mainland and Table 6 for Tasmania; and~~

~~(h)~~(f) ~~for~~ Slow FCAS or Delayed FCAS will be based on the allocated Frequency Deviation Setting shown in Table 7 for the Mainland and Table 8 for Tasmania~~alone~~.

~~(i) 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 both of the following conditions are satisfied:~~

~~(i) Local Frequency < 49.85; and~~

~~(ii) Local Frequency < FDS + (FRCM * LFRC).~~

~~Where:~~

FDS is the allocated Frequency Deviation Setting

FRCM is taken from Table 5 for the Mainland and Table 6 for Tasmania

LFRC is the measured rate of change of Local Frequency.

(j) 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 both of the following conditions are satisfied:

(i) if Local Frequency > 50.15; and

(ii) Local Frequency > FDS – (FRCM * LFRC)

Where acronyms in the formula bear the same meanings as in paragraph (g).

(k)(g) At AEMO's absolute discretion, a Frequency Deviation Setting outside the range specified in Table 7Table 5 for the Mainland and Table 8Table 6 for Tasmania may be allocated.

AEMO encourages FCAS Providers with FCASAncillary Service Facilities using Switchinged Controllers to configure them so that different Frequency Settings can be assigned to different parts of their FCASAncillary Service Facilities.

6.1.3. FCAS Provider request to change allocation

An FCAS Provider may request AEMO to change a Frequency Deviation Setting if there is a technical reason preventing an FCASAncillary Service Facility from delivering Contingency FCAS due to its Frequency Deviation Setting. AEMO may change the Frequency Deviation Setting in its absolute discretion subject to the principles in section 6.1.2.

6.1.4. AEMO request to change allocation

The only circumstances in which AEMO may request a change to a Frequency Deviation Setting are the following:

(a) the principles in section 6.1.2 have been amended;

(b) the classification of an FCASAncillary Service Facility that uses a Switching Controller to deliver a Contingency FCAS has changed;

(c) at least six months have elapsed since the last change of Frequency Deviation Settings and one or more FCASAncillary Service Facility has changed its maximum response capability; or

(d) a Frequency Disturbance that involved loss of *load* or *generation* has occurred and AEMO has determined that the relevant Frequency Deviation Setting was inadequate under those circumstances.

6.2. Control of Contingency FCAS

6.2.1. Notification of Control System Settings

Each FCAS Provider must inform AEMO of the details of each relevant *control system* as reasonably required by AEMO for the purposes of *central dispatch* or allocating the Frequency Settings.

6.2.2. Control System Requirements

(a) Whenever Contingency FCAS is enabled, the FCAS~~Ancillary Service~~ Facility used to deliver the requested Contingency FCAS must have a *control system* to automatically initiate:

(i) a Raise Response when Local Frequency exceeds the FCAS~~Ancillary Service~~ Facility's Frequency Deadband, which for a Variable Controller must not be less than the lower limit of the NOFB and for a Switching~~ed~~ Controller, must be equal to the Frequency Deviation Setting; and

(ii) a Lower Response when Local Frequency exceeds the FCAS~~Ancillary Service~~ Facility's Frequency Deadband, which for a Variable Controller must not be greater than the upper limit of the NOFB and for a Switching~~ed~~ Controller, must be equal to the Frequency Deviation Setting.

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

(i) for a Variable Controller, an amount commensurate with the difference between Local Frequency and Frequency Deadband where the Local Frequency is between the Frequency Deadband and the lower limit of the OFTB (for a Raise Response) or upper limit of the OFTB (for a Lower Response) in accordance with the FCAS~~Ancillary Service~~ Facility's proportional response function[14];

(ii) for a Switching Controller, one or more step changes if Local Frequency falls below its Frequency Deviation Setting (for a Raise Response) or exceeds its Frequency Deviation Setting (for a Lower Response); or

(iii) for a discrete combination of both, responses in accordance with sub-paragraphs (~~a~~i) and (~~b~~ii).

(c) Where a Switching Controller is used, it must be capable of adjusting its Frequency Deviation Setting to the Frequency Setting provided by AEMO with an Intrinsic Uncertainty ~~error margin~~ of <0.05 Hz for absolute Frequency Deviation Settings~~ and <0.05 s for Frequency Rate of Change Multiplier~~.

(d) The *control system* of a Variable Controller or a Switching Controller, or a discrete combination of both, must scan for changes in Local Frequency at a rate of ≤50 ms and automatically cause the FCAS Facility to deliver the required amount of Raise Response or Lower Response.

(e) The FCAS Facility used to deliver the required Contingency FCAS must have a *control system* to reserve the necessary headroom or footroom required for the delivery of frequency response whenever Contingency FCAS is *enabled*.

[14] Commonly known as a 'droop function' or 'droop curve'.

6.3. Ancillary service offer requirements [proposed replacement for sections 7, 8, 9 & 10)

(a) Contingency FCAS Providers must make market *ancillary service offers* based on their expectation of what their FCAS Facility can deliver at its *connection point* in response to the Frequency Ramp from 50 Hz shown in Table 9 to the Raise Reference Frequency or Lower Reference Frequency (as applicable) while a *price band* is *enabled*.

(b) Subject to paragraph (a), the amount of a Contingency FCAS in a *price band* and all cheaper *price bands* must exclude any Inertial Response and is calculated as the lesser of twice the Time Average of the Raise Response or Lower Response between the times shown in Column 3 and Column 4 of Table 9 and is capped at the *peak active power* change.

Table 9 Market ancillary service offer requirements

Type of Contingency FCAS	Frequency Ramp	Column 3	Column 4
very fast raise service ***very fast lower service***	Fast Frequency Ramp	FDT and 1 s from FDT	1 s and 6 s from FDT
fast raise service	Standard Frequency Ramp or Fast Frequency Ramp if the FCAS Provider is also a Very Fast FCAS Provider	1 s and 6 s from FDT, excluding any *very fast raise service* provided	6 s and 60 s from FDT
fast lower service		1 s and 6 s from FDT, excluding any *very fast lower service* provided	
slow raise service		6 s and 60 s from FDT, excluding any *fast raise service* provided	60 s and 5 min from FDT
slow lower service		6 s and 60 s from FDT, excluding any *fast lower service* provided	
delayed raise service		1 min and 5 min from FDT, excluding any *slow raise service* provided	5 min and 10 min from FDT
delayed raise service		1 min and 5 min from FDT, excluding any *slow lower service* provided	

6.4. Dispatch

AEMO will issue *dispatch instructions* for the delivery of a Contingency FCAS to enable the required quantities based on the *market ancillary service offers* received.

During *enablement*, an FCAS Facility must respond to Local Frequency without further instruction from AEMO.

~~6.3.~~6.5. Measurement when using a combination of Variable Controller and Switching Controller

In addition to the requirements specified in section 5.3, when proposing to use a combination of a Variable Controller and a Switching Controller, FCAS Providers must agree with AEMO on the process used to determine separate amounts of each Contingency FCAS that will be delivered through each type of controller.

~~6.4.~~6.6. Verification

The verification requirements that must be followed by FCAS Providers are provided in Table 10:

~~Table 7~~Table 10 Verification Requirements of Contingency FCAS

Requirement	Very Fast FCAS	Fast FCAS	Slow FCAS	Delayed FCAS
Assessment Period - From ~~the Contingency Event Time~~ FDT to Frequency Recovery up to a maximum of:	6 s	60 s	300 s	600 s
Calculation Method	The amount of Contingency FCAS delivered must be compared with the amount of *enabled* Contingency FCAS as follows: (a) If the FCAS~~Ancillary Service~~ Facility is a *scheduled generating unit*, *scheduled load* or *semi-scheduled generating unit*, determine the *generation* or electricity consumption Reference Trajectory it would be expected to have followed if the Frequency Disturbance had not occurred[15]. (b) Use this Reference Trajectory to adjust the measured Generation Amount and Load Amount to obtain the response relative to this Reference Trajectory. (c) Remove the impact of any Inertial Response. (d) The difference between the value calculated following paragraph (c) and a measure of the output of the FCAS~~Ancillary Service~~ Facility just prior to the Frequency Disturbance constitutes the FCAS~~Ancillary Service~~ Facility's 'basic response'. Note that the 'basic response' includes all *frequency* response, regardless of whether it is inside or outside the NOFB. (e) Where a Variable Controller was used, the 'basic response' is adjusted to take into account the expected frequency response of the FCAS Facility in the period just prior to the Frequency Disturbance based on the known deadband and proportional response function. (e~~f~~) Where a Variable Controller was used, the 'basic response' is compensated to take into account the difference between Local Frequency and the Fast Frequency Ramp (for Very Fast FCAS) or the Standard Frequency Ramp (for all other Contingency FCAS) if the FCAS Facility is not registered in the Very Fast FCAS markets. (~~f~~g) Where a Switching Controller was used, the 'basic response' is compensated to take into account the timing difference for Local Frequency to reach the Frequency Setting, compared to the Fast Frequency Ramp (for Very Fast FCAS) or the Standard Frequency Ramp (for all other Contingency FCAS) if the FCAS Facility is not registered in the Very Fast FCAS markets. (~~g~~h) Where a discrete combination of Switching Controller and Variable Controller was used, the compensated 'basic response' is the sum of the compensated 'basic responses' of each.			
Where more than one Contingency FCAS Enabled	If more than one type Contingency FCAS is *enabled* at the same time, the FCAS Facility must deliver at least the amount enabled in each FCAS category. For the avoidance of doubt, delivering an amount of Raise (or Lower) FCAS based on the greatest *enablement* across the Raise (or			NR

[15] Reference Trajectories take into account AGC control signals if required.

Requirement	Very Fast FCAS	Fast FCAS	Slow FCAS	Delayed FCAS
	Lower) Contingency services is an appropriate (but not mandatory) strategy.			
~~Where more than one Contingency FCAS Enabled~~		~~If a Slow FCAS was also *enabled*, the FCASAncillary Service Facility's response should exceed the required response, such that the Slow FCAS can be delivered.~~	~~If a Delayed FCAS was also *enabled*, the FCASAncillary Service Facility's response should exceed the required response such that the Delayed FCAS can be delivered.~~	~~NR~~
Specification of Market Ancillary Service Offers to calculate the Contingency FCAS offered	See sections 7.1 and 7.2	~~The specifications in sections 7.1 and 7.2 are applied to calculate the Fast FCAS offered.~~See sections 8.1 and 8.2	~~The specifications in sections 8.1 and 8.2 are applied to calculate the Fast FCAS offered.~~See sections 9.1 and 9.2	~~The specifications in sections 9.1 and 9.2 are applied to calculate the Fast FCAS offered.~~See sections 10.1 and 10.2
Delivery Requirements	The amount of ~~Fast~~ each Contingency FCAS delivered in response to a change in Local Frequency must be at least equal to ~~the~~ the corresponding ~~*dispatched*~~ *enabled* quantity. ~~The amount of a Slow FCAS delivered in response to a change in Local Frequency must be at least equal to the *dispatched* quantity.~~ ~~The amount of Delayed FCAS delivered in response to a change in Local Frequency must be at least equal to the *dispatched* quantity.~~			

~~6.5.~~6.7. The FCAS Verification Tool

The FCASVT[16] is available to help calculate the quantity of any Contingency FCAS delivered by an FCAS~~Ancillary Service~~ Facility. It contains detailed algorithms used by AEMO to verify whether Contingency FCAS has been delivered in accordance with the MASS.

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 is not part of the MASS.

NOTE: SECTIONS 7, 8, 9 & 10 WILL BE DELETED IF NO ADVERSE COMMENT ON CONSOLIDATION IN SECTION 6.3

[16] Available at http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Ancillary-services/Market-ancillary-services-specifications-and-FCAS-verification.

7. Very Fast FCAS Requirements

7.1. Specification of Very Fast Raise Service in Market Ancillary Service Offer

The amount of *very 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 starting at the FDT and ending 1 s from the FDT, excluding any Inertial Response and capped at the peak *active power* change; and

(b) twice the Time Average of the Raise Response between 1 s and 6 s from the FDT, excluding any Inertial Response and capped at the peak *active power* change,

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

7.2. Specification of Very Fast Lower Service in Market Ancillary Service Offer

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 starting at the FDT and ending 1 s past the FDT, excluding any Inertial Response and capped at the peak active power change; and

(b) twice the Time Average of the Lower Response between 1 s and 6 s from the FDT, excluding any Inertial Response and capped at the peak active power change,

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

~~6.6. Dispatch~~

~~AEMO will issue *dispatch instructions* for the delivery of Very Fast FCAS to *enable* the required quantities based on the *market ancillary service offers* received.~~

~~During *enablement*, an Ancillary Service Facility must respond to Local Frequency without further instruction from AEMO.~~

~~7.~~8. Fast FCAS Requirements

~~7.1.~~8.1. Specification of Fast Raise Service in Market Ancillary Service Offer

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 ~~starting at the Contingency Event Time and ending~~between 1 s and 6 s from the FDT, excluding any *very fast raise service* provided and any Inertial Response, and capped at the peak *active power* change; and

(b) twice the Time Average of the Raise Response between 6 s and 60 s from the FDT, excluding any Inertial Response and capped at the peak *active power* change,

that the FCAS Provider making the *market ancillary service offer* expects would be delivered at the relevant *connection point* in response to a Standard Frequency Ramp (or Fast Frequency Ramp if the FCAS Provider is also a Very Fast FCAS Provider) from 50 Hz to the Raise Reference Frequency while this *price band* is *enabled*.

~~7.2.~~8.2. Specification of Fast Lower Service in Market Ancillary Service Offer

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 1 s and ~~starting at the Contingency Event Time and ending~~ 6 s ~~past~~ from the FDT, excluding any *very fast lower service* provided and any Inertial Response, and capped at the peak *active power* change; and

(b) twice the Time Average of the Lower Response between 6 s and 60 s from the FDT, excluding any Inertial Response and capped at the peak *active power* change,

that the FCAS Provider making the *market ancillary service offer* expects would be delivered at the relevant *connection point* in response to a Standard Frequency Ramp (or Fast Frequency Ramp if the FCAS Provider is also a Very Fast FCAS Provider) from 50 Hz to the Lower Reference Frequency while this *price band* is *enabled*.

~~7.3. Dispatch~~

~~AEMO will issue *dispatch instructions* for the delivery of Fast FCAS to *enable* the required quantities based on the *market ancillary service offers* received.~~

~~During *enablement*, an Ancillary Service Facility must respond to Local Frequency without further instruction from AEMO.~~

~~8.~~9. Slow FCAS Requirements

~~8.1.~~9.1. Specification of Slow Raise Service in Market Ancillary Service Offer

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 6 s and 60 s from the FDT, excluding any *fast raise service* provided and capped at the peak *active power* change; and

(b) twice the Time Average of the Raise Response between 60 s and 5 min from the FDT and capped at the peak *active power* change,

that the FCAS Provider making the *market ancillary service offer* expects would be delivered at the relevant *connection point* in response to a Standard Frequency Ramp (or Fast Frequency Ramp if the FCAS Provider is also a Very Fast FCAS Provider) from 50 Hz to the Raise Reference Frequency while this *price band* is *enabled*.

~~8.2.~~9.2. Specification of Slow Lower Service in Market Ancillary Service Offer

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 6 s and 60 s from the FDT, excluding any *fast lower service* provided and capped at the peak *active power* change; and

(b) twice the Time Average of the Lower Response between 60 s and 5 min from the FDT and capped at the peak *active power* change,

that the FCAS Provider making the *market ancillary service* offer expects would be delivered at the relevant *connection point* in response to a Standard Frequency Ramp (or Fast Frequency Ramp if the FCAS Provider is also a Very Fast FCAS Provider) from 50 Hz to the Lower Reference Frequency while the *slow lower service* in this *price band* is *enabled*.

~~8.3. Dispatch~~

~~AEMO will issue *dispatch instructions* for the delivery of Slow FCAS to enable the required quantities based on the *market ancillary service offers* received.~~

~~During *enablement*, an Ancillary Service Facility must respond to Local Frequency without further instruction from AEMO.~~

~~9.~~10. Delayed FCAS Requirements

~~9.1.~~10.1. ~~Amount~~ Specification of Delayed Raise Service in Market Ancillary Service Offer

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 1 min and 5 min from the FDT, ~~and~~ excluding any *slow raise service* provided and capped at the peak *active power* change; and

(b) the Time Average of the Raise Response between 5 min and 10 min from the FDT and capped at the peak *active power* change,

that the FCAS Provider making the *market ancillary service offer* expects would be delivered at the relevant *connection point* in response to a Standard Frequency Ramp (or Fast Frequency Ramp if the FCAS Provider is also a Very Fast FCAS Provider) from 50 Hz to the Raise Reference Frequency while the *delayed raise service* in this *price band* is *enabled*.

~~9.2.~~10.2. ~~Amount~~ Specification of Delayed Lower Service in Market Ancillary Service Offer

The amount of *delayed lower service* in a *price band* is the **lesser** of:

(a) twice the Time Average of the Lower Response between 1 min and 5 min from the FDT, excluding ~~a~~nd~~y~~ *slow lower service* provided and capped at the peak *active power* change; and

(b) the Time Average of the Lower Response between 5 min and 10 min from the FDT and capped at the peak *active power* change,

that the FCAS Provider making the *market ancillary service* offer expects would be delivered at the relevant *connection point* in addition to the amounts in all cheaper *price bands* in response to a Standard Frequency Ramp (or Fast Frequency Ramp if the FCAS Provider is also a Very Fast FCAS Provider) from 50 Hz to the Lower Reference Frequency while the *delayed lower service* in this *price band* is *enabled*.

~~10.~~11. Regulation FCAS

~~10.1.~~11.1. Specification of Regulating Raise Service in Market Ancillary Service Offer

Provided the amount bid is at least the greater of 1 MW or 1% (rounded to nearest whole MW) of the 'Max Cap' recorded for 'Raisereg' in the Ancillary Services worksheet in AEMO's NEM Registration and Exemption List,[17] the amount of *regulating raise service* specified in a *price band* must be the amount of Regulating Raise Response that the FCAS Provider making the *market ancillary service offer* expects would be delivered at the relevant *connection point* progressively over a *trading*~~*dispatch*~~ *interval* in addition to the amounts in all cheaper *price bands* in response to Raise Signals sent to request the maximum possible Regulating Raise Response while this *price band* is *enabled*.

~~10.2.~~11.2. Specification of Regulating Lower Service in Market Ancillary Service Offer

Provided the amount bid is at least the greater of 1 MW or 1% (rounded to nearest whole MW) of the 'Max Cap' recorded for 'Lowerreg' in the Ancillary Services worksheet in AEMO's NEM Registration and Exemption List,[18] the amount of *regulating lower service* specified in a *price band* must be the amount of Regulating Lower Response that the FCAS Provider making the *market ancillary service offer* expects would be delivered at the relevant *connection point* progressively over a *trading*~~*dispatch*~~ *interval* in addition to the amounts in all cheaper *price*

[17] Available at https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/participate-in-the-market/registration. FCAS Providers must comply with this requirement by 22 December 2023.

[18] Available at https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/participate-in-the-market/registration. FCAS Providers must comply with this requirement by 22 December 2023.

bands in response to Lower Signals sent to request the maximum possible Regulating Lower Response while this *price band* is *enabled*.

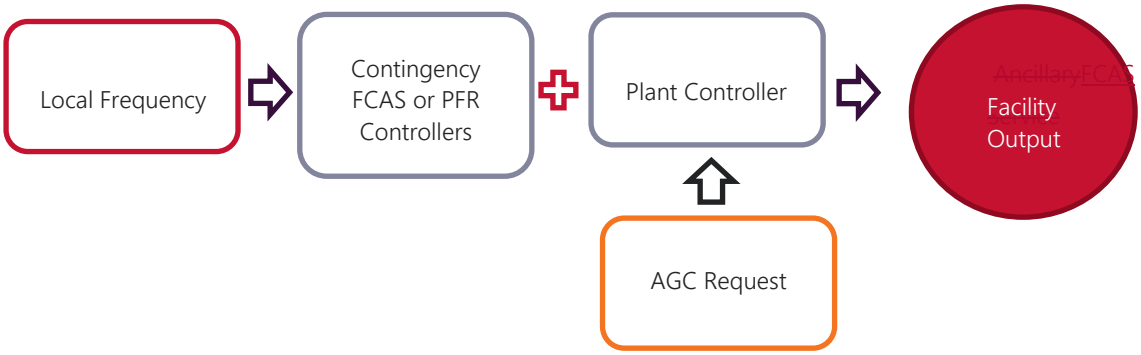
~~10.3.~~11.3. Compliance monitoring and action

AEMO needs assurance that an FCAS~~Ancillary Service~~ Facility or Aggregated FCAS~~Ancillary Service~~ Facility (as applicable) *enabled* to deliver Regulation FCAS will respond in an accurate, timely and co-ordinated manner.

AGC control requests apply to an FCAS~~Ancillary Service~~ Facility's Load Reference point. If Local Frequency is not 50 Hz, any active Contingency FCAS or PFR controllers should adjust the FCAS~~Ancillary Service~~ Facility output to take into account Local Frequency in accordance with the FCAS ~~Ancillary Service~~ Facility's droop function.

To achieve this control co-ordination, FCAS~~Ancillary Service~~ Facilities that are controlled by AGC must ensure that their Plant Controller is able to respond in an additive manner (i.e. a net sum) using their Contingency FCAS or PFR controllers and AGC controls. The total expected change in output is subject to *enabled* quantities of each FCAS and a applicable PFR obligations[19]. A high-level example is shown in Figure 1, which outlines the expected FCAS~~Ancillary Service~~ Facility behaviour. Actual control design will vary by *plant* and technology and may be subject to other control actions, various limits and intermediate controllers.

Figure 1 High level frequency-coordinated control design



Hence, where relevant, Contingency FCAS or PFR controllers must detect Local Frequency and calculate an appropriate response. The FCAS~~Ancillary Service~~ Facility's Plant Controller should take the sum of the response calculated by the Contingency FCAS or PFR controllers and response requested by the AGC control signal to determine the required output from the FCAS~~Ancillary Service~~ Facility.

Because AGC must balance various objectives simultaneously (including frequency control, load following, time error correction and dispatch ramping), occasionally, the direction of the Contingency FCAS or PFR response calculated by the FCAS Provider could be the opposite to the AGC control signal. Example responses are provided in Appendix B.

[19] Only *Scheduled Generators* and *Semi-Scheduled Generators* have PFR obligations.

AEMO will monitor the output of FCAS~~Ancillary Service~~ Facilities and Aggregated FCAS~~Ancillary Service~~ Facilities *enabled* to deliver Regulation FCAS in accordance with Appendix A of the Dispatch Procedure[20].

AEMO may invoke a fixed *constraint* equation until it is reasonably satisfied that the FCAS~~Ancillary Service~~ Facility or Aggregated FCAS~~Ancillary Service~~ Facility (as applicable) responds as contemplated by the MASS.

~~10.4.~~11.4. Control System

The FCAS~~Ancillary Service~~ Facility must have a *control system* that can:

(a) transmit an agreed set of control parameters including Controlled Quantity, Control Request Feedback, Online/Offline Status, Remote/Local Status, Raise Control Limit, Lower Control Limit, Raise Rate Limit and, if different from the Raise Rate Limit, the Lower Rate Limit every 4 s to AEMO via SCADA and with no greater than 8 s latency, excluding external processing and communications delays[21];

(b) receive Raise Signals and Lower Signals;

(c) when enabled for Regulation FCAS, automatically deliver a Regulating Raise Response or a Regulating Lower Response corresponding to those Raise Signals or Lower Signals[22];

(d) ensure the Regulating Raise Response or Regulating Lower Response, where it exceeds the FCAS Facility's Setpoint Change Deadband, is clearly discernible from any noise and oscillation in the telemetered output; and

(e) maintain at all times a Control Response Delay (CRD) no greater than 150 s[23]; and

(f) maintain at all times a Setpoint Change Deadband greater than or equal to half of the FCAS~~Ancillary Service~~ Facility's minimum Regulation FCAS offer quantity as required by Sections 11.1~~10.1~~ and 11.2~~10.2~~[24].

~~(f)~~(g) The FCAS Facility used to deliver the requested Regulation FCAS must have a *control system* to reserve the headroom or footroom required for delivery of the *enabled* Regulation FCAS.

An Aggregated FCAS~~Ancillary Service~~ Facility's *control system* for *regulating raise service* or *regulating lower service* must only apply to the whole Aggregated FCAS Facility ~~*generating unit or load*~~.

~~10.5.~~11.5. Verification

For the purpose of verifying the maximum 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

[20] Available at http://aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3705---Dispatch.pdf.

[21] FCAS Providers must comply with this requirement by 22 December 2023.

[22] AGC will control FCAS~~Ancillary Service~~ Facility output within the ramp~~ing~~ rates telemetered to AEMO by the FCAS~~Ancillary Service~~ Facility.

[23] FCAS Providers must comply with this requirement by 22 December 2023.

[24] FCAS Providers must comply with this requirement by 22 December 2023.

service to be compared with the *enabled price bands* of the relevant *market ancillary service* offer must be determined using the recordings made under section 5.3.2 as follows:

(a) If AEMO or the FCAS Provider wishes to verify delivery of Regulation FCAS, AEMO must transmit no Raise Signals or Lower Signals to the relevant FCAS~~Ancillary Service~~ Facility for at least 60 s and then immediately transmit Raise Signals or Lower Signals to the FCAS~~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[25] of the relevant market ancillary services offer and the corresponding Raise Rate Limit or Lower Rate Limit for at least 5 min 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 = P1 + R1 * t) to the power measurements made during the 60 s to which paragraph (a) refers;

(ii) fit a linear function of time (of the form P = P2 + R2 * t) to the earliest power measurements made over the following 5 min 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/min) multiplied by 5 min.

(c) The test must be discarded if the FCAS~~Ancillary Service~~ Facility produces a Contingency FCAS response or significant PFR action during the test as this may invalidate the results.

~~10.6.~~11.6. Tests

FCAS Providers must notify AEMO of the date on which they intend to undertake tests to reasonably demonstrate that their FCAS~~Ancillary Service~~ Facilities meet the MASS requirements applicable to Regulation FCAS:

(a) no less than every 4 years;

(b) within 8 weeks following a major overhaul of the FCAS Facility or any change to *active power* controls; and

(c) within 8 weeks of a request from AEMO.

Tests should be undertaken within 8 weeks after the date of the FCAS Provider's notice to AEMO.

Test results must be provided to AEMO within 20 *business days* of completion of the relevant test. Any failure to provide test results to AEMO or to demonstrate that an FCAS~~Ancillary Service~~ Facility complies with the MASS may result in AEMO constraining the FCAS~~Ancillary Service~~ Facility's participation in the Regulation FCAS *market* as contemplated in the NER.

[25] For assessing Raise capability, only the enabled Raise price bands apply. For assessing Lower capability, only the enabled Lower price bands apply.

~~11.~~12. Trials of new technologies

~~11.1.~~12.1. AEMO's requirements

From time to time, a trial to demonstrate the capability of new technologies in the delivery of FCAS may be authorised. Where this occurs, AEMO may specify the capabilities, measurements, verification, duration and other requirements and conditions of the trial in its absolute discretion.

~~11.2.~~12.2. Report to AEMO

AEMO may specify the contents of a report and supporting data that trial participants must submit to AEMO upon the conclusion of a trial to enable AEMO to assess the efficacy of reviewing the MASS to address any issues that the trial has raised as to the performance of the new technologies in the delivery of FCAS or the operation of the *spot markets* for FCAS.

~~11.3.~~12.3. Transitional arrangements for VPP Demonstrations facilities

~~11.3.1.~~12.3.1. VPP Demonstrations and definitions

AEMO commenced a trial of the ability of virtual power plant (**VPP**) to deliver Contingency FCAS in June 2019 (**VPP Demonstrations**).

Participants enrolled in the VPP Demonstrations (**Trial Participants**) were permitted to deliver Fast FCAS in accordance with the VPP Demonstrations FCAS Specification[26] (**Trial Specification**), which included a power flow and *frequency* measurement time resolution of 1 s taken at the *connection point* of each *ancillary service load*.

For the period ending on 30 June 2023, (**VPP transition period**), the transitional requirements in section ~~11.3.2~~ 12.3.2 will apply to Aggregated FCAS~~Ancillary Service~~ Facilities that were classified by a Trial Participant and included in the VPP Demonstrations as at the date this section 12.3~~11.3~~ comes into effect (**Trial Facilities**).

~~11.3.2.~~12.3.2. VPP transitional requirements

During the VPP transition period:

(a) Fast FCAS from a Trial Facility must be provided in accordance with the MASS, as varied by section 2.1 and clauses 2.2(a) and 2.2(b) of the Trial Specification;

(b) Trial Participants are not permitted to make changes to the device types or controller types in their Trial Facilities;

(c) where, in accordance with the Trial Specification, measurements of power flow and Local Frequency at a Trial Facility's *connection points* are captured with a sampling rate >200

[26] AEMO. VPP Demonstrations FCAS Specification. Available at~~:~~ https://aemo.com.au/initiatives/major-programs/nem-distributed-energy-resources-der-program/der-demonstrations/virtual-power-plant-vpp-demonstrations.

ms, AEMO will apply a discount of 5% to the quantity of Fast FCAS measured at all those *connection points*;

(d) FCAS~~Ancillary Service~~ Facilities that were not part of a Trial Facility immediately prior to the VPP transition period can only be added to a Trial Facility:

(i) to replace or add *ancillary service loads* so as to maintain (but not exceed) the total aggregate MW capacity of the Trial Facility to deliver Contingency FCAS immediately before the VPP transition period, allowing for customer churn and for the discount applied under paragraph (c); and

(ii) in accordance with all applicable registration and classification requirements, including relevant fees.

~~11.3.3.~~12.3.3. After the VPP transition period

All Trial Facilities that are not providing Contingency FCAS in accordance with the requirements of the MASS as if this section 12.3~~11.3~~ did not apply (i.e, not as varied by the Trial Specification) by the end of the VPP transition period will be declassified by AEMO, effective on and from the day after the VPP transition period ends.

Appendix A. Standard Frequency Ramp

Figure 2 Standard Frequency Ramp for the Mainland

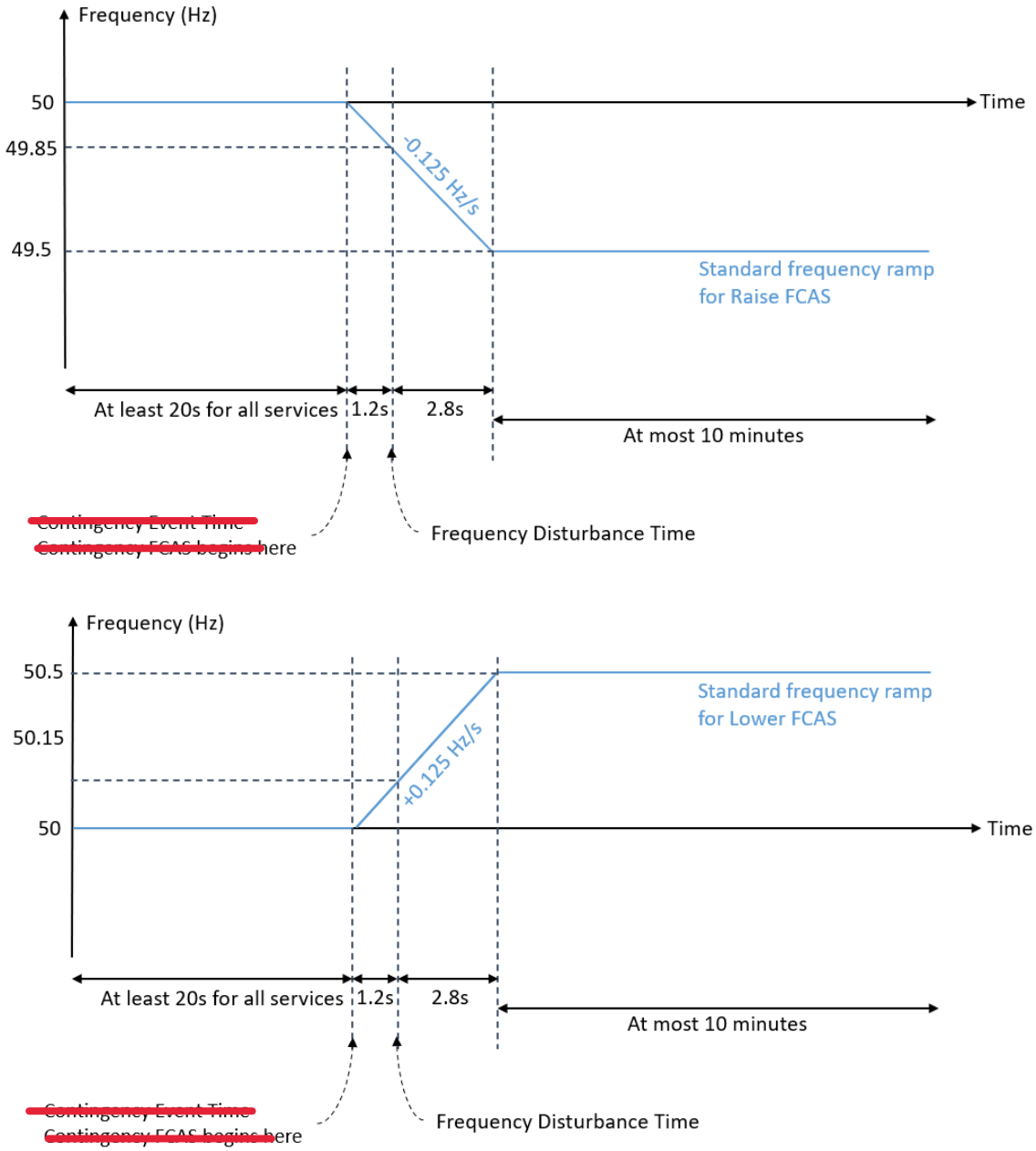
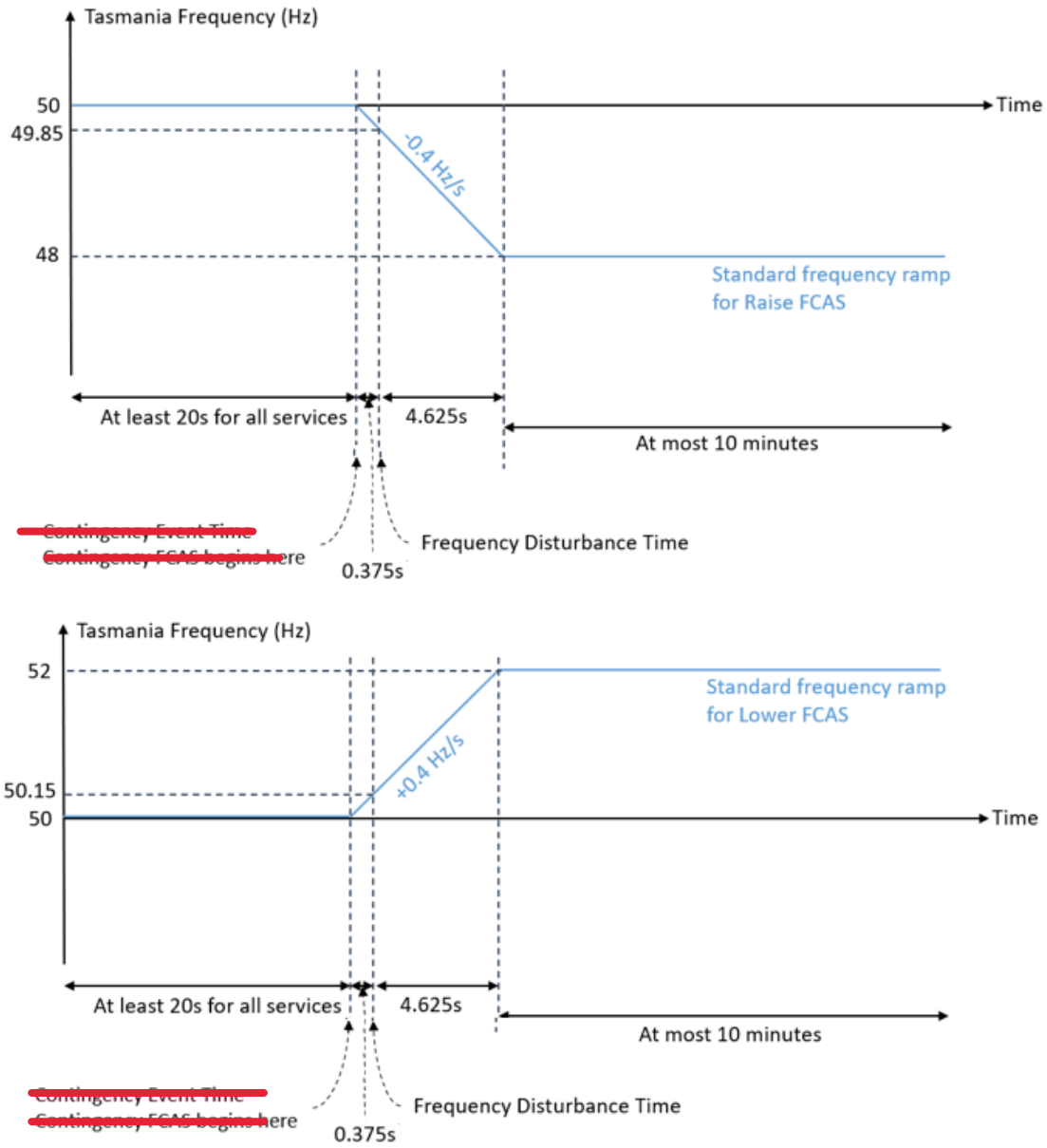
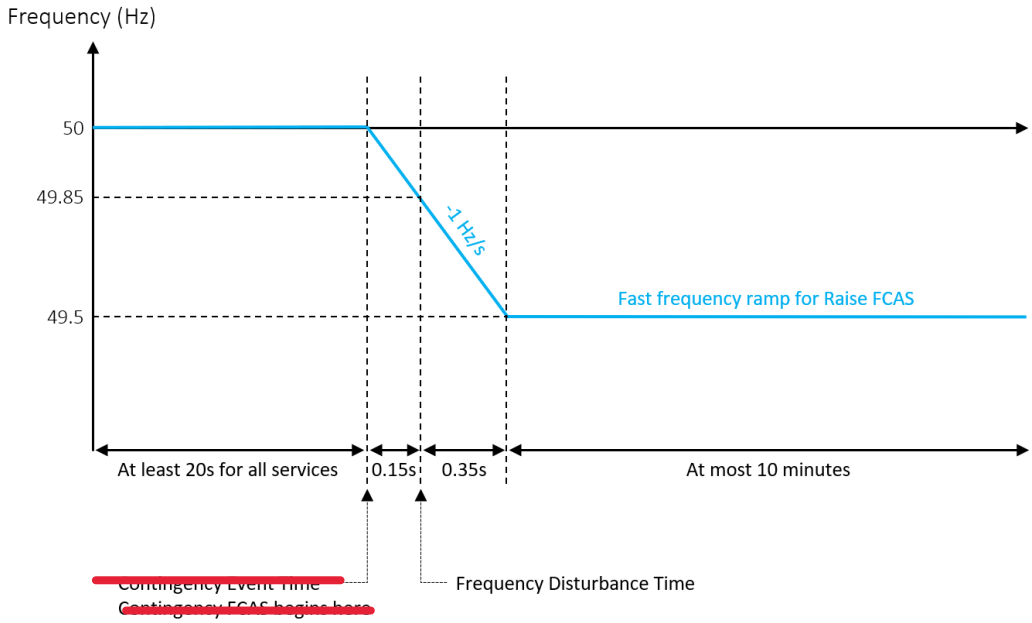


Figure 3 Standard Frequency Ramp for Tasmania



Appendix B. Fast Frequency Ramp

Figure 4 Fast Frequency Ramp for the Mainland



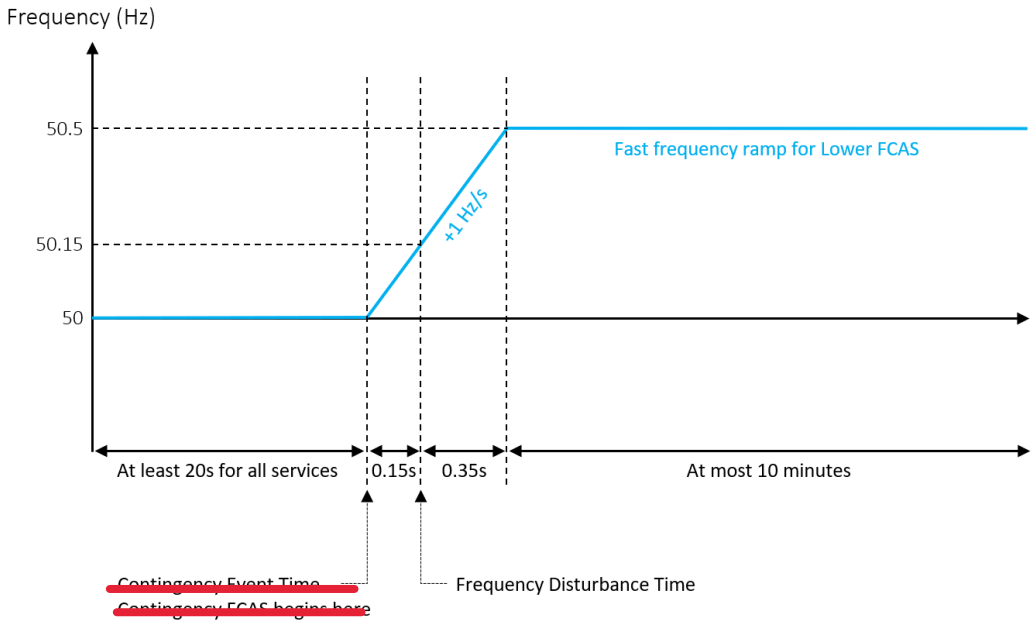
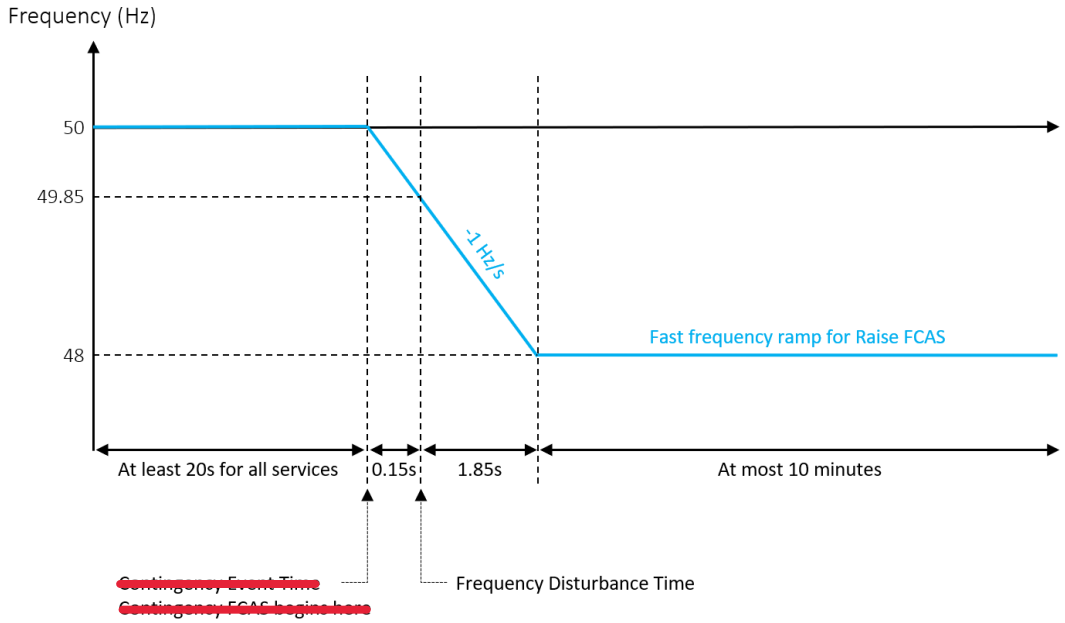
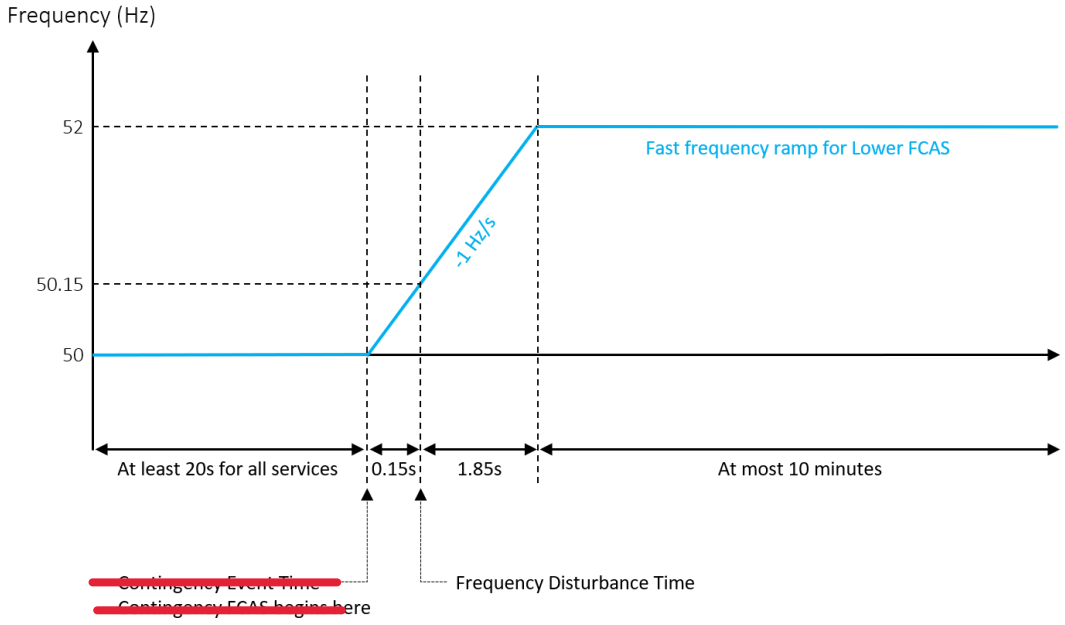


Figure 5 Fast Frequency Ramp for Tasmania





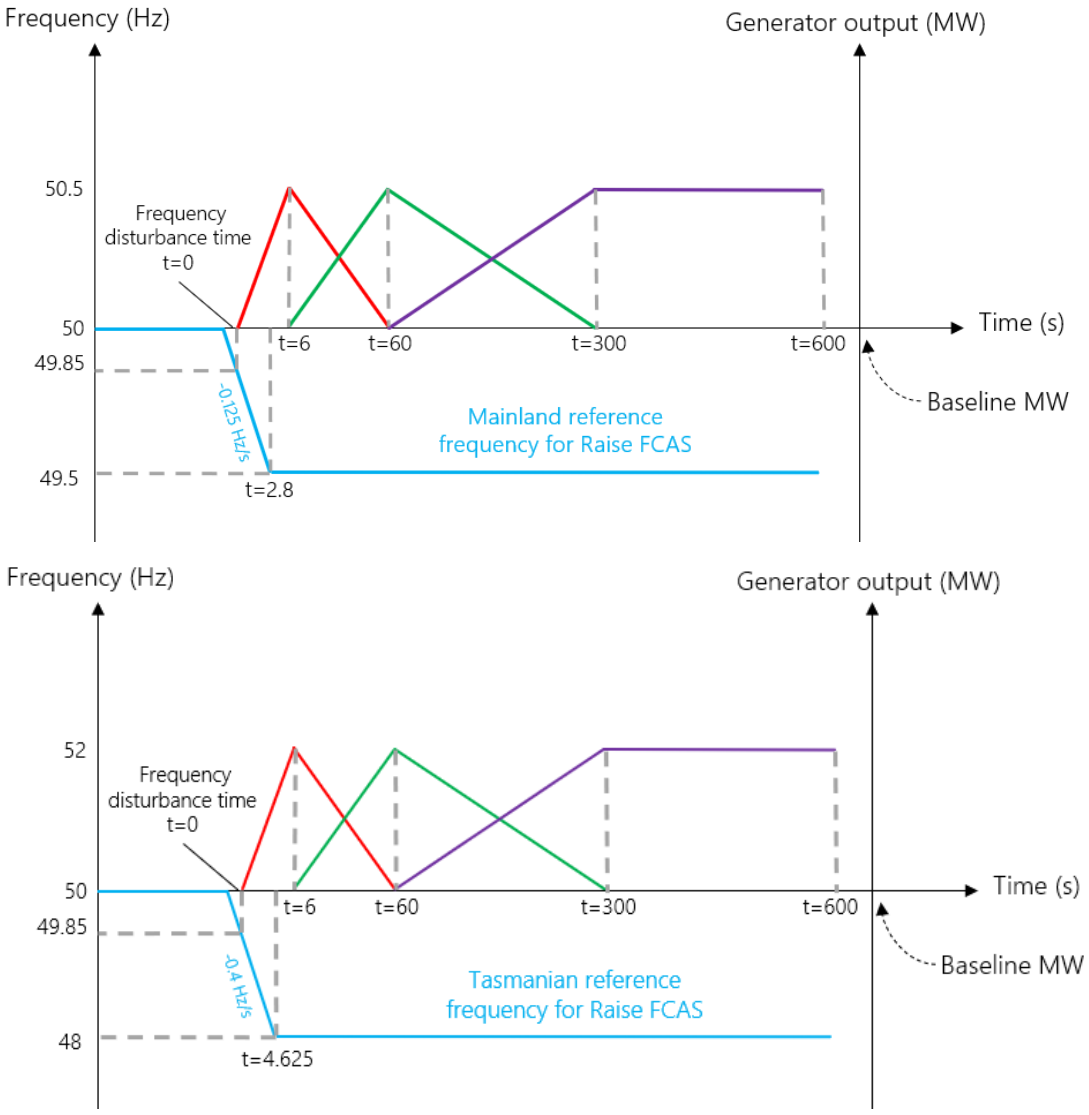
~~Appendix B.~~Appendix C.Examples of FCAS measurement and delivery

Measurement and delivery of Contingency FCAS

Figure 6 shows a visual representation of the measurements applied to verify that at least the minimum required Contingency FCAS has been delivered in each timeframe by an FCAS Provider not registered in the Very Fast FCAS markets.

It is not recommended that FCAS Providers use these measurements as the sole basis of FCAS control design.

~~Figure 4~~Figure 6 Measurement timeframes for Raise Contingency FCAS for the Mainland and Tasmania



~~Figure 5~~ Figure 7 shows an example of how a simple Variable Controller that supplies a droop-based response to a Frequency Disturbance can deliver across the Contingency FCAS timeframes by an FCAS Provider not registered in the Very Fast FCAS markets.

~~Figure 5~~Figure 7 Combined measurement timeframes for Raise Contingency FCAS for Mainland and Tasmania

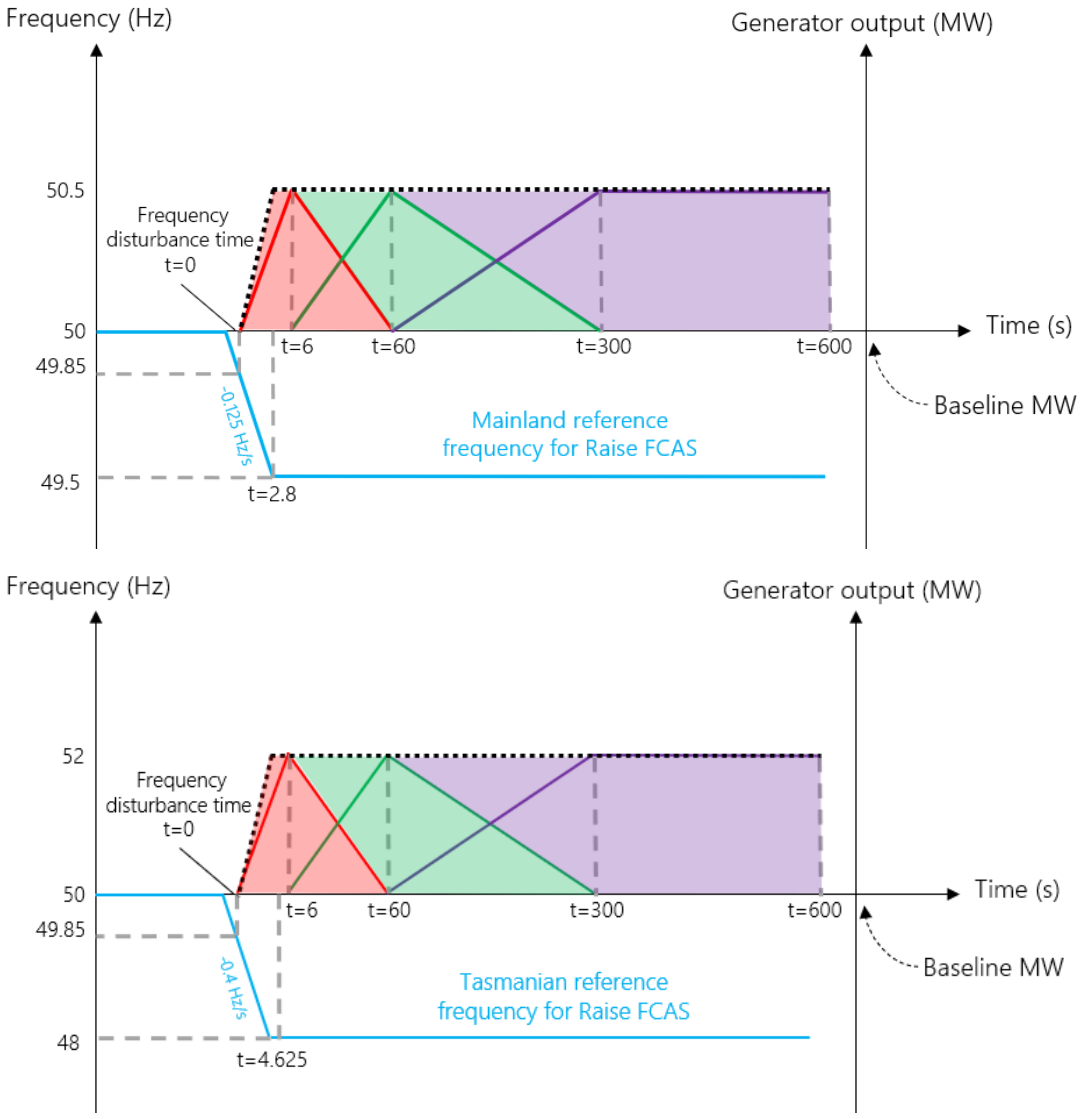


Figure 8 shows a visual representation of the measurements applied to verify that at least the minimum required Contingency FCAS has been delivered in each timeframe by an FCAS Provider also registered in the Very Fast FCAS markets.

Figure 8 Measurement timeframes for Raise Contingency FCAS for the Mainland and Tasmania

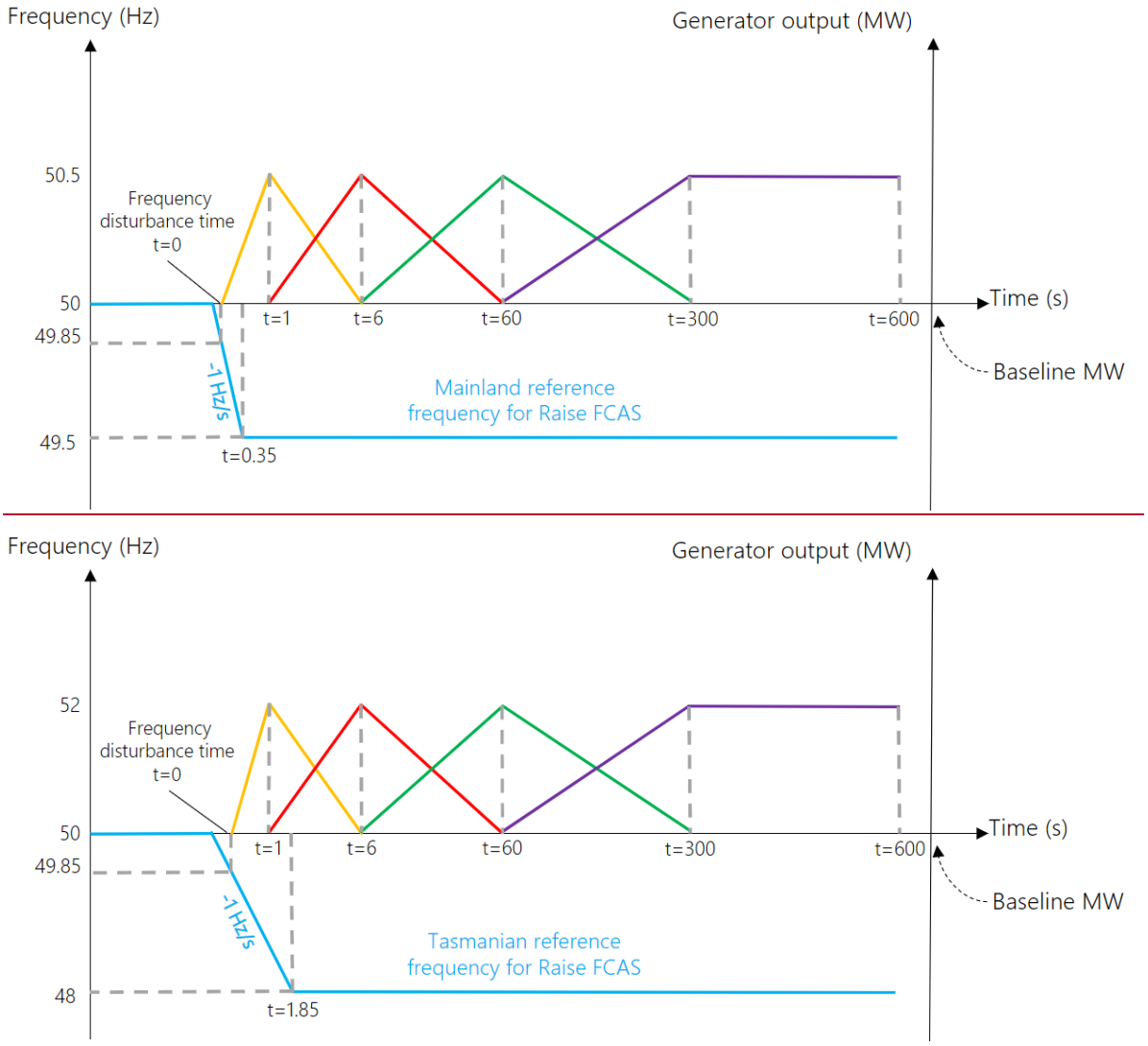
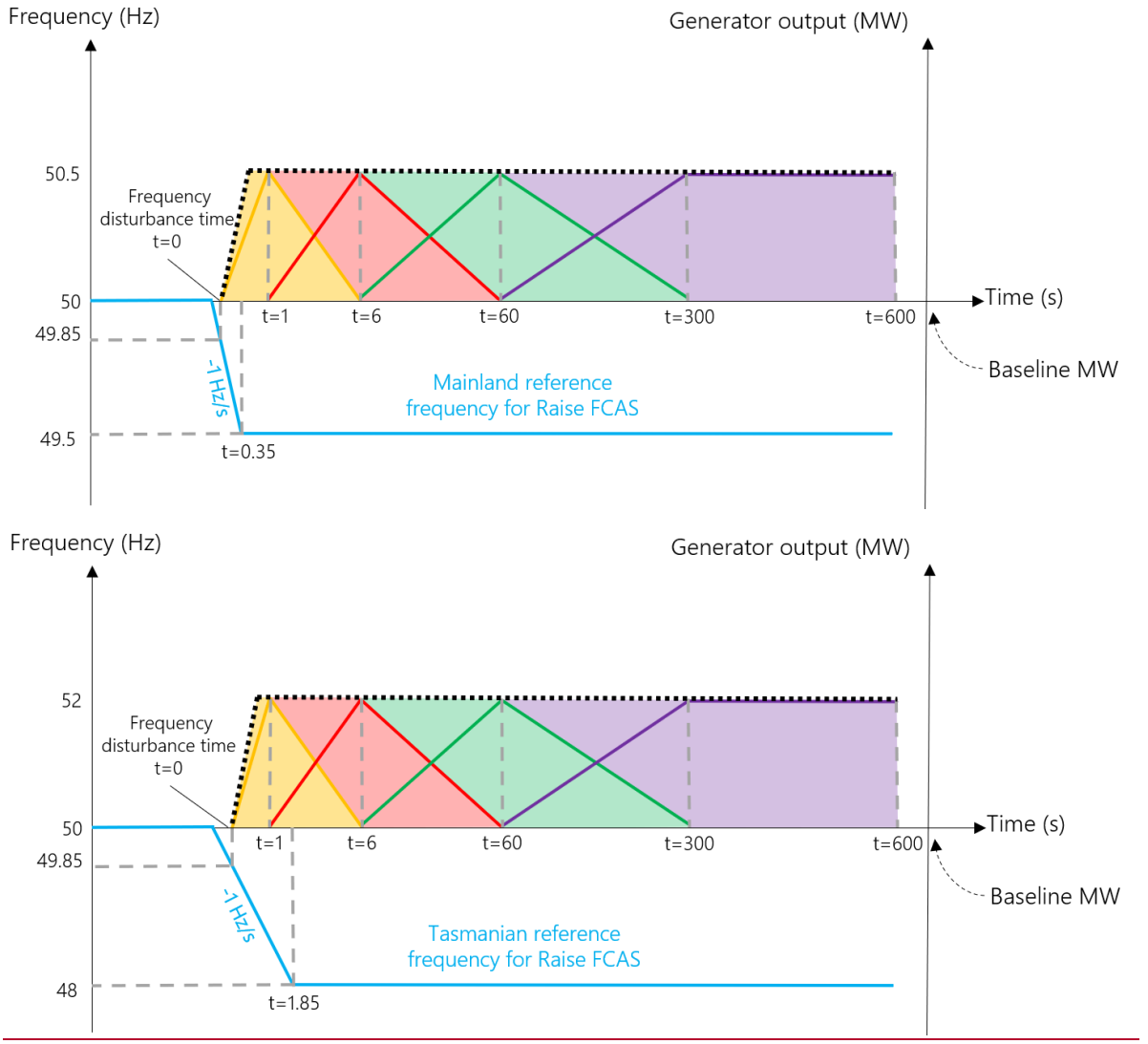


Figure 9 shows an example of how a simple Variable Controller that supplies a droop-based response to a Frequency Disturbance can deliver across the Contingency FCAS timeframes by an FCAS Provider also registered in the Very Fast FCAS markets.

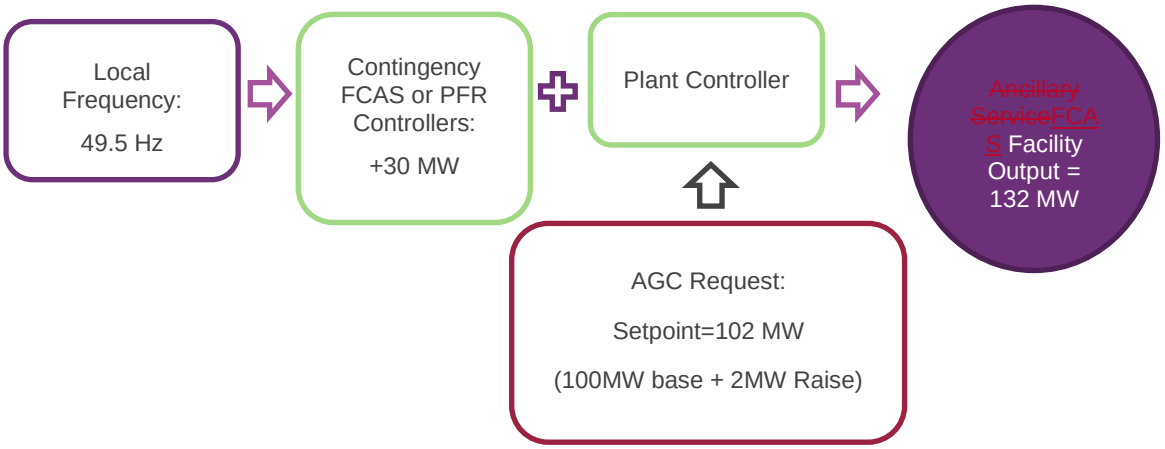
Figure 9 Combined measurement timeframes for Raise Contingency FCAS for Mainland and Tasmania



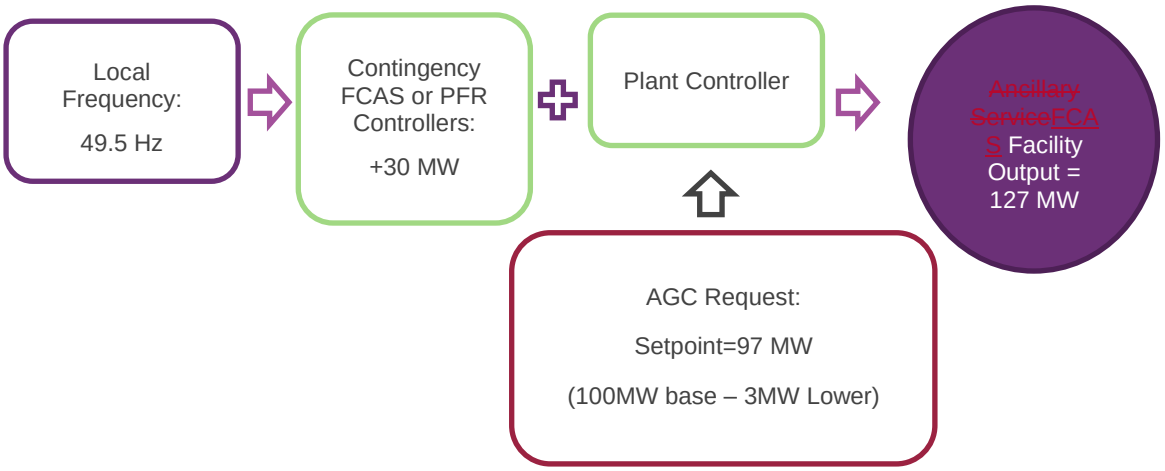
Examples of frequency co-ordinated response

Note that these examples are high level only and use a ~~Setpoint Controlled~~ FCAS~~Ancillary Service~~ Facility with Setpoint Control. ~~Raise/Lower Controlled~~ FCAS~~Ancillary Service~~ Facilities~~)~~ with Raise/Lower Controls are given Raise Controls or Lower Controls that are relative to their current output, rather than a setpoint, but otherwise the desired behaviour is consistent. In all cases, the minimum expected Regulation FCAS response is subject to *enabled* quantities, ramp rates and PFR settings, where relevant.

~~Figure 6~~Figure 10 Co-ordinated output for FCAS~~Ancillary Service~~ Facility at 100 MW given Raise Regulation FCAS request of 2 MW while responding with 30 MW to a Frequency Disturbance



~~Figure 7~~Figure 11 Co-ordinated output for FCAS~~Ancillary Service~~ Facility at 100 MW given Lower Regulation FCAS request of 3 MW while responding with 30 MW to a Frequency Disturbance



Version release history

Version	Effective date	Summary of changes
7.1	9 Oct 2023 (TBC)	Revised following consultation on the creation of Very Fast FCAS markets.
7.0	1 Feb 2022	• Revised following consultation on measurement arrangements for aggregated ancillary service facilities. • Restructure to remove unnecessary duplication and improve readability.
6.0	1 Jun 2020	• Revised following consultation on relationship with the draft Primary Frequency Response rule change (ERC0274). • Minor drafting updates, corrections and clarifications.
5.0	30 Jun 2017	Revised after consultation
4.0	30 Mar 2012	Revised after consultation
3.0	1 Jul 2010	Revised after consultation
2.0	5 May 2009	Revised to align with the revised Tasmania frequency operating standards
1.5	27 Feb 2004	Revised to include the Tasmania region
1.0	Sep 2001	Initial document issued at the commencement of the market ancillary services