~~DRAFT~~ Frequency Contribution Factors Procedure

Prepared by:	AEMO Operations
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[1.0]	[8 June 2025]	First issue

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

1. Introduction

1.1. Purpose and scope

This is the Frequency Contribution Factors Procedure (**Procedure**) made under clause 3.15.6AA(f) of the National Electricity Rules (**NER**). The contribution factors (**CFs**) and other ~~matters~~factors determined ~~under~~in accordance with this Procedure are used for the purpose of determining the allocation and amount of:

(a) payments relating to frequency performance under NER 3.15.6AA(b) (**Frequency Performance Payments** or **FPPs**); and

(b) cost recovery for *regulating raise service* and *regulating lower service* (**Regulation FCAS**) under NER 3.15.6AA(c) and (d).

This Procedure has effect only for the purposes set out in ~~th~~et he NER. The NER and the National Electricity Law prevail over this Procedure to the extent of any inconsistency.

1.2. Definitions and interpretation

1.2.1. Definitions

Terms defined in the National Electricity Law and the NER (in chapter 10 or clause 3.15.6AA) have the same meanings in this Procedure unless otherwise specified in this ~~clause.~~section 1.2.1.

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

In addition, the words, phrases and abbreviations in the table below have the meanings set out opposite them when used in this Procedure.

Table 1 Glossary

Term	Definition
~~AGC~~AGC (automatic generation control system)	~~Automatic generation control system~~The system into which the *loading levels* from economic *dispatch* will be entered for *generating units* operating on automatic generation control in accordance with clause 3.8.21(d)
Bad ~~SCADA~~Quality	Any ~~SCADA~~telemetered data that is not 'Good Quality', as defined in the Power System Data Communication Standard.
~~Contribution Factor~~CF (contribution factor)	A factor calculated in accordance with section 16 ~~of this Procedure~~ and applied to an *eligible unit* ~~(and includes a Default Contribution Factor unless otherwise specified).~~with *appropriate metering*.
~~Default Contribution Factor~~DCF (default contribution factor)	A ~~Contribution Factor~~CF determined in accordance with section 6.36.2 ~~of this Procedure~~ and applied to an *eligible unit* with *appropriate metering* in the circumstances described in NER 3.15.6AA(g)(4~~)~~).
~~Frequency Measure~~FM (frequency measure)	The indication of a need to raise or lower *frequency* calculated by AEMO in accordance with section 4 ~~of this Procedure~~.
~~Frequency Performance Payment or FPP~~FPP (frequency performance payment)	A *trading amount* payable by, or to, a *Cost Recovery Market Participant* determined ~~under~~in accordance with NER 3.15.6AA(b~~)~~).
~~Historical Performance Period~~	~~The 28 days immediately prior to the Historical Performance Period cut-off~~

Term	Definition
~~Historical Performance Period cut-off~~ HPP (historical performance period)	~~5 business days prior to the date that AEMO is required to publish the data used to determine Default Contribution Factors under NER 3.15.6AA(i)~~A seven-day period, starting at 12:00 AM on a Sunday and ending at 12:00 AM on the following Sunday, which concludes 14 days prior to the commencement of the *billing period*, inclusive of the 5 business days' notice period, as referred to in NER 3.15.6AA(i).
Lower Performance	The performance in MWHz of the Residual or an *eligible unit* with *appropriate metering* where the FM is negative, in respect of *trading intervals* ~~where the Frequency Measure is negative~~.
Mainland	The part of the NEM comprising the regions of Queensland, New South Wales, Victoria and South Australia.
MMS Data Model	The interface to participants of data published by AEMO from the NEM system.
NEM	*National Electricity Market*.
NEMDE	National Electricity Market Dispatch Engine.
NER	National Electricity Rules~~, and~~. NER followed by a number refers to that numbered rule or clause of the NER.
~~Negative Contribution Factor~~NCF (negative contribution factor)	A ~~Contribution Factor capped at~~CF that is less than zero.
Performance	Collectively refers to Raise Performance and Lower Performance.
Power System Data Communication Standard	The standards and protocols determined by AEMO under NER 4.11.1 and 4.11.2(c).
Raise Performance	The performance in MWHz of the Residual or an *eligible unit* with *appropriate metering* where the FM is positive, in respect of *trading intervals* ~~where the Frequency Measure is positive~~.
~~RCR~~RCR (requirement for corrective response)	~~Requirement~~The requirement for corrective response~~,~~ as described in NER 3.15.6AA(g)(6~~)~~)(i).
Relevant Eligible Units	*Eligible units* located within a *region* that is included in a Regulation FCAS Requirement.
Reference Trajectory	The expected *active power* output or consumption of an *eligible unit* or the Residual, calculated in accordance with section 5~~5 of this Procedure~~.
Regulation FCAS	*Regulating lower service* and *regulating raise service*.
Regulation FCAS Requirement	A *market ancillary service requirement* for Regulation FCAS.
Residual	~~The aggregate of all relevant *eligible units*~~All Relevant Eligible Units without *appropriate metering*.
Residual Deviation	The aggregate deviation of the Residual.
Residual Performance	The aggregate Performance of the Residual.
SCADA	Supervisory control and data acquisition.
Usage or U	The proportion of Regulation FCAS that is deemed to be Used Regulation FCAS, calculated in accordance with section 8 ~~of this Procedure~~.
Unused Regulation FCAS	Regulation FCAS that is deemed to be unused and for which costs are ~~recovered~~determined in accordance with NER 3.15.6AA(d~~)~~).
Used Regulation FCAS	Regulation FCAS that is deemed ~~used~~to be Used and for which costs are ~~recovered~~determined in accordance with NER 3.15.6AA(c~~)~~).

1.2.2. Interpretation

This Procedure is subject to the principles of interpretation set out in Schedule 2 of the National Electricity Law.

1.3. Related documents

Reference	Title	Location
160-0392	Efficient Dispatch and Localised Recovery of Regulation Services Business Specification	~~https://www.aemo.com.au/-/media/files/electricity/nem/security_and_reliability/ancillary_services/0160-0049-pdf.pdf~~https://www.aemo.com.au/-/media/files/electricity/nem/security_and_reliability/ancillary_services/0160-0049-pdf.pdf
N.A.	Power System Data Communication Standard	~~https://aemo.com.au/-/media/files/electricity/nem/network_connections/transmission-and-distribution/aemo-standard-for-power-system-data-communications.pdf~~https://aemo.com.au/-/media/files/electricity/nem/network_connections/transmission-and-distribution/aemo-standard-for-power-system-data-communications.pdf
N.A.	Frequency Contribution Factor Tuning Parameters and Input Sources	~~[TBD] – will include weightings for FM, detail on where frequency will be obtained etc.~~https://aemo.com.au/energy-systems/electricity/national-electricity-market-nem/system-operations/ancillary-services/frequency-contribution-factors
N.A.	Guide to Ancillary Services in the National Electricity Market	~~https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/ancillary_services/guide-to-ancillary-services-in-the-national-electricity-market.pdf~~https://aemo.com.au/-/media/files/electricity/nem/security_and_reliability/ancillary_services/guide-to-ancillary-services-in-the-national-electricity-market.pdf
N.A.	MMS Data Model Reports	https://visualisations.aemo.com.au/aemo/di-help/Content/Data_Model/MMS_Data_Model.htm

2. Process overview

2.1. Frequency Performance Payments and Regulation FCAS

Frequency Performance Payments (**FPPs**) ~~are a financial mechanism that provides~~provide *Cost Recovery Market Participants* (among whom the costs of Regulation FCAS ~~may be~~are allocated) with an incentive to operate their *facilities* in a way that provides the *power system* with good primary *frequency* control, and a disincentive against operating in a way that negatively impacts *frequency*. It is a zero-sum system in which *Cost Recovery Market Participants* whose *eligible units* are determined to contribute to poor *frequency* outcomes fund payments ~~in respect of~~made to *Cost Recovery Market Participants* whose *eligible units* ~~with~~contributed to positive *frequency* performance.

~~Regulation FCAS is a *market ancillary service* that AEMO procures. It provides secondary *frequency* control designed to counteract small changes in *frequency*, and any accumulation of these changes over time.~~

For each *eligible unit*, each Regulation FCAS Requirement, and each *trading interval*, AEMO calculates a *trading amount* under ~~each of~~ the following ~~clauses of the NER~~provisions:

(a) NER 3.15.6AA(b) (~~Frequency Performance Payments~~FPPs payable to, or by, *Cost Recovery Market Participants*);

(b) NER 3.15.6AA(c) (~~payments to recover~~ Recovery of the ~~cost of~~ Used Regulation FCAS cost); and

(c) NER 3.15.6AA(d) (~~payments to recover~~ Recover of the ~~cost of~~ Unused Regulation FCAS cost).

2.2. Calculation overview

Broadly, the process ~~steps are~~undertaken for each *trading interval* is as follows:

1. For each *eligible unit* with *appropriate metering*, compare SCADA measurements with a Reference Trajectory to determine deviations from ~~the~~that trajectory. Calculate Residual ~~deviations~~Deviations based on the sum of deviations of *eligible units* with *appropriate metering*.
2. Determine the ~~Frequency Measure (~~FM~~),~~ which indicates whether there is a need to raise or lower *power system frequency*.
3. For each *eligible unit* with *appropriate metering* and the Residual, calculate Performance based on the FM and the deviations.
4. Calculate ~~Contribution Factors (CF)~~CFs for *eligible unit*s with *appropriate metering* and for the Residual ~~(RCF)~~ based on Performance.
5. Determine a price for FPPs based on the marginal ~~price~~cost of each Regulation FCAS Requirement ($P_{regulation}$~~).~~) as determined by the *market management systems*.
6. Determine the RCR ~~(requirement for corrective response) amount~~, which~~,~~ is multiplied ~~with~~by price~~, scales~~ to calculate the total amount of FPPs based on the amount of *frequency* response provided by *eligible units*.
7. Use the ~~Contribution Factors~~CFs for each *Cost Recovery Market Participant* to apportion FPPs.
8. Apportion the Residual ~~Contribution Factor~~CF to *eligible unit*s without *appropriate metering* pro rata, based on total *adjusted gross energy* amounts.
9. Calculate ~~usage of Regulation FCAS (U).~~Usage.
10. Apportion ~~costs~~the cost of Used Regulation FCAS to each *Cost Recovery Market Participant* on the basis of ~~Negative Contribution Factors (~~NCFs~~).~~.
11. Apportion the cost of Unused Regulation FCAS to each *Cost Recovery Market Participant* ~~on the basis of Default Contribution Factors (~~using DCFs~~).~~.

~~Note that for the purposes of this Procedure, relevant *eligible units* are *eligible units* that are located within a *region* that is included in the relevant Regulation FCAS Requirement.~~

Figure 1 shows the general workflow of this process~~.~~, excluding the application of any exceptions.

Figure 1 Flowchart of the general process

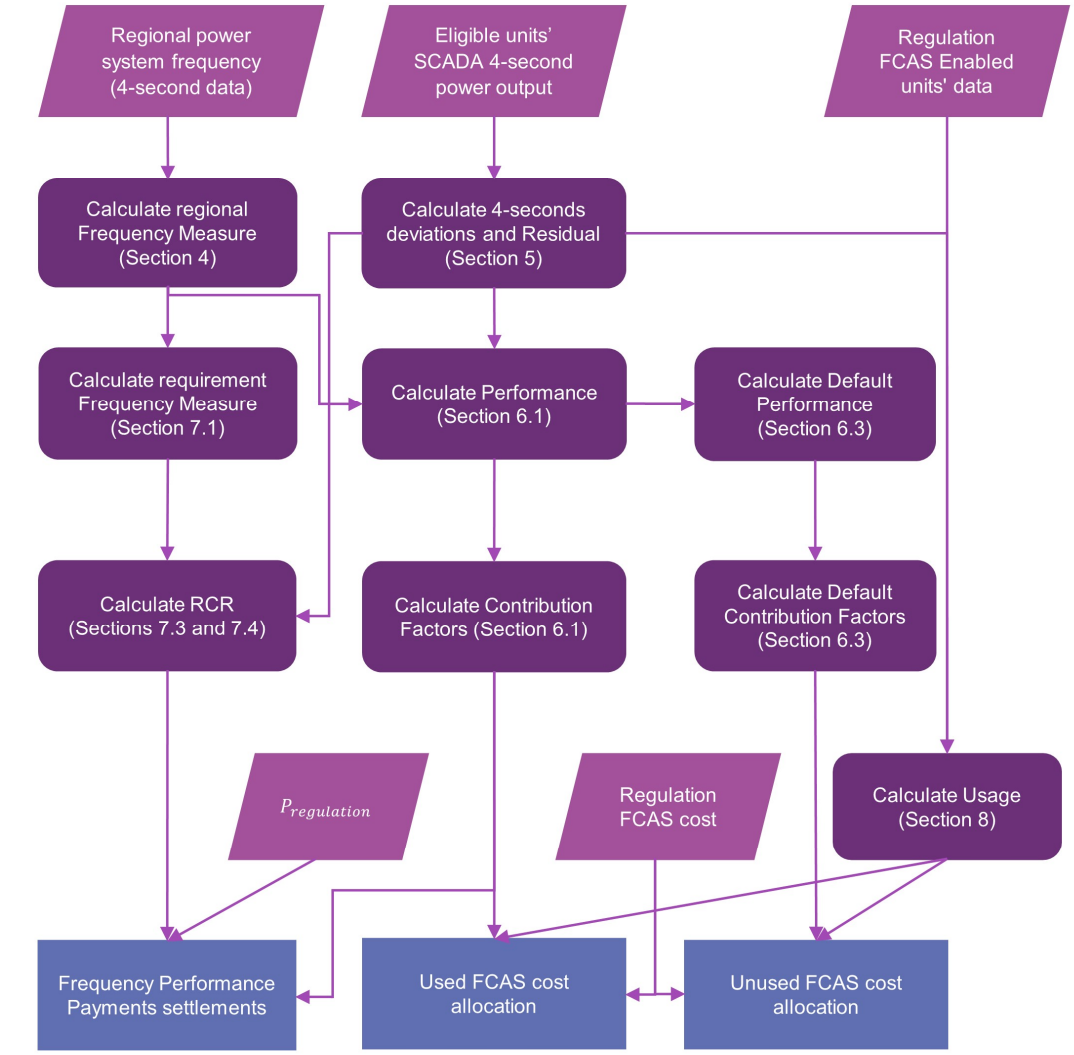


Table 2 details the equations that are used to determine the FPPs and the recovery of Regulation FCAS ~~cost, as per NER 3.16.5AA~~costs.

Figure 1 Flowchart of the general process

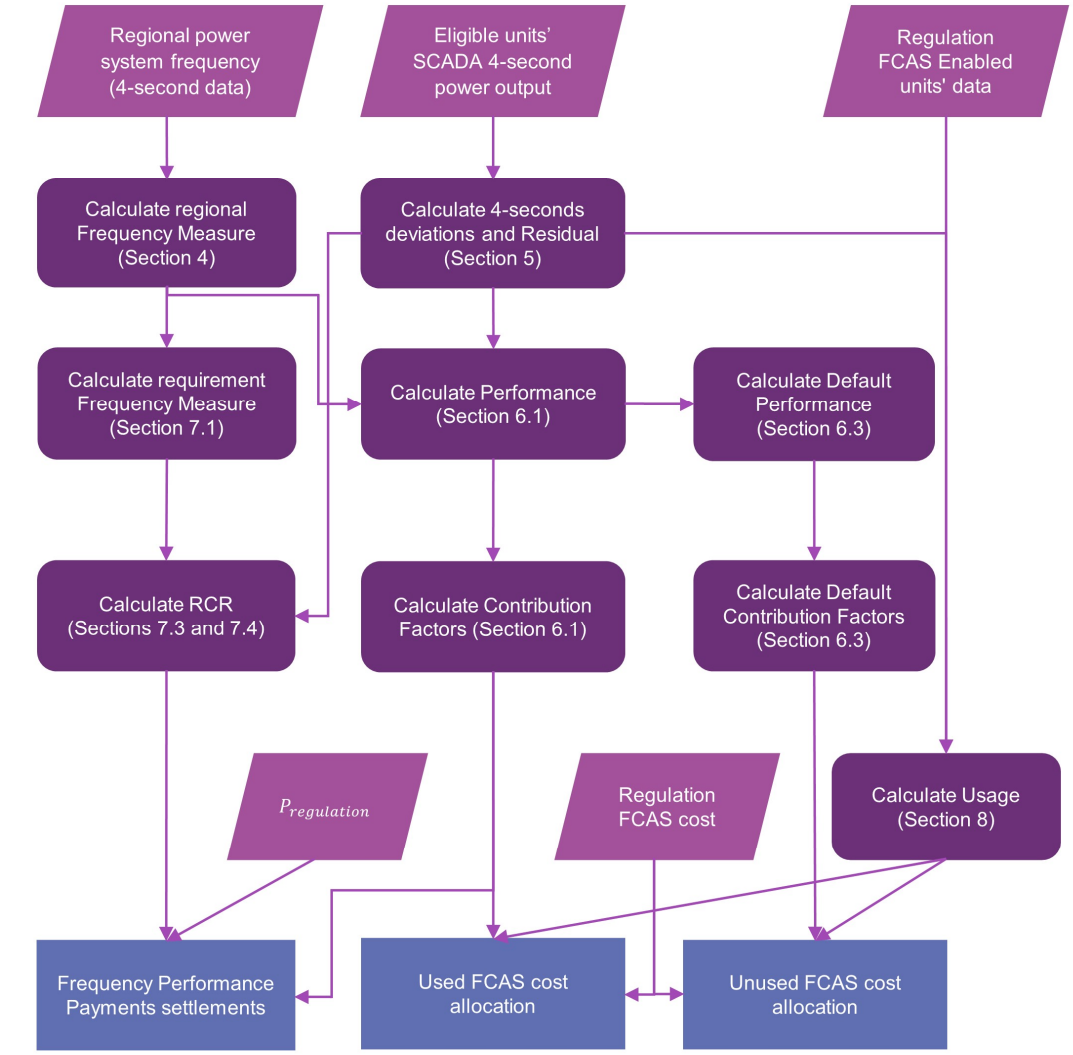


Table 2 Settlement equations

Trading Amounts	Eligible unit	Residual deviationDeviation
~~Frequency Performance Payments – 3.15.6AA (b)~~FPPs	NER 3.15.6AA-(b)(1)	NER 3.15.6AA-(b)(2)
	$TA = \boldsymbol{CF} \times \frac{P_{regulation}}{12} \times RCR$	$TA = \boldsymbol{RCF} \times \frac{P_{regulation}}{12} \times RCR \times \frac{TE}{ATE}$
Recovery of Used Regulation FCAS ~~that is "used" - 3.15.6AA (c)~~	NER 3.15.6AA-(c)(1)	NER 3.15.6AA-(c)(2)
	$TA = TSFCAS \times U \times \boldsymbol{NCF}$	$TA = TSFCAS \times U \times \boldsymbol{NRCF} \times \frac{TE}{ATE}$
Recovery of Unused Regulation FCAS ~~that is "unused" - 3.15.6AA (d)~~	NER 3.15.6AA-(d)(1)	NER 3.15.6AA-(d)(2)

Trading Amounts	Eligible unit	Residual deviationDeviation
	$TA = TSFCAS \times (1 - U) \times \boldsymbol{DCF}$	$TA = TSFCAS \times (1 - U) \times \boldsymbol{DRCF} \times \frac{TE}{ATE}$

2.3. Unit aggregation

Eligible units with *appropriate metering* that are aggregated must be in the same *region* and owned by the same financially responsible *Market Participant* of the same participant ID.

2.3.1. NER 3.8.3 bid aggregation

Eligible units with *appropriate metering* that have been aggregated under NER 3.8.3, will also be treated as aggregated units when determining their CFs.

2.3.1.2.3.2. Aggregation of eligible units for aggregated dispatch conformance

WhereIf, during a *trading interval*, two or more *eligible units* in an *integrated resource system* registerwith *appropriate metering* are registered to participate in "aggregated dispatch conformance"[1] under NER 4.9, for the purposes of this Procedure, they will be assessed as a single *eligible unit*, regardless of the status of their compliance mode in NEMDE "dispatch" for a specificthat *trading interval*.

2.3.2.2.3.3. Aggregation of other eligible units

AEMO may, where it considers appropriate, elect to assess the deviation of *eligible units* with *appropriate metering* with more than one NER classification as a single *eligible unit*. An example of where this would apply is with a battery system not registered as a bidirectional unit, which operates with more than one dispatchable unit identifier (**DUID**) and are classified as a *scheduled generating unit* and a *scheduled load*, but, physically, operate as one integrated unit.

3. Criteria for determining whether an eligible unit has appropriate metering

For a *trading interval*, an *eligible unit* will have '*appropriate metering*'*metering* if it has *remote monitoring equipment* that transmits the *active power* output or consumption of the *eligible unit* at its *connection point* to AEMO (in accordance with the Power System Data Communication Standard[2]) at intervals of not more than 4 seconds if the *eligible unit* is located in the Mainland area, and not more than 8 seconds if in Tasmania.

[1] As that term is defined in that provision.

[2] This document incorporates the standards and protocols determined under NER 4.11.1(a).

4. Determination of the need to raise or lower power system frequency

4.1. Formulation of Frequency Measure

For each ~~four~~4-second interval ~~(eight seconds for Tasmania),~~ AEMO determines ~~a Frequency Measure~~an FM based on the *frequency* of the *power system* that signals the direction (raise or lower) in which *eligible unit* deviations from the Reference Trajectory are helpful (helping to correct *power system frequency* towards 50 Hz), or unhelpful.

~~4.1.1.1. Formulation of Frequency Measure~~

Power system frequency, which is fed into the calculation of ~~the Frequency Measure~~FM, is measured uniquely for each *region* ~~in the NEM~~. For *regions* ~~that have multiple~~ with more than one suitable *frequency* measurement, multiple measurements~~, the average~~ will provide redundancy, but only one is used~~.~~ as the input for FM in the *region*.

The ~~Frequency Measure~~FM in ~~each~~a *region* is derived by applying an exponential weighted moving average filter (a low-pass filter) to the negative of the *frequency* deviations in the ~~relevant~~ *region*.

$$FM_t = (1 - \alpha)FM_{t-1} + \alpha(-FD_t)$$

~~Where~~where:

~~(a)~~ t is the index of 4-second ~~time~~ intervals;

~~(b)~~ FM_t is the ~~Frequency Measure~~FM at 4-second interval t;

~~(c)~~ FD_t is the real-time *frequency* deviation~~;~~ (difference between instantaneous frequency and 50Hz); and

~~(d)~~ α (alpha) is the smoothing factor, ~~a value~~which is between 0 and 1, as ~~defined~~specified in ~~the~~AEMO's document "Frequency Contribution Factor Tuning Parameters and Input Sources~~" document.~~".

4.2. Misalignment between FM and real-time frequency deviations

AEMO will exclude from the Performance calculation (sections 6.2.1 and 6.2.3) the 4-second intervals where FM and *frequency* deviations indicate opposite needs to raise or lower *power system frequency*. This happens when the FM and *frequency* deviation in a 4-second interval have the same sign, and *power system frequency* is outside the *primary frequency control band*.

~~4.2.~~4.3. Frequency Measure conditions

~~4.2.1.~~4.3.1. When the Frequency Measure is considered unreliable

~~A Frequency Measure~~An FM for *regulating raise services* will be considered unreliable for a *trading interval* if:

(a) there are ~~less~~fewer than ~~7 four~~seven 4-second intervals within a *trading interval* in which the ~~Frequency Measure~~FM is positive ~~(in respect of *regulating raise services*);~~ or ~~negative (in respect of *regulating lower services*);~~

(b) there are no ~~four~~4-second intervals within a *trading interval* where the ~~Frequency Measure~~FM is above 0.01 Hz ~~(in respect of~~.

An FM for *regulating lower services* will be considered unreliable for a *trading interval* if:

(c) there are less than seven 4-second intervals within a *trading interval* in which the FM is negative; or

(d) there are no 4-second intervals within a *trading interval* where the FM is below -0.01 Hz.

~~(b)~~ An FM for both *regulating raise services*~~) or below -0.01 Hz (in respect of~~ and *regulating lower services*~~);~~ will be considered unreliable for a *trading interval* if:

~~(c)~~(e) a system separation occurs and the AGC area does not align with the *dispatched* Regulation FCAS Requirement in NEMDE and a manual reconfiguration of AEMO's systems is required; or

~~(d)~~(f) a ~~large~~significant number of ~~SCADA~~raw frequency data points ~~have failed and it may not be possible to remediate these inputs and maintain accurate dispatch~~[3] are Bad Quality or missing within the *trading interval*.

~~4.2.2.~~4.3.2. Consequences of unreliable Frequency Measure

~~For~~In a *region*, for a *trading interval* where one or more of the conditions in section ~~4.2.1~~4.3.1 is met for *regulating raise services*:

(a) ~~all~~Raise Performance of all *eligible units* in the *region* is ~~null; and~~NULL;

(b) ~~the~~Raise RCR for any Regulation FCAS Requirement ~~that relates to~~which includes the ~~relevant~~ *region* is zero~~.~~; and

(c) Raise Usage for any Regulation FCAS Requirement which includes the *region* is zero.

In a *region*, for a *trading interval* where one or more of the conditions in section 4.3.1 is met for *regulating lower services*:

(d) Lower Performance of all *eligible units* in the *region* is NULL;

(e) Lower RCR for any Regulation FCAS Requirement which includes the *region* is zero; and

(f) Lower Usage for any Regulation FCAS Requirement which includes the *region* is zero.

Note:

A NULL Performance at a *trading interval* for an *eligible unit* with *appropriate metering* means no value is stored at the *trading interval*. As a result, the *trading interval* would not be included in the Historical Performance Period (**HPP**) used to determine the data for the DCFs of the *eligible unit*.

This applies to all ~~RCRs~~RCR and U values for a given Regulation FCAS Requirement even where the ~~Frequency Measure~~FM for other *regions* included in the same Regulation FCAS Requirement is not subject to ~~the same Requirement do not meet any~~ any of the conditions described in section ~~4.2.1.~~4.3.1.

[3] As defined in AEMO's Frequency Contribution Factor Tuning Parameters and Input Sources document.

5. Reference Trajectory and deviation calculation

~~Four~~AEMO calculates 4-second deviations (in MW) ~~are calculated~~ by comparing SCADA measurements against a Reference Trajectory ~~which~~that differs depending on the deviation source. The sign of deviations is always with respect to the relevant *region* ~~of the NEM~~ – a positive deviation is one that increases the net amount of energy within ~~the *power system*~~that *region* (more *generation* or less *load*) and vice versa for negative deviations. These calculations are described in the ~~next subsections.~~remainder of section 5.

5.1. Deviation of scheduled and semi-scheduled plants, and interconnectors

~~5.1.~~

The Reference Trajectory for *scheduled generating units, semi-scheduled generating units*, *scheduled loads*, *scheduled bidirectional units* and *interconnectors* is illustrated in Table 3.

Table 3 Scheduled generating units, semi-scheduled generating units, and scheduled loads

Reference ~~Trajectory~~trajectory	Actual ~~Measurement~~measurement	Example
Straight line between previous NEMDE *dispatch* target/*dispatch level* and current NEMDE *dispatch* target/*dispatch level*.	SCADA ~~metering~~ data for the eligible unit, load, or interconnector.	

Thus, for each *scheduled generating unit, semi-scheduled generating unit, scheduled load, scheduled bidirectional unit* or *interconnector,* the Reference Trajectory at 4-second interval t (Ref_t) and the deviation (Dev_t) are calculated as follows:

$$Ref_t = DT_{ti-1} + (DT_{ti} - DT_{ti-1}) \times \frac{t}{75}$$

$$Dev_t = Gen_t - Ref_t$$

~~Where~~where:

~~(a)~~ ti is the index of *trading intervals*;

~~(b)~~ t is the index of 4-second intervals during *trading interval* ti, which can be from 1 to 75;

~~(c)~~ DT_{ti} is the NEMDE *dispatch* target/*dispatch level* at *trading interval* ti; and

~~(d) Ref_t is the Reference Trajectory at 4-second interval t;~~

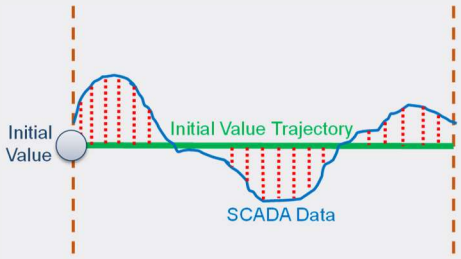
~~(e)~~ Gen_t is the SCADA metered value at 4-second interval t;.

~~(f) Dev_t is the deviation at 4-second interval t.~~

5.2. Deviation of ~~other eligible units~~non-scheduled plants with appropriate metering

The Reference Trajectory for *non-scheduled market generating* units, non-scheduled bidirectional *units* and non-scheduled *market loads* with *appropriate metering* is illustrated in Table 4.

Table 4 Non-scheduled generating units and non-scheduled loads with appropriate metering

Reference ~~Trajectory~~trajectory	Actual ~~Measurement~~measurement	Example
Continuation of SCADA metered value at the start of the current *trading interval*.	SCADA ~~metering~~ data for the *eligible unit* or *load*.	

Thus, for each *non-scheduled market generating unit*, non-scheduled bidirectional unit and non-scheduled *market load* with *appropriate metering*, the Reference Trajectory at 4-second interval t (Ref_t) and the deviation (Dev_t), are calculated as follows:

$$Ref_t = Gen_{ti-1}$$

$$Dev_t = Gen_t - Ref_t$$

~~Where~~where:

~~(a)~~ ti is the index of *trading intervals*;

~~(b)~~ t is the index of 4-second intervals during *trading interval* ti, which can be from 1 to 75;

~~(c) Ref_t is the Reference Trajectory at 4-second interval t;~~

~~(d)~~ Gen_t is the SCADA metered value at 4-second interval t; and

~~(e)~~ Gen_{ti-1} is the SCADA metered value in the last 4-second of *trading interval* $ti - 1$;.

~~(f) Dev_t is the deviation at 4-second interval t.~~

5.3. Residual ~~deviation~~Deviation

AEMO calculates the Residual ~~deviation~~Deviation and Performance ~~regionally. However~~on a *regional* basis, however, the Residual Performance of all *regions* included in each Regulation FCAS Requirement ~~are~~is aggregated before determining the ~~Contribution Factor~~CF and apportioning the FPPs and the costs of Regulation FCAS to the ~~relevant *eligible units*~~Relevant Eligible Units without *appropriate metering*. The Residual ~~deviation~~Deviation in *region* R at 4-second interval t ($Dev^R_{Res,t}$) is calculated as:

$$Dev^R_{Res,t} = -1 \times \left(\sum_m Dev_{m,t} + \sum_{ic} Dev_{ic,t} \right)$$

~~Where:~~

~~(a) R is the index of *regions*;~~

where:

~~(b)~~ m is the index of *eligible units* with *appropriate metering* in *region* R;

~~(c)~~ ic is the index of ~~inter-connectors~~*interconnectors* relevant to *region* R;

~~(d) $Dev^{R}_{Res,t}$ is the Residual in region R at 4-second interval t;~~

~~(e)~~ $Dev_{m,t}$ is the deviation of *eligible unit* m with *appropriate metering* ~~at 4-second interval t;~~in *region* R; and

~~(f)~~ $Dev_{ic,t}$ is the deviation of ~~inter-connector~~*interconnector* ic relevant to *region* R ~~at 4-second interval t~~.

~~6. Contribution Factors and Default Contribution Factors~~

~~6. Contribution Factors~~factors and ~~Default Contribution Factors~~default contribution factors

6.1. NER references

CFs and DCFs will be determined for each ~~relevant *eligible unit*~~Relevant Eligible Unit with *appropriate metering* and for the Residual, for use in the calculation of *trading amounts* under NER 3.15.6AA.

Table 5 Cross references from NER

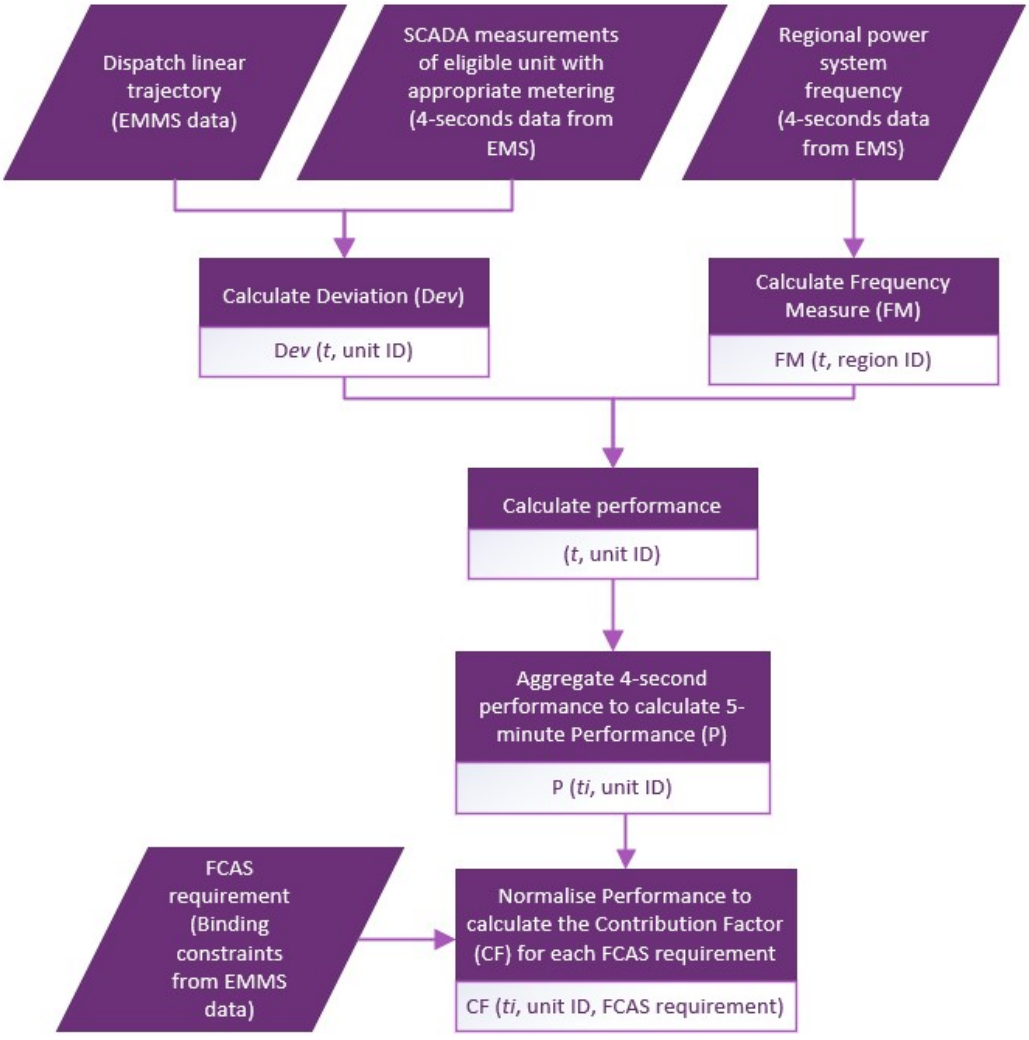
Relevant Rule	Variable in settlement equation	Cross-reference
3.15.6AA(b)	CF, RCF	Calculated under sections ~~6.1.2~~6.2.2 (for raise requirements) and 6.~~1~~2.4 (for lower requirements~~) of this Procedure.~~). There is no distinction ~~in this Procedure~~ between RCF and CF as they are calculated together in the same manner. The Residual is ~~effectively~~ treated as just another ~~*eligible unit*~~Relevant Eligible Unit with *appropriate metering* ~~for this purpose~~.
3.15.6AA(c)	NCF, NRCF	~~As above.~~Calculated under sections 6.2.2 (for raise requirements) and 6.2.4 (for lower requirements). There is no separate calculation for ~~Negative Contribution Factors; we simply ignore~~NCFs; AEMO ignores positive ~~Contribution Factors~~CFs when applying this ~~NER settlement~~ equation.
3.15.6AA(d)	DCF, DRCF	Calculated under section ~~6.3.1 of this Procedure.~~6.4.1. There is no distinction ~~in this Procedure~~ between DCF and DRCF as they are calculated together in the same manner. The Residual is ~~effectively~~ treated as ~~just~~if it

Relevant Rule	Variable in settlement equation	Cross-reference
		were another ~~eligible unit~~Relevant Eligible Unit with *appropriate metering* ~~for this purpose~~.

~~6.1.~~6.2. Calculation of Contribution Factors

Unless a ~~Default Contribution Factor~~DCF applies under section ~~6.2~~(6.4(b), the ~~Contribution Factors~~CFs for FPPs and the ~~Negative Contribution Factors~~NCFs for Used Regulation FCAS will be calculated in accordance with this section ~~6.1~~6.2.

Figure 2 Contribution Factor calculation process



~~6.1.1.~~6.2.1. Raise Performance

For a *trading interval*, the Raise Performance for each *eligible unit* with *appropriate metering* or Residual in *region* R ~~in each *trading interval*~~ (P^{raise}) is:

$$P^{raise} = \sum_{t=1}^{75} \max(0, FM_t^R) \times Dev_t$$

~~Where:~~

~~(a) P^{raise} is the Raise Performance of the *eligible unit* or Residual in the *trading interval*;~~

where:

~~(b)~~ t is the index of ~~four~~4-second intervals within the *trading interval;*

~~(c)~~ Dev_t is the deviation of *eligible units* with *appropriate metering* or Residual in MW at ~~four~~4-second interval t, as defined in section ~~5.3.~~5.3. The sign of the deviation is determined from the perspective of the relevant *region ~~or regions~~.(s).* A positive deviation represents a net addition of MW into the relevant *region ~~or regions~~,(s),* and vice versa for negative deviations; and

~~(d)~~ FM_t^R is the ~~Frequency Measure~~FM at ~~four~~4-second interval t in *region* R~~;~~.

~~(e)~~ Note that P^{raise} is ~~null~~NULL when:

(i) a condition under section ~~4.3~~4.2 applies;

(ii) where AEMO has ~~an~~ incomplete data ~~set (whether due to missing data or Bad SCADA)~~ for the ~~relevant~~ *eligible ~~unit~~units* with *appropriate metering*~~;~~ (under sections 9.1 or 9.2); or

(iii) AEMO is otherwise unable to calculate P^{raise}.

When P^{raise} is ~~null~~NULL, it will be substituted with a default Performance calculated under either section ~~6.3.2~~6.4.3 or ~~6.3.3~~,6.4.2, depending on whether the calculation is ~~for the purpose of~~under NER 3.15.6AA(~~c~~b) or 3.15.6AA(~~b) respectively.~~c).

~~6.1.2.~~6.2.2. Raise Contribution Factor

~~The~~ For a *trading interval*, the Raise Contribution Factor ~~($CF_{m,req}^{raise}$),~~ for each ~~*eligible unit*~~Relevant Eligible Unit with *appropriate metering* or Residual, m, for the *regulating raise service* of a Regulation FCAS Requirement ~~at each *trading interval*,~~ $(CF_{m,req}^{raise})$, is determined as follows:

$$AP_{req}^{raise} = \sum_{m} P_m^{raise}$$

$$CF_{m,req}^{raise} = \frac{P_m^{raise}}{AP_{req}^{raise}}$$

~~Where~~where:

~~(a)~~ m is the index of *eligible units* with *appropriate metering* and Residual that relate to Regulation FCAS Requirement req;

~~(b)~~ req is the index of Regulation FCAS Requirements;

~~(c)~~ P_m^{raise} is the Raise Performance of the ~~*eligible unit*~~Relevant Eligible Unit with *appropriate metering* or Residual, m~~, in the *trading interval*~~;; and

~~(d)~~ AP_{req}^{raise} is the absolute value of the sum of the Raise Performances (including Raise Performance that is substituted under section ~~6.2~~(6.3(b)) for all ~~relevant *eligible units*~~Relevant

Eligible Units with *appropriate metering* and the Residual in Regulation FCAS Requirement req, ~~that~~which have the same sign (positive or negative) as P_m^{raise}.

~~(e) $CF_{m,req}^{raise}$ is the raise Contribution Factor of the *eligible unit* or Residual, m, that relate to Regulation FCAS Requirement req in the *trading interval*.~~

~~6.1.3.~~6.2.3. Lower Performance

For a *trading interval*, the Lower Performance for each *eligible unit* with *appropriate metering* or Residual in *region* R ~~in each *trading interval*~~(P^{lower}) is:

$$P^{lower} = \sum_{t=1}^{75} \min(0, FM_t^R) \times Dev_t$$

~~Where:~~

~~P^{lower}~~where:

t is the ~~Lower Performance~~index of ~~the~~4-second intervals within the *trading interval;*

~~(a)~~ Dev_t is the deviation of *eligible* ~~*unit*~~*units* with *appropriate metering* or Residual in ~~the *trading interval*~~;MW at 4-second interval t, as defined in section 5.3. The sign of the deviation is determined from the perspective of the relevant *region(s)*. A positive deviation represents a net addition of MW into the relevant *region(s)*, and vice versa for negative deviations; and

~~(b) t is as defined in section 6.1.1;~~

~~(c) Dev_t is as defined in section 6.1.1;~~

~~(d)~~ FM_t^R is ~~as defined in section 6.1.1;~~the FM at 4-second interval t in *region* R.

~~(e)~~ Note that P^{lower} is ~~null~~NULL when:

(i) a condition under section ~~4.2~~4.3 applies;

(ii) where AEMO has ~~an~~ incomplete data ~~set (whether due to missing data or Bad SCADA) for the relevant~~ for the *eligible* ~~*unit*~~*units* with *appropriate metering*~~;~~ (under sections 9.1 or 9.2); or

(iii) AEMO is otherwise unable to calculate P^{lower}.

When P^{lower} is ~~null~~NULL, it will be substituted with a default Performance calculated under either section ~~6.3.2~~6.4.3 or ~~6.3.3,~~6.4.2, depending on whether the calculation is ~~for the purpose of~~under NER 3.15.6AA(~~c~~b) or 3.15.6AA(~~b) respectively.~~c).

~~6.1.4.~~6.2.4. Lower Contribution Factor

~~The~~ For a *trading interval*, the Lower Contribution Factor ~~($CF_{m,req}^{lower}$),~~ for each ~~*eligible unit*~~Relevant Eligible Unit with *appropriate metering* or Residual ~~for the *regulating lower service*~~, m, of a Regulation FCAS Requirement ~~at each *trading interval*,~~ req ($CF_{m,req}^{lower}$), is determined as follows:

$$AP_{req}^{lower} = \sum_{m} P_m^{lower}$$

$$CF_{m,req}^{lower} = \frac{P_m^{lower}}{AP_{req}^{lower}}$$

~~Where~~where:

~~(a)~~ m is the index of *eligible units* with *appropriate metering* and Residual that relate to Regulation FCAS Requirement req;

~~(b) req is the index of Regulation FCAS Requirements;~~

~~(c)~~ P_m^{lower} is the Lower Performance of the ~~*eligible unit*~~Relevant Eligible Unit with *appropriate metering* or Residual, m, in the *trading interval*; and

~~(d)~~ AP_{req}^{lower} is the absolute value of the sum of the Lower Performances (including Lower Performance ~~that is~~ substituted under section ~~6.2~~(6.3(b)) for all ~~relevant *eligible units*~~Relevant Eligible Units with *appropriate metering* and the Residual in Regulation FCAS Requirement req, ~~that~~which have the same sign (positive or negative) as P_m^{lower};.

~~(e) $CF_{m,req}^{lower}$ is the lower Contribution Factor of the *eligible unit* or Residual, m, that relate to Regulation FCAS Requirement req in the *trading interval*.~~

~~6.2.~~6.3. Application of Default Contribution Factors

~~Default Contribution Factors~~DCFs will be applied:

(a) to determine the *trading amount* payable by *a Cost Recovery Market Participant* ~~in respect of~~for each *eligible unit* under NER 3.15.6AA(d); and

(b) to determine a *trading amount* payable by a *Cost Recovery Market Participant* under NER 3.15.6AA(b) or (c), where Performance, calculated under section ~~6.1, is null~~6.2, is NULL.

~~Note that Default Contribution Factors~~DCFs will be calculated differently depending on whether they are applied under NER 3.15.6AA(b), ~~or NER~~ 3.15.6AA(c), or ~~NER~~ 3.15.6AA(d).

~~6.3.~~6.4. Calculation of Default Contribution Factors

~~Default Contribution Factors~~DCFs are based on Performance during the ~~Historical Performance Period (defined in the glossary). Note that Default Contribution Factors~~HPP and can only be used to determine *trading amounts* payable by (not to) a *Cost Recovery Market Participant* ~~and therefore~~. Therefore, the Performance value for all ~~Default Contribution Factors~~DCFs is capped at zero.

~~6.3.1.~~6.4.1. Calculation of a Default Contribution Factor for the purposes of NER 3.15.6AA(d)

Raise Performance for Default Contribution Factors

Raise Performance for ~~Default Contribution Factors~~DCFs applied under NER 3.15.6AA(d) for each *eligible unit* with *appropriate metering* or the Residual in a *region* ~~is:~~($P_{raise}^{default}$) is:

$$P_{raise}^{default} = \frac{\sum_{ti} \min(0, P_{ti}^{raise})}{H_{raise}}$$

~~Where:~~

~~(a) $P_{raise}^{default}$ is the Raise Performance for Default Contribution Factors under this section;~~

where:

~~(b)~~ H_{raise} is the number of *trading intervals* that have a Raise Performance value for the ~~relevant~~ *eligible unit* with *appropriate metering* or the Residual within the ~~Historical Performance Period~~HPP;

~~(c)~~ ti is the index of *trading intervals* amongst the ~~set of~~ *trading intervals* that have a Raise Performance value for the ~~relevant~~ *eligible unit* with *appropriate metering* or Residual within the ~~Historical Performance Period;~~HPP; and

~~(d)~~ P_{ti}^{raise} ~~is as defined~~is the Raise Performance of the *eligible unit* with *appropriate metering* or Residual in ~~section 6.1.1 at~~ *trading interval* ti.

Raise Default Contribution Factor~~:~~

For each *trading interval*, the Raise ~~Default Contribution Factor~~DCF for each ~~*eligible unit*~~Relevant Eligible Unit with *appropriate metering* or Residual for the *regulating raise service* of a Regulation FCAS Requirement ~~at each *trading interval*~~(DCF_{raise}) is:

$$DCF_{raise} = \frac{P_{raise}^{default}}{AP_{raise}^{default}}$$

~~Where:~~

~~(a) DCF_{raise} is the Default Contribution Factor under this section in respect of the *regulating raise service* of a Regulation FCAS Requirement;~~

where:

~~(b)~~ $P_{raise}^{default}$ ~~is as defined above;~~is the Raise Performance for DCFs for the Relevant Eligible Unit with appropriate metering or Residual; and

~~(c)~~ $AP_{raise}^{default}$ is the absolute value of the sum of the Raise Performance for ~~Default Contribution Factors under this section~~DCFs for all ~~relevant *eligible units*~~Relevant Eligible Units with *appropriate metering* and the Residual that relate to a Regulation FCAS Requirement.

Lower Performance for Default Contribution Factors

Lower Performance for ~~Default Contribution Factors~~DCFs applied under NER 3.15.6AA(d) for each *eligible unit* with *appropriate metering* or the Residual in a *region* ~~is:~~(P_{lower}^{defau}) is:

$$P_{lower}^{default} = \frac{\sum_{ti} \min(0, P_{ti}^{lower})}{H_{lower}}$$

~~Where:~~

~~(a) $P_{lower}^{default}$ is the Lower Performance for Default Contribution Factors under this section;~~

where:

~~(b)~~ H_{lower} is the number of *trading intervals* that have a Lower Performance value for the ~~relevant~~ *eligible unit* with *appropriate metering* or the Residual within the ~~Historical Performance Period;~~HPP;

~~(c)~~ ti is the index of a *trading interval* amongst the ~~set of~~ *trading intervals* that have a Lower Performance value for the ~~relevant~~ *eligible unit* with *appropriate metering* or Residual within the ~~Historical Performance Period;~~HPP; and

(d) P_{ti}^{lower} is as defined in section 6.1.3 for is the Lower Performance of the *eligible unit* with *appropriate metering* or Residual for *trading interval* ti.

Lower Default Contribution Factor:

For each *trading interval*, the Lower Default Contribution FactorDCF for each *eligible unit*Relevant Eligible Unit with *appropriate metering* or Residual for the *regulating lower service* of a Regulation FCAS Requirement at each *trading interval*(DCF_{lower}) is:

$$DCF_{lower} = \frac{P_{lower}^{default}}{AP_{lower}^{default}}$$

Where:

(a) DCF_{lower} is the Default Contribution Factor under this section in respect of the *regulating lower service* of a Regulation FCAS Requirement;

where:

(b) $P_{lower}^{default}$ is as defined above; is the Lower Performance for DCF for the Relevant Eligible Unit with appropriate metering or Residual; and

(c) $AP_{lower}^{default}$ is the absolute value of the sum of the Lower Performance for Default Contribution Factors under this sectionDCFs for all relevant *eligible units*Relevant Eligible Units with *appropriate metering* and the Residual that relate to a Regulation FCAS Requirement.

6.3.2.6.4.2. Calculation of a Default Contribution Factor for NER 3.15.6AA(c)

A Default Contribution FactorDCF applied under NER 3.15.6AA(c) is calculated in the same manner as a Contribution FactorCF under section 6.16.2, except that Performance (P_{raise} or P_{lower}) of the *eligible unit* with *appropriate metering* or Residual is substituted with the Performance calculated under this section 6.4.2 ($P_{raise}^{substitute}$ and $P_{lower}^{substitute}$).

Raise Performance

$$P_{raise}^{substitute} = \frac{\sum_{ti} \min(0, P_{ti}^{raise})}{H_{raise}}$$

Wherewhere:

(d) $P_{raise}^{substitute}$ is the value that will be substituted for Raise Performance of the *eligible unit* with *appropriate metering* or Residual under this section;

(e) H_{raise} is as defined in section 6.3.1;

ti is the index of a *trading interval* amongst the setthe number of *trading intervals* that have a Raise Performance value for the relevant *eligible unit* with *appropriate metering* or the Residual within the HistoricalHPP;

(f) ti is the index of a *trading interval* amongst the *trading intervals* that have a Raise Performance Period;value for the *eligible unit* with *appropriate metering* or Residual within the HPP; and

(g) P_{ti}^{raise} is as defined in section 6.1.1 forthe Raise Performance of the *eligible unit* with *appropriate metering* or Residual in *trading interval* ti.

Lower Performance

$$P_{lower}^{substitute} = \frac{\sum_{ti} \min(0, P_{ti}^{lower})}{H_{lower}}$$

~~Where~~where:

~~(h)~~ $P_{lower}^{substitute}$ is the value that will be substituted for Lower Performance of the *eligible unit* with *appropriate metering* or Residual under this section;

~~(i)~~ H_{lower} is ~~as defined in section 6.3.1;~~

~~(j)~~ ~~ti is the index of a *trading interval* amongst the set~~the number of *trading intervals* that have a Lower Performance value for the ~~relevant~~ *eligible unit* with *appropriate metering* or the Residual within the ~~Historical Performance Period~~HPP;

ti is the index of a *trading interval* amongst the *trading intervals* that have a Lower Performance value for the *eligible unit* with *appropriate metering* or Residual within the HPP; and

~~(k)~~ P_{ti}^{lower} is ~~as defined in section 6.1.3 for~~ the Lower Performance of the *eligible unit* with *appropriate metering* or Residual in *trading interval* ~~ti~~.

~~6.3.3.~~6.4.3. Calculation of a Default Contribution Factor for NER 3.15.6AA(b)

A ~~Default Contribution Factor applied~~DCF under NER 3.15.6AA(b) is calculated in the same manner as a ~~Contribution Factor~~CF under section ~~6.1~~6.2, except that Performance (P_{raise} or P_{lower}) of the *eligible unit* with *appropriate metering* or Residual is substituted with the Performance calculated under this section 6.4.3 ($P_{raise}^{substitute}$ and $P_{lower}^{substitute}$).

Raise Performance

$$P_{raise}^{substitute} = \min(0, \frac{\sum_{ti} P_{ti}^{raise}}{H_{raise}})$$

~~Where~~where:

~~(a)~~ $P_{raise}^{substitute}$ is the value that will be substituted for Raise Performance under this section of the *eligible unit* with *appropriate metering* or Residual under this section;

~~(b)~~ H_{raise} is ~~as defined in section 6.3.1;~~

~~*ti* is the index of a *trading interval* amongst the set~~the number of *trading intervals* that have a Raise Performance value for the ~~relevant~~ *eligible unit* with *appropriate metering* or the Residual within the ~~Historical~~HPP;

~~(c)~~ ti is the index of a *trading interval* amongst the *trading intervals* that have a Raise Performance ~~Period;~~value for the *eligible unit* with *appropriate metering* or Residual within the HPP; and

~~(d)~~ P_{ti}^{raise} is ~~as defined in section 6.1.1 for~~the Raise Performance of the *eligible unit* with *appropriate metering* or Residual in *trading interval* ti.

Lower Performance

$$P_{lower}^{substitute} = \min(0, \frac{\sum_{ti} P_{ti}^{lower}}{H_{lower}})$$

~~Where~~where:

~~(e)~~ $P_{lower}^{substitute}$ is the value that will be substituted for Lower Performance of the *eligible unit* with *appropriate metering* or Residual under this section;

~~(f)~~ H_{lower} is ~~as defined in section 6.3.1;~~

~~(g)~~ ~~ti is the index of a *trading interval* amongst the set~~the number of *trading intervals* that have a Lower Performance value for the ~~relevant~~ *eligible unit* with *appropriate metering* or the Residual within the ~~Historical Performance Period~~HPP;

ti is the index of a *trading interval* amongst the *trading intervals* that have a Lower Performance value for the *eligible unit* with *appropriate metering* or Residual within the HPP; and

~~(h)~~ P_{ti}^{lower} is ~~as defined in section 6.1.3~~the Lower Performance of the *eligible unit* with *appropriate metering* or Residual for *trading interval* ~~ti~~.

~~6.3.4.~~6.4.4. ~~No~~not enough historical data to calculate a Default Contribution Factor

~~Where there is no historical data within the relevant time frame that can be used to calculate a Default Contribution Factor, the Default Contribution Factor will be zero.~~

Within an HPP, if an *eligible unit* with *appropriate metering* does not have Raise or Lower Performance values in a significant number of *trading intervals*[4], AEMO will use the data from the last HPP in which the unit has Performance values in a significant number of *trading intervals* to determine its Raise or Lower DCFs applied under NER 3.15.6AA(b), 3.15.6AA(c), and 3.15.6AA(d).

If there is no HPP in which an *eligible unit* with *appropriate metering* has Performance values in a significant number of *trading intervals*[5], the DCFs applied under NER 3.15.6AA(b), 3.15.6AA(c), and 3.15.6AA(d) for the *eligible unit* in all Regulation FCAS Requirements will be zero.

7. Requirement for Corrective Response

The RCR is used to scale FPPs in accordance with ~~clause~~NER 3.15.6AA(b) and is determined separately for *trading amounts* ~~in respect of~~for *regulating raise* ~~*service*~~*services* and *regulating lower* ~~*service*~~*services*.

7.1. Frequency Measure for RCR

AEMO calculates the ~~Frequency Measure~~FM relevant to a Regulation FCAS Requirement for the purpose of calculating the RCR ~~calculation~~ based on a weighted average of ~~Frequency Measures~~FMs in the relevant *regions*, where the weight of each *region* is ~~generally associated with~~ the ~~*power system* inertia~~total amount of generation in the *region* for the *trading interval*.

[4] As defined in AEMO's Frequency Contribution Factor Tuning Parameters and Input Sources document.

[5] As defined in AEMO's Frequency Contribution Factor Tuning Parameters and Input Sources document.

7.2. Residual ~~deviation~~Deviation for RCR

~~The~~Within a *trading interval*, the Residual ~~deviation~~Deviation ($Dev_{Res,t}^{req}$) relevant to Regulation FCAS Requirement req at 4-second interval t is determined as follows:

$$Dev_{Res,t}^{req} = -1 \times \left(\sum_{m} Dev_{m,t} \right)$$

~~Where~~where:

~~(a)~~ t is the index of 4-second intervals within the *trading interval*;

~~(b)~~ req is the index of Regulation FCAS Requirements;

~~(c)~~ m is the index of *eligible units* with *appropriate metering* that relate to Regulation FCAS Requirement req; and

~~(d)~~ $Dev_{m,t}$ is the deviation of *eligible* ~~*unit*~~*units* with *appropriate metering* m at 4-second interval t.

7.3. Raise RCR

Subject to sections 4.3~~4.2~~ and 7.5~~7.5~~, for each *trading interval*, in respect of *regulating raise services*, ~~at each trading interval~~the Raise RCR in MW for Regulation FCAS Requirement req (RCR_{req}^{raise}) is determined as follows:

$$SumPosDev_{t}^{req} = \sum_{m} \max(0, Dev_{m,t}) + \max(0, Dev_{Res,t}^{req})$$

$$RCR_{req}^{raise} = \max \begin{pmatrix} SumPosDev_{t}^{req} \\ where\ FM_{t}^{req} > 0 \end{pmatrix}$$

~~Where~~where:

~~(a)~~ t is the index of 4-second intervals within the *trading interval*;

~~(b)~~ req is the index of Regulation FCAS Requirements;

~~(c)~~ m is the index of *eligible units* with *appropriate metering* that relate to Regulation FCAS Requirement req;

~~(d)~~ $Dev_{m,t}$ is the deviation of an *eligible unit* with *appropriate metering* m at 4-second interval t;

~~(e)~~ $Dev_{Res,t}^{req}$ is Residual ~~deviation~~Deviation relevant to Regulation FCAS Requirement req at 4-second interval t;

~~(f)~~ $SumPosDev_{t}^{req}$ is the sum of all positive deviations and Residual, if positive, in MW, that relate to Regulation FCAS Requirement req at 4-second interval t; and

~~(g) RCR_{req}^{raise} is the raise RCR in MW for Regulation FCAS Requirement req in the trading interval;~~

~~(h)~~ FM_{t}^{req} is the ~~Frequency Measure~~FM relevant to Regulation FCAS Requirement req at 4-second interval t.

7.4. Lower RCR

Subject to sections 4.34.2 and 7.57.5, for each *trading interval,* in respect of *regulating lower services*, at each trading intervalthe Lower RCR in MW for Regulation FCAS Requirement req (RCR_{req}^{lower}) is determined as follows:

$$SumNegDev_t^{req} = \sum_m \min(0, Dev_{m,t}) + \min(0, Dev_{Res,t}^{req})$$

$$RCR_{req}^{lower} = -\min\begin{pmatrix} SumNegDev_t^{req} \\ where\ FM_t^{req} < 0 \end{pmatrix}$$

Wherewhere:

(a) t is the index of 4-second intervals within the *trading interval*;

(b) req is the index of Regulation FCAS Requirements;

(c) m is the index of *eligible units* with *appropriate metering* that relate to Regulation FCAS Requirement req;

(d) $Dev_{m,t}$ is the deviation of *eligible unit* with *appropriate metering* m at 4-second interval t;

(e) $Dev_{Res,t}^{req}$ is Residual deviationDeviation relevant to Regulation FCAS Requirement req at 4-second interval t;

(f) $SumNegDev_t^{req}$ is the sum of all negative deviations and Residual, if negative, in MW, that relate to Regulation FCAS Requirement req at 4-second interval t; and

(g) RCR_{req}^{lower} is the lower RCR in MW for Regulation FCAS Requirement req in the trading interval;

(h) FM_t^{req} is the Frequency MeasureFM relevant to Regulation FCAS Requirement req at 4-second interval t.

7.5. Exceptions related to RCR

7.5.1. Global requirements

For a *global market ancillary service requirement*, the sum of the gross values (MW) of all deviations at each 4-second interval will be considered in the RCR calculation only when the Frequency MeasureFMs relevant to the Mainland NEM and Tasmania are aligned during the *trading interval*. (i.e., have the same sign).

7.5.2. General exceptions

(a) Where AEMO is:

(a)(i) unable to calculate the Performance of the relevant Residual; or

(b)(ii) otherwise unable to calculate the RCR for any reason,

the RCR will be deemed equal to zero.

~~7.5.3. RCR cap~~

~~If the raise or lower RCR relating to a Regulation FCAS Requirement, calculated as defined in sections 7.3 or 7.4, is higher than the relevant RCR cap, the RCR will be set to the cap. The RCR cap of a Regulation FCAS Requirement is determined as:~~

$$CapRCR_{req}^{raise} = k \times regLHS_{req}^{raise}$$

$$CapRCR_{req}^{lower} = k \times regLHS_{req}^{lower}$$

~~Where:~~

~~(a) req is the index of Regulation FCAS Requirements;~~

~~(b) $CapRCR_{req}^{raise}$ is the raise RCR cap for Regulation FCAS Requirement req;~~

~~(c) $CapRCR_{req}^{lower}$ is the lower RCR cap for Regulation FCAS Requirement req;~~

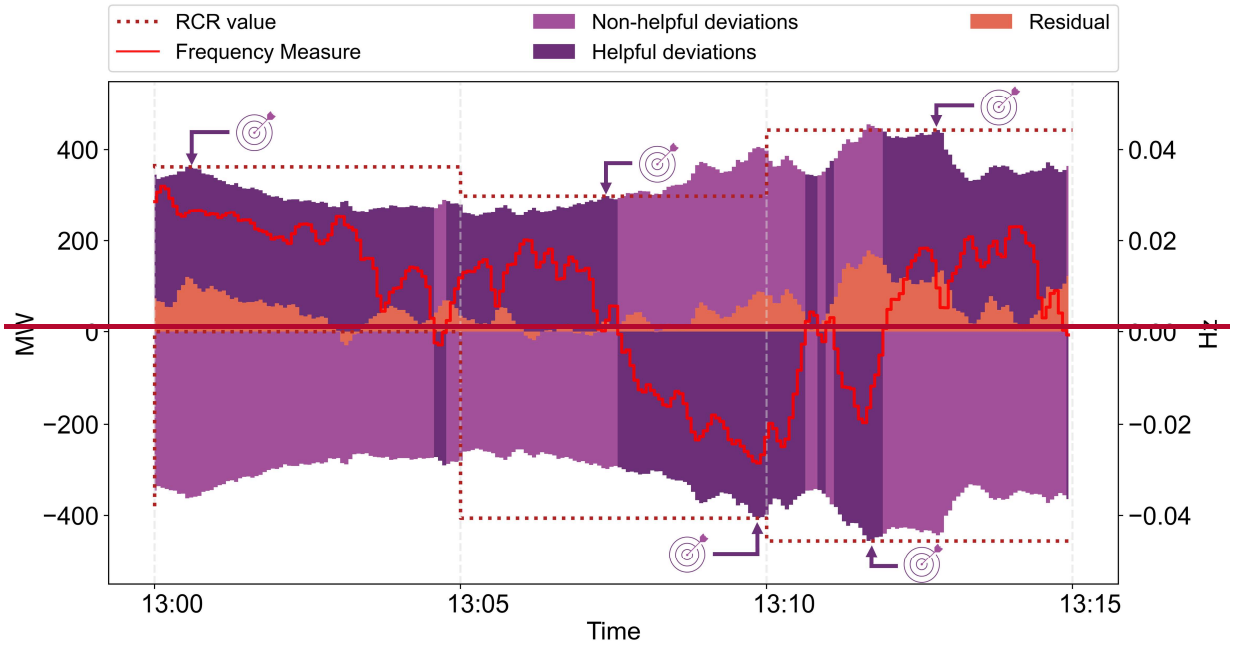
~~(d) $regLHS_{req}^{raise}$ is the summation of left-hand-side (LHS) terms that relate to the *regulating raise services* in the constraint that determines the Regulation FCAS Requirement req;~~

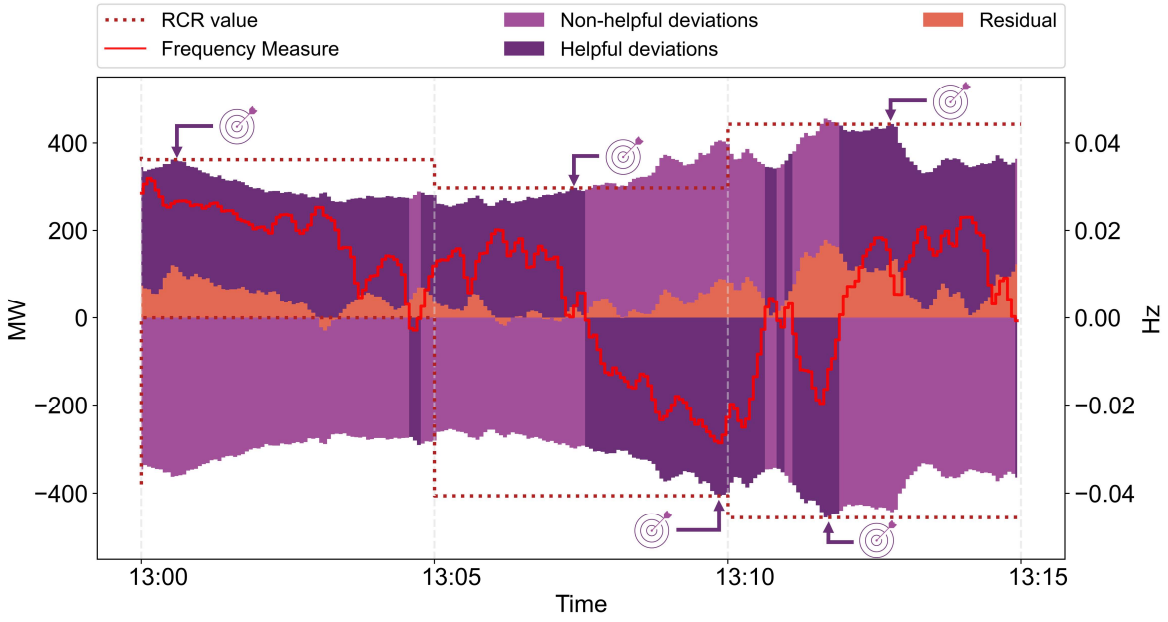
~~(e) $regLHS_{req}^{lower}$ is the summation of LHS terms that relate to the *regulating lower services* in the constraint that determines the Regulation FCAS Requirement req;~~

~~(f) k is a coefficient bigger than 2, as defined in the "Frequency Contribution Factor Tuning Parameters and Input Sources" document.~~

(b) AEMO may recalculate RCR in accordance with section 9.1.

Figure 3 RCR visual





8. Usage of Regulation FCAS

Usage is described in NER 3.15.6AA(g)(ii) as the proportion of *enabled* Regulation FCAS that contributes to reducing the deviation in *power system frequency*.

In section 8, Usage is a factor that ~~determines~~, for the purposes of ~~clauses~~NER 3.15.6AA(c) and (d~~) of~~), determines the ~~NER, what~~ percentage of Regulation FCAS costs ~~are~~to be recovered on the basis of ~~Negative Contribution Factors (that are~~ NCFs (based on measured performance within a *trading interval*) and ~~what~~the percentage ~~are~~to be recovered on the basis of ~~Default Contribution Factors~~DCFs.

8.1. Raise Usage

~~Subject to section 8.3, at each *trading interval*~~Subject to sections 4.3 and 8.3, for each *trading interval*, in respect of *regulating raise services*, the Raise Usage for Regulation FCAS Requirement req (U_{req}^{raise}) is determined as follows:

$$RegPosDev_t^{req} = \sum_m \min\left(RegEn_m^{raise}, \max(0, Dev_{m,t})\right)$$

$$U_{req}^{raise} = \frac{RegPosDev_t^{req}}{TotReg_{req}^{raise}}$$

~~Where~~where:

~~(a)~~ t is the index of 4-second intervals within the *trading interval*;

~~(b)~~ req is the index of Regulation FCAS Requirements in the *trading interval*;

~~(c)~~ m is the index of *eligible units* that relate to Regulation FCAS Requirement req and are *enabled* to provide the *regulating raise service* ~~in the *trading interval*~~;

~~(d)~~ $Dev_{m,t}$ is the deviation of *eligible unit* m at 4-second interval t;

~~(e)~~ $RegEn_m^{raise}$ is the amount of *enabled regulating raise service* for *eligible unit* m in *the trading interval*;

~~(f)~~ $RegPosDev_t^{req}$ is the sum of all positive deviations of ~~*eligible units* within relevant regions of~~Relevant Eligible Units for Regulation FCAS Requirement req that ~~are~~were *enabled* to provide the *regulating raise service* at 4-second interval t, where the deviation of each *eligible unit* is capped to its *enabled* amount; and

~~(g)~~ $TotReg_{req}^{raise}$ is the total amount of *enabled regulating raise service* that relates to Regulation FCAS Requirement req in the *trading interval*~~;~~.

~~(h) U_{req}^{raise} is the Usage for a *regulating raise service* that relates to Regulation FCAS Requirement req in the *trading interval*.~~

8.2. Lower Usage

Subject to ~~section 8.3, at each *trading interval*~~sections 4.3 and 8.3, for each *trading interval*, in respect of *regulating lower services*, the Lower Usage for Regulation FCAS Requirement req (U_{req}^{lower}) is determined as follows:

$$RegNegDev_t^{req} = \sum_m \min\left(RegEn_m^{lower}, -\min(0, Dev_{m,t})\right)$$

$$U_{req}^{lower} = \frac{RegNegDev_t^{req}}{TotReg_{req}^{lower}}$$

~~Where~~where:

~~(a)~~ t is the index of 4-second intervals within the *trading interval*;

~~(b)~~ req is the index of Regulation FCAS Requirements in the *trading interval*;

~~(c)~~ m is the index of *eligible units* that relate to Regulation FCAS Requirement req and are *enabled* to provide the *regulating lower service* in the *trading interval*;

~~(d)~~ $Dev_{m,t}$ is the deviation of *eligible unit* m at 4-second interval t;

~~(e)~~ $RegEn_m^{lower}$ is the amount of *enabled regulating lower service* for *eligible unit* m in the *trading interval*;

~~(f)~~ $RegNegDev_t^{req}$ is the sum of all negative deviations of ~~*eligible units* within relevant regions of~~Relevant Eligible Units for Regulation FCAS Requirement req that are *enabled* to provide the *regulating lower service* at 4-second interval t, where the deviation of each *eligible unit* is capped to its *enabled* amount; and

~~(g)~~ $TotReg_{req}^{lower}$ is the total amount of *enabled regulating lower service* that relates to Regulation FCAS Requirement req in the *trading interval*~~;~~.

~~(h) U_{req}^{lower} is the Usage for a *regulating lower service* that relates to Regulation FCAS Requirement req in the *trading interval*.~~

8.3. Exceptions related to Usage

(a) Where AEMO is unable to calculate Usage, Usage will be ~~deemed to be~~ zero.

(b) AEMO may recalculate Usage in accordance with section 9.1.

9. Bad Quality data

9.1. Impact of eligible unit with Bad Quality data

If the proportion of Bad Quality data points that AEMO receives for a Relevant Eligible Unit with *appropriate metering* during a *trading interval* is significant[6], AEMO will exclude the Relevant Eligible Unit from all calculations for that *trading interval* and then:

(a) Set its Performance to NULL and calculate its DCFs under section 6.4;

(b) recalculate the Residual Performance for all Regulation FCAS Requirements involving the Relevant Eligible Unit; and

(c) recalculate RCR, U, and CFs for all Regulation FCAS Requirements involving the Relevant Eligible Unit.

9.2. Impact of significant number of units with Bad Quality data

If a significant proportion[7] of Relevant Eligible Units with *appropriate metering* in a *region* contain more than significant Bad Quality data points, AEMO will not calculate the CFs for the Regulation FCAS Requirements that include the region and will recover the Regulation FCAS costs using DCFs.

~~9.~~10. Data provision

~~9.1.~~10.1. Data description and frequency

To the extent reasonably practicable, AEMO will make data relating to the determination and application of ~~Contribution Factors~~CFs available as outlined in Table 6~~:~~. These are in addition to the data that will be provided by settlement reports.

Table 6 Data provision

Timing	Data	Public~~/~~ or Private[8]	Comments	~~NER~~ Requirement
End of *billing period* minus 5 *business days*	**Data to determine ~~Default Contribution Factor~~DCF**			
	Default Raise Performance ($P_{raise}^{default}$)	Public	For DCFs applied under NER 3.15.6AA(d~~)~~). ~~Default factors fixed for a week~~ Same ~~factor for Substitute default~~as substitute Raise Performance ~~in~~for DCFs applied under NER 3.15.6AA(c~~)~~).	NER 3.15.6AA(i)
	Default Lower Performance ($P_{lower}^{default}$)	Public	For DCFs applied under NER 3.15.6AA(d~~)~~).	

[6] As defined in AEMO's Frequency Contribution Factor Tuning Parameters and Input Sources document.

[7] As defined in AEMO's Frequency Contribution Factor Tuning Parameters and Input Sources document.

[8] Public means that the data will be published on AEMO's website.

[9] Private means that notices will be issued confidentially to each affected *Registered Participant*.

Timing	Data	Public[4] or Private[5]	Comments	NER Requirement
			~~Default factors fixed for a week~~ Same ~~factor for Substitute default~~as substitute Lower Performance ~~in~~for DCFs applied under 3.15.6AA(c~~)~~).	
	Default Raise ~~Contribution Factor~~CF (DCF_{raise})	Public	NER 3.15.6AA(d)	
	Default Lower ~~Contribution Factor~~CF (DCF_{lower})	Public	NER 3.15.6AA(d)	
	Substitute ~~default~~ Raise Performance ($P_{raise}^{substitute}$)	Public	~~Applied for the purposes of~~For DCFs applied NER 3.15.6AA(b)	
	Substitute ~~default~~ Lower Performance ($P_{lower}^{substitute}$)	Public	~~Applied for the purposes of~~For DCFs applied NER 3.15.6AA(b)	
5 *business days* prior to application	**Parameters used to determine ~~Frequency Measure~~FM, RCR and ~~Usage~~U**			
	α (alpha) ~~Smoothing Factors~~smoothing factor of ~~EMA~~exponential weighted moving average	Public	For ~~frequency measure~~FM calculation	NER 3.15.6AA(j)
	~~RCR cap coefficients (k)~~	~~Public~~		~~3.15.6AA(j)~~
ASAP after start of *trading interval*	Unit target (MW)	Private	Published in Dispatchload table	NER 3.8.21
	FCAS Requirement	Public	Binding ~~constraints~~constraint equations and *regions*	
	TSFCAS	Public	Published as adjusted cost in FCAS_requirement table	
	$P_{regulation}$	Public	Published as marginal value in FCAS_requirement table	
ASAP after the FPP run	Raise ~~Contribution Factors~~RCFs (CF^{raise})	Public~~Private~~	5-minute per requirement	NER 3.15.6AA(k)(1)
	Lower RCFs (CF^{lower})	Public	5-minute per requirement	NER 3.15.6AA(k)(1)
	Raise CFs (CF^{raise})	Private	5-minute per requirement	NER 3.15.6AA(k)(1)
	Lower ~~Contribution Factors~~CFs (CF^{lower})	Private	5-minute per requirement	NER 3.15.6AA(k)(1)
	Raise or Lower RCR	Public	5-minute per requirement	NER 3.15.6AA(k)(3)
	Raise or Lower Usage	Public	5-minute per requirement	NER 3.15.6AA(k)(4)
	Data calculated from determining ~~Frequency Measure~~FM			
	Frequency deviation (FD)	Public	4-seconds per *region*	NER 3.15.6AA(k)(2)
	~~Frequency Measure (FM)~~FM	Public	4-seconds per *region*	
	FM for RCR	Public	4-seconds per requirement	
	Data to determine ~~Contribution Factor~~CF			
	~~Unit~~*Eligible unit* SCADA data	Private	4-seconds per *eligible unit*	NER 3.15.6AA(l)
	Deviation (Dev_t)	Private	4-seconds per *eligible unit*	
	Raise Performance (P^{raise})	Private	5-minute per *eligible unit*	
	Lower Performance (P^{lower})	Private	5-minute per *eligible unit*	
	Absolute sum of Raise ~~Performance~~Performances (AP^{raise}) with positive (AP^{+}) or negative sign (AP^{-})	Public	5-minute per requirement	

Timing	Data	Public[A] or Private[B]	Comments	NER Requirement
	Absolute sum of Lower PerformancePerformances (AP^{lower}) with positive (AP^{+}) or negative sign (AP^{-})	Public	5-minute per requirement	
	Residual Performance	Public	5-minute per requirement	N/A
	Settlements and relevant information (per requirement per 5-minute)			
	FPP payment rate per Performance ((\$/MWHz) of each *eligible unit* with *appropriate metering*	Public	(($P_{regulation}$ * RCR)/12) / AP $^{+}$	N/A
	FPP payment rate per total energy ((\$/MWh) of each *eligible unit* without *appropriate metering*	Public	(RCF * ($P_{regulation}$ * RCR)/12) / ATE	N/A
	FPP recovery rate per Performance ((\$/MWHz) of each *eligible unit* with *appropriate metering*	Public	(($P_{regulation}$ * RCR)/12) / AP $^{-}$	N/A
	FPP recovery rate per total energy ((\$/MWh) of each *eligible unit* without *appropriate metering*	Public	(RCF * ($P_{regulation}$ * RCR)/12) / ATE	N/A
	Used Regulation FCAS cost recovery rate per Performance ((\$/MWHz) of each *eligible unit* with *appropriate metering*	Public	(TSFCAS * U) / AP $^{-}$	N/A
	Use recovery rate per total energy ((\$/MWh) of each *eligible unit* without *appropriate metering*	Public	TSFCAS * U * NRCF / ATE	N/A
	Unused recovery rate per default Performance ((\$/MWHz) of each *eligible unit* with *appropriate metering*	Public	(TSFCAS *(1- U)) / AP $^{-(default)}$	N/A
	Unused recovery rate per total energy ((\$/MWh) of each *eligible unit* without *appropriate metering*	Public	TSFCAS * (1-U) * DRCF / ATE	N/A
	FPP \$(\$)	Private	NER 3.15.6AA(b)(1) known as TA	N/A
	Recovery of regulation used \$Used Regulation FCAS (\$)	Private	NER 3.15.6AA(c)(1) known as TA	N/A
	Recovery of regulation unused \$Unused Regulation FCAS (\$)	Private	NER 3.15.6AA(d)(1) known as TA	N/A
***Pre-dispatch* timeframes**	Estimates of recovery amounts of Regulation FCAS costs based on Default Contribution FactorsDCFs	Public		N/A

~~9.2.~~10.2. Failure to calculate and publish ~~contribution factors~~CFs within ~~X~~the required timeframe

~~[Placeholder] Proposal - that where AEMO fails~~NER 3.15.6AA(k) requires CFs to ~~publish contribution factors within a X mins of the end of a~~be *published* as soon as practicable after the relevant *trading interval*~~, no FPPs~~.

AEMO's systems are configured to retrieve relevant input data (as listed in sections 6.2.1 to 6.2.4) for the CF calculation for 30 minutes after the end of each *trading interval*. If AEMO's systems are unable to receive relevant data after that 30-minute period expires, the Performances of Relevant Eligible Units with *appropriate metering* and Residual will ~~take place and~~ be NULL, all ~~regulation~~Regulation FCAS costs will be allocated ~~on the basis of historical performance.~~to *eligible units* using DCFs, and no FPP will be due or paid.

When this occurs, AEMO will:

- issue a market notice; and
- inform affected *Registered Participants* via MMS Data Model that DCFs are being used for the relevant period.

If AEMO's inability to retrieve data applies only to specific *eligible units*, AEMO will only inform the affected *Registered Participants* via MMS Data Model.

Version release history

Version	Effective date	Summary of changes
1.0	1 June 2025	First issue