

DRAFT Frequency Contribution Factors Procedure

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Current version release details

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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 of the National Electricity Rules (NER). The contribution factors and other matters determined under 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); 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 the 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.

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	Automatic generation control system
Bad SCADA	Any SCADA data that is not 'Good Quality' as defined in the Power System Data Communication Standard
Contribution Factor	A factor calculated in accordance with section 6 of this Procedure and applied to an <i>eligible unit</i> (and includes a Default Contribution Factor unless otherwise specified).
Default Contribution Factor	A Contribution Factor determined in accordance with section 6.2 of this Procedure and applied to an <i>eligible unit</i> in the circumstances described in NER 3.15.6AA(g)(4)
Frequency Measure	The indication of need to raise or lower <i>frequency</i> calculated in accordance with section 4 of this Procedure
Frequency Performance Payment or FPP	A <i>trading amount</i> payable by or to a <i>Cost Recovery Market Participant</i> determined under NER 3.15.6AA(b)
Historical Performance Period	The 28 days immediately prior to the Historical Performance Period cut-off
Historical Performance Period cut-off	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)
Lower Performance	The performance in MWhz of the Residual or an <i>eligible unit</i> with appropriate metering in respect of <i>trading intervals</i> where the Frequency Measure is negative

Term	Definition
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	A Contribution Factor capped at zero.
Performance	Collectively refers to Raise Performance and Lower Performance
Raise Performance	The performance in MWhz of the Residual or an <i>eligible unit</i> with appropriate metering in respect of <i>trading intervals</i> where the Frequency Measure is positive
RCR	Requirement for corrective response, described in NER 3.15.6AA(g)(6)
Reference Trajectory	The expected <i>active power</i> output or consumption of an <i>eligible unit</i> or the Residual, calculated in accordance with section 5 of this Procedure
Regulation FCAS	<i>Regulating lower service</i> and <i>regulating raise service</i>
Regulation FCAS Requirement	A <i>market ancillary service requirement</i> for Regulation FCAS
Residual	The aggregate of all relevant <i>eligible units</i> without <i>appropriate metering</i>
SCADA	Supervisory control and data acquisition
Usage	The proportion of Regulation FCAS that is deemed Used Regulation FCAS, calculated in accordance with section 8 of this Procedure
Unused Regulation FCAS	Regulation FCAS that is deemed unused and for which costs are recovered in accordance with NER 3.15.6AA(d)
Used Regulation FCAS	Regulation FCAS that is deemed used and for which costs are recovered 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
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
N.A.	Frequency Contribution Factor Tuning Parameters and Input Sources	[TBD] – will include weightings for FM, detail on where frequency will be obtained etc.
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

2. Process overview

2.1. Frequency Performance Payments and Regulation FCAS

Frequency Performance Payments (FPPs) are a financial mechanism that provides *Cost Recovery Market Participants* (among whom the costs of Regulation FCAS may be 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 units are determined to contribute to poor *frequency* outcomes fund payments in respect of units with 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:

- (a) 3.15.6AA(b) (Frequency Performance Payments payable to or by *Cost Recovery Market Participants*);
- (b) 3.15.6AA(c) (payments to recover the cost of Used Regulation FCAS); and
- (c) 3.15.6AA(d) (payments to recover the cost of Unused Regulation FCAS).

2.2. Calculation overview

Broadly, the process steps are as follows:

1. For each *eligible unit* with *appropriate metering*, compare SCADA measurements with a Reference Trajectory to determine deviations from the trajectory. Calculate Residual 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 *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) for *eligible units* with *appropriate metering* and for the Residual (RCF) based on Performance.
5. Determine a price for FPPs based on the marginal price of each Regulation FCAS Requirement ($P_{\text{regulation}}$).
6. Determine the RCR (requirement for corrective response) amount which, multiplied with price, scales the total amount of FPPs based on the amount of *frequency* response provided.
7. Use the Contribution Factors for each *Cost Recovery Market Participant* to apportion FPPs.
8. Apportion the Residual Contribution Factor to *eligible units* without *appropriate metering* pro rata, based on total *adjusted gross energy* amounts.

9. Calculate usage of Regulation FCAS (U).
10. Apportion costs 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 (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.

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.

Figure 1 Flowchart of the general process

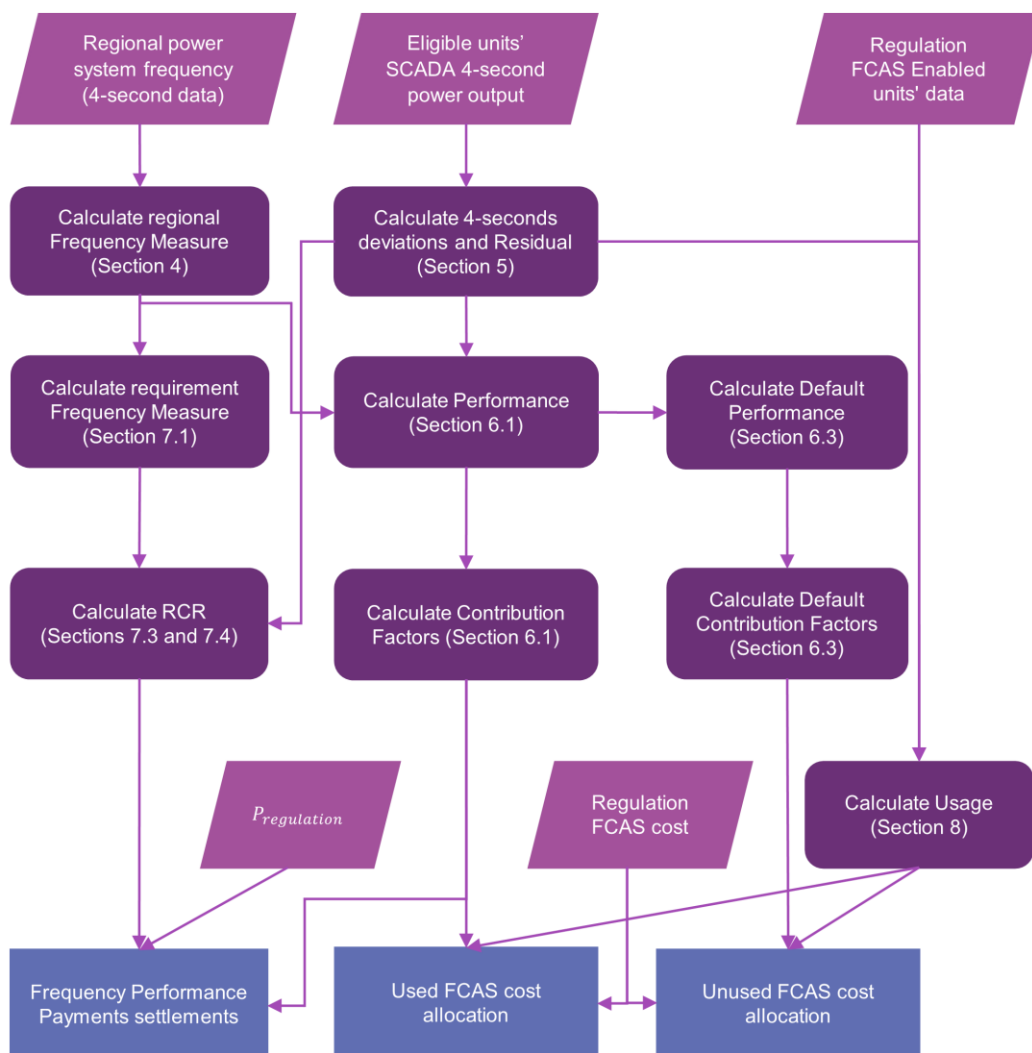


Table 2 Settlement equations

Trading Amounts	Eligible unit	Residual deviation
Frequency Performance Payments – 3.15.6AA (b)	3.15.6AA (b)(1) $TA = CF \times \frac{P_{regulation}}{12} \times RCR$	3.15.6AA (b)(2) $TA = RCF \times \frac{P_{regulation}}{12} \times RCR \times \frac{TE}{ATE}$
Recovery of Regulation FCAS that is “used”- 3.15.6AA (c)	3.15.6AA (c)(1) $TA = TSFCAS \times U \times NCF$	3.15.6AA (c)(2) $TA = TSFCAS \times U \times NRCF \times \frac{TE}{ATE}$
Recovery of Regulation FCAS that is “unused” - 3.15.6AA (d)	3.15.6AA (d)(1) $TA = TSFCAS \times (1 - U) \times DCF$	3.15.6AA (d)(2) $TA = TSFCAS \times (1 - U) \times DRCF \times \frac{TE}{ATE}$

2.3. Unit aggregation

2.3.1. Aggregation of eligible units for aggregated dispatch conformance

Where two or more *eligible units* in an *integrated resource system* register to participate in aggregated dispatch conformance 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 dispatch for a specific *trading interval*.

2.3.2. Aggregation of other eligible units

AEMO may, where it considers appropriate, elect to assess the deviation of *eligible units* with more than one NER classification as a single *eligible unit*.

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

For a *trading interval*, an *eligible unit* will have ‘*appropriate 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 Standard¹) at intervals of not more than 4 seconds in the Mainland area, and not more than 8 seconds in Tasmania.

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

For each four-second interval (eight seconds for Tasmania), AEMO determines a Frequency Measure based on the *frequency* of the *power system* that signals the direction (raise or lower)

¹ This document incorporates the standards and protocols determined under NER 4.11.1(a).

in which *eligible unit* deviations from the Reference Trajectory are helpful (helping to correct power system frequency towards 50 Hz), or unhelpful.

4.1. Formulation of Frequency Measure

Power system frequency, which is fed into the calculation of the Frequency Measure, is measured uniquely for each *region* in the NEM. For *regions* that have multiple suitable frequency measurements, the average is used.

The Frequency Measure in each *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:

- (a) t is the index of 4-second time intervals;
- (b) FM_t is the Frequency Measure at 4-second interval t ;
- (c) FD_t is the real-time frequency deviation;
- (d) α (alpha) is the smoothing factor, a value between 0 and 1, as defined in the “Frequency Contribution Factor Tuning Parameters and Input Sources” document.

4.2. Frequency Measure conditions

4.2.1. When the Frequency Measure is considered unreliable

A Frequency Measure will be considered unreliable if:

- (a) there are less than 7 four-second intervals within a *trading interval* in which the Frequency Measure is positive (in respect of *regulating raise services*) or negative (in respect of *regulating lower services*);
- (b) there are no four-second intervals within a *trading interval* where the Frequency Measure is above 0.01 Hz (in respect of *regulating raise services*) or below -0.01 Hz (in respect of *regulating lower services*);
- (c) a system separation occurs and the AGC area does not align with the dispatched Regulation FCAS Requirement in NEMDE; or
- (d) a large number of SCADA points have failed and it may not be possible to remediate these inputs and maintain accurate dispatch.

4.2.2. Consequences of unreliable Frequency Measure

For a *trading interval* where one or more of the conditions in section 4.2.1 is met:

- (a) all Performance in the region is null; and
- (b) the RCR for any Regulation FCAS Requirement that relates to the relevant region is zero.

Note: This applies to all RCRs for a given Regulation FCAS Requirement even where the Frequency Measure for other *regions* subject to the same Requirement do not meet any of the conditions described in section 4.2.1.

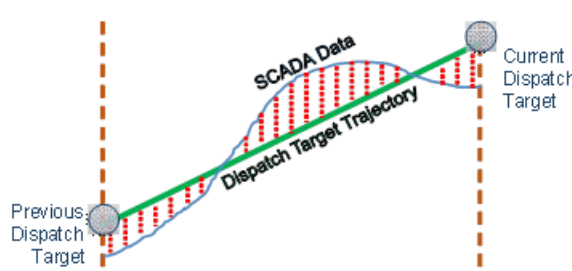
5. Reference Trajectory and deviation calculation

Four-second deviations (in MW) are calculated by comparing SCADA measurements against a Reference Trajectory which 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* (more generation or less load) and vice versa for negative deviations. These calculations are described in the next subsections.

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

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

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

Reference Trajectory	Actual Measurement	Example
Straight line between previous <i>dispatch target/level</i> and current <i>dispatch target/level</i> .	SCADA metering data for the unit, load, or interconnector.	

Thus, for each *scheduled generating unit, semi-scheduled generating unit, scheduled load* or interconnector, the Reference Trajectory and the deviation are calculated as follows:

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

$$Dev_t = Gen_t - Ref_t$$

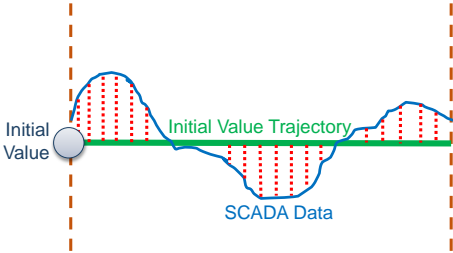
Where:

- (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 *dispatch target/level* at *trading interval* ti ;
- (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 with appropriate metering

The Reference Trajectory for *non-scheduled market generating 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	Actual Measurement	Example
Continuation of SCADA metered value at the start of the current <i>trading interval</i> .	SCADA metering data for the unit or load.	

Thus, for each *non-scheduled market generating unit* and *non-scheduled market load* with *appropriate metering*, the Reference Trajectory and the deviation are calculated as follows:

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

$$Dev_t = Gen_t - Ref_t$$

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 ;
- (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

AEMO calculates the Residual deviation and Performance regionally. However, the Residual Performance of all *regions* included in each Regulation FCAS Requirement are aggregated before determining the Contribution Factor and apportioning the FPPs and costs of Regulation FCAS to the relevant *eligible units* without *appropriate metering*. The Residual deviation is calculated as:

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

Where:

- (a) R is the index of *regions*;
- (b) m is the index of *eligible units* with *appropriate metering* in region R ;
- (c) ic is the index of inter-connectors relevant to *region* R ;

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

6. Contribution Factors and Default Contribution Factors

Contribution Factors and Default Contribution Factors will be determined for each relevant *eligible unit with appropriate metering* and for the Residual, for use in the calculation of *trading amounts* under NER 3.15.6AA.

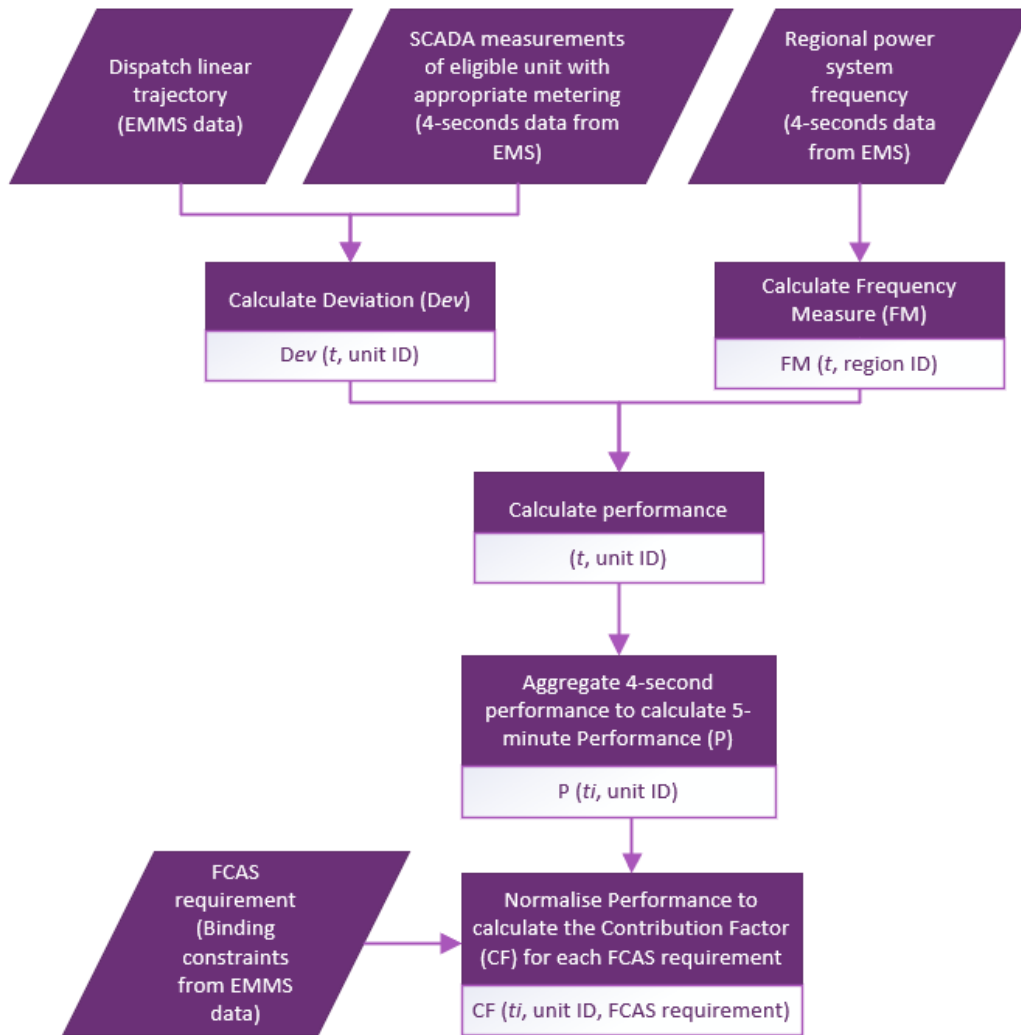
Table 5 Cross references from NER

Relevant Rule	Variable in settlement equation	Cross-reference
3.15.6AA(b)	CF, RCF	Calculated under sections 6.1.2 (for raise requirements) and 6.1.4 (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 <i>eligible unit with appropriate metering</i> for this purpose.
3.15.6AA(c)	NCF, NRCF	As above. There is no separate calculation for Negative Contribution Factors; we simply ignore positive Contribution Factors when applying this NER settlement equation.
3.15.6AA(d)	DCF, DRCF	Calculated under section 6.3.1 of this Procedure. 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 another <i>eligible unit with appropriate metering</i> for this purpose.

6.1. Calculation of Contribution Factors

Unless a Default Contribution Factor applies under section 6.2(b), the Contribution Factors for FPPs and the Negative Contribution Factors for Used Regulation FCAS will be calculated in accordance with this section 0.

Figure 2 Contribution Factor calculation process



6.1.1. Raise Performance

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

- (d) FM_t^R is the Frequency Measure at four-second interval t in region R ;
- (e) p^{raise} is null when:
 - (i) a condition under section 4.2 applies;
 - (ii) where AEMO has an incomplete data set (whether due to missing data or Bad SCADA) for the relevant *eligible unit with appropriate metering*; or
 - (iii) AEMO is otherwise unable to calculate p^{raise} .

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

6.1.2. Raise Contribution Factor

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

$$AP_{req}^{raise} = \sum_m p_m^{raise}$$

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

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* or Residual, m , in the *trading interval*;
- (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(b)) for all relevant *eligible units with appropriate metering* and the Residual in Regulation FCAS Requirement req , that 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. Lower Performance

Lower Performance for each *eligible unit with appropriate metering* or Residual in *region R* in each *trading interval* is:

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

Where:

- (a) p^{lower} is the Lower Performance of the *eligible unit* or Residual in the *trading interval*;
- (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;
- (e) P^{lower} is null when:
 - (i) a condition under section 4.2 applies;
 - (ii) where AEMO has an incomplete data set (whether due to missing data or Bad SCADA) for the relevant *eligible unit* with appropriate metering; or
 - (iii) AEMO is otherwise unable to calculate P^{lower} .

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

6.1.4. Lower Contribution Factor

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

$$AP_{req}^{lower} = \sum_m P_m^{lower}$$

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

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* or Residual, m , in the *trading interval*;
- (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(b)) for all relevant *eligible units* with *appropriate metering* and the Residual in Regulation FCAS Requirement req , that 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. Application of Default Contribution Factors

Default Contribution Factors will be applied:

- (a) to determine the *trading amount* payable by a *Cost Recovery Market Participant* in respect of 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.

Note that Default Contribution Factors 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. Calculation of Default Contribution Factors

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

6.3.1. Calculation of a Default Contribution Factor for NER 3.15.6AA(d)

Raise Performance for Default Contribution Factors

Raise Performance for Default Contribution Factors for each *eligible unit* with *appropriate metering* or the Residual in a region 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;
- (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;
- (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;
- (d) P_{ti}^{raise} is as defined in section 6.1.1 at *trading interval ti*.

Raise Default Contribution Factor:

Raise Default Contribution Factor for each *eligible unit* with *appropriate metering* or Residual for the *regulating raise service* of a Regulation FCAS Requirement at each *trading interval* 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;
- (a) $P_{raise}^{default}$ is as defined above;
- (b) $AP_{raise}^{default}$ is the absolute value of the sum of the Raise Performance for Default Contribution Factors under this section for all 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 for each *eligible unit* with *appropriate metering* or the Residual in a region 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;
- (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;
- (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;
- (d) P_{ti}^{lower} is as defined in section 6.1.1 for *trading interval* ti .

Lower Default Contribution Factor:

Lower Default Contribution Factor for each *eligible unit* with *appropriate metering* or Residual for the *regulating lower service* of a Regulation FCAS Requirement at each *trading interval* 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;
- (b) $P_{lower}^{default}$ is as defined above;
- (c) $AP_{lower}^{default}$ is the absolute value of the sum of the Lower Performance for Default Contribution Factors under this section for all relevant *eligible units* with appropriate metering and the Residual that relate to a Regulation FCAS Requirement.

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

A Default Contribution Factor applied under NER 3.15.6AA(c) is calculated in the same manner as a Contribution Factor under section 0, 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 ($P_{raise}^{substitute}$ and $P_{lower}^{substitute}$).

Raise Performance

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

Where:

- (d) $P_{raise}^{substitute}$ is the value that will be substituted for Raise Performance under this section;
- (e) H_{raise} is as defined in section 6.1.1;
- (f) ti is the index of a *trading interval* 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;

- (g) P_{ti}^{raise} is as defined in section 6.1.1 for *trading interval ti*.

Lower Performance

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

Where:

- (h) $P_{lower}^{substitute}$ is the value that will be substituted for Lower Performance under this section;
- (i) H_{lower} is as defined in section 6.1.1;
- (j) 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;
- (k) P_{ti}^{lower} is as defined in section 6.1.3 for *trading interval ti*.

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

A Default Contribution Factor applied under NER 3.15.6AA(b) is calculated in the same manner as a Contribution Factor under section 0, 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 ($P_{raise}^{substitute}$ and $P_{lower}^{substitute}$).

Raise Performance

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

Where:

- (a) $P_{raise}^{substitute}$ is the value that will be substituted for Raise Performance under this section;
- (b) H_{raise} is as defined in section 6.1.1;
- (c) ti is the index of a *trading interval* 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;
- (d) P_{ti}^{raise} is as defined in section 6.1.1 for *trading interval ti*.

Lower Performance

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

Where:

- (a) $P_{lower}^{substitute}$ is the value that will be substituted for Lower Performance under this section;
- (b) H_{lower} is as defined in section 6.1.1;
- (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;
- (d) P_{ti}^{lower} is as defined in section 6.1.3 for *trading interval ti*.

6.3.4. Where there is no 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.

7. Requirement for Corrective Response

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

7.1. Frequency Measure for RCR

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

7.2. Residual deviation for RCR

The Residual deviation relevant to Regulation FCAS Requirement *req* at 4-second interval *t* is:

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

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 *eligible unit* with *appropriate metering m* at 4-second interval *t*.

7.3. Raise RCR

Subject to sections 4.2 and 7.5, in respect of *regulating raise services*, at each trading interval:

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

$$RCR_{req}^{raise} = \max \left(\begin{array}{l} SumPosDev_t^{req} \\ \text{where } FM_t^{req} > 0 \end{array} \right)$$

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 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 ;
- (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 relevant to Regulation FCAS Requirement req at 4-second interval .

7.4. Lower RCR

Subject to sections 4.2 and 7.5, in respect of *regulating lower services*, at each trading interval:

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

$$RCR_{req}^{lower} = - \min \left(\begin{array}{l} SumNegDev_t^{req} \\ \text{where } FM_t^{req} < 0 \end{array} \right)$$

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 *eligible unit* with *appropriate metering* m at 4-second interval t ;
- (e) $Dev_{Res,t}^{req}$ is Residual deviation 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 ;
- (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 Measure relevant to Regulation FCAS Requirement req at 4-second interval t .

7.5. Exceptions

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 Measure relevant to the Mainland NEM and Tasmania are aligned during the *trading interval*.

7.5.2. General exceptions

Where AEMO is:

- (a) unable to calculate the Performance of the relevant Residual; or
 - (b) 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:

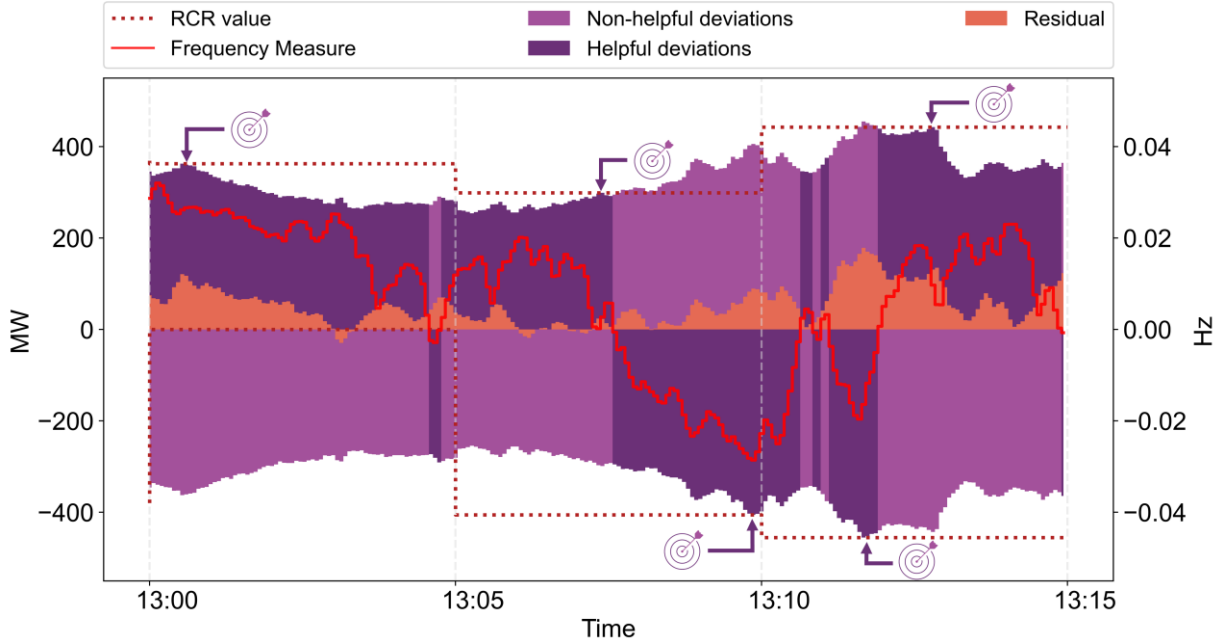
$$CapRCR_{req}^{raise} = k \times regLHS_{req}^{raise}$$

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

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.

Figure 3 RCR visual



8. Usage of Regulation FCAS

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

8.1. Raise Usage

Subject to section 87.5, at each *trading interval*:

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

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

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 Regulation FCAS Requirement req that are *enabled* to provide the *regulating raise service* at 4-second interval t , where the deviation of each unit is capped to its *enabled* amount;
- (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 87.5, at each *trading interval*:

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

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

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 Regulation FCAS Requirement req that are *enabled* to provide the *regulating lower service* at 4-second interval t , where the deviation of each unit is capped to its enabled amount;
- (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

Where AEMO is unable to calculate Usage, Usage will be deemed to be zero.

9. Data provision

9.1. Data description and frequency

To the extent reasonably practicable, AEMO will make data relating to the determination and application of Contribution Factors available as outlined in Table 6:

Table 6 Data provision

Timing	Data	Public/Private	Comments	NER Requirement
Data to determine Default Contribution Factor				
End of billing period minus 5 business days	Default Raise Performance ($P_{raise}^{default}$)	Public	3.15.6AA(d) Default factors fixed for a week Same factor for Substitute default Raise Performance in 3.15.6AA(c)	3.15.6AA(i)
	Default Lower Performance ($P_{lower}^{default}$)	Public	3.15.6AA(d) Default factors fixed for a week Same factor for Substitute default Lower Performance in 3.15.6AA(c)	
	Default Raise Contribution Factor (DCF_{raise})	Public		
	Default Lower Contribution Factor (DCF_{lower})	Public		
	Substitute default Raise Performance ($P_{raise}^{substitute}$)	Public	Applied for the purposes of NER 3.15.6AA(b)	
	Substitute default Lower Performance ($P_{lower}^{substitute}$)	Public	Applied for the purposes of NER 3.15.6AA(b)	
Parameters used to determine Frequency Measure, RCR and Usage				
5 business days prior to application	α (alpha) Smoothing Factor of EMA	Public	For frequency measure calculation	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	3.8.21
	FCAS Requirement	Public	Binding constraints 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 (CF^{raise})	Private	5-minute per requirement	3.15.6AA(k)(1)

Timing	Data	Public/Private	Comments	NER Requirement
	Lower Contribution Factors ($C_{F^{lower}}$)	Private	5-minute per requirement	3.15.6AA(k)(1)
	Raise or Lower RCR	Public	5-minute per requirement	3.15.6AA(k)(3)
	Raise or Lower Usage	Public	5-minute per requirement	3.15.6AA(k)(4)
Data calculated from determining Frequency Measure				
	Frequency deviation (FD)	Public	4-seconds per region	3.15.6AA(k)(2)
	Frequency Measure (FM)	Public	4-seconds per region	
Data to determine Contribution Factor				
	Unit SCADA data	Private	4-seconds per unit	3.15.6AA(l)
	Deviation (Dev_t)	Private	4-seconds per unit	
	Raise Performance (P^{raise})	Private	5-minute per unit	
	Lower Performance (P^{lower})	Private	5-minute per unit	
	Absolute sum of Raise Performance (AP^{raise}) with positive (AP^+) or negative sign (AP^-)	Public	5-minute per requirement	
	Absolute sum of Lower Performance (AP^{lower}) with positive (AP^+) or negative sign (AP^-)	Public	5-minute per requirement	
	Residual Performance	Public	5-minute per requirement	
Settlements and relevant information (per requirement per 5-minute)				
	FPP payment rate per Performance (MWHZ) of each <i>eligible unit</i> with <i>appropriate metering</i>	Public	$((P_{regulation} * RCR)/12) / AP^+$	N/A
	FPP payment rate per total energy (MWh) of each <i>eligible unit</i> without <i>appropriate metering</i>	Public	$(RCF * (P_{regulation} * RCR)/12) / ATE$	N/A
	FPP recovery rate per Performance (MWHZ) of each <i>eligible unit</i> with <i>appropriate metering</i>	Public	$((P_{regulation} * RCR)/12) / AP^-$	N/A
	FPP recovery rate per total energy (MWh) of each <i>eligible unit</i> without <i>appropriate metering</i>	Public	$(RCF * (P_{regulation} * RCR)/12) / ATE$	N/A
	Used Regulation FCAS cost recovery rate per Performance (MWHZ) of each <i>eligible unit</i> with <i>appropriate metering</i>	Public	$(TSFCAS * U) / AP^-$	N/A
	Use recovery rate per total energy (MWh) of each <i>eligible unit</i> without <i>appropriate metering</i>	Public	$TSFCAS * U * NRCF / ATE$	N/A
	Unused recovery rate per default Performance	Public	$(TSFCAS * (1 - U)) / AP^-$ (default)	N/A

Timing	Data	Public/Private	Comments	NER Requirement
	(MWhz) of each <i>eligible unit with appropriate metering</i>			
	Unused recovery rate per total energy (MWh) of each <i>eligible unit without appropriate metering</i>	Public	TSFCAS * (1-U) * DRCF / ATE	N/A
	FPP \$	Private	3.15.6AA(b)(1) known as TA	N/A
	Recovery of regulation used \$	Private	3.15.6AA(c)(1) known as TA	N/A
	Recovery of regulation unused \$	Private	3.15.6AA(d)(1) known as TA	N/A
<i>Pre-dispatch timeframes</i>	Estimates of recovery amounts of Regulation FCAS costs based on Default Contribution Factors	Public		N/A

9.2. Failure to publish contribution factors within X timeframe

[Placeholder] Proposal - that where AEMO fails to publish contribution factors within a X mins of the end of a *trading interval*, no FPPs will take place and all regulation FCAS will be allocated on the basis of historical performance.

Version release history

Version	Effective Date	Summary of Changes
[1.0]	[08 June 2025]	First issue