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16 June 2022

Ben Hiron
Australian Energy Market Commission
Submitted online
ERC0263

Dear Ben,

Directions Paper - Primary Frequency Response Incentives

This letter and attachment constitute AEMO's submission to the AEMC's consultation, "Directions Paper, 2022 Primary Frequency Response Incentive arrangements", published on 19 May 2022. AEMO welcomes the work you've completed since the Draft Determination. The Directions Paper, supported by the consultant report, provides:

- improved NER drafting, specifically the setting out of calculations, to the original amendment;
- substantive description of the proposed frequency performance payments and amendments to the allocation of costs the regulating raise and lower FCAS; and
- adequate explanation of the financial effects of the amendment.

The attachment is in three parts discussing the:

1. need for the arrangements, the relationship with tight deadband mandatory Primary Frequency Response (MPFR) and observations on the design;
2. proposed drafting of the amendment, with reasons to amend further; and
3. implementation timeframes, cost estimates and coordination with other projects.

In summary, AEMO considers the incentive arrangements are needed to resolve any cross-subsidy between poor performing elements of the power system masked by corrective response of units under mandated primary and regulating secondary control.

AEMO requests a meeting to discuss this submission and the drafting in detail. If you have any questions please contact David Scott, Manager – Markets and Operations Regulation, david.scott@aemo.com.au.

Yours sincerely,

Kevin Ly

Executive General Manager – Reform Delivery (acting)

Attachments: 1-3 as stated above.

Attachment 1

Need for the arrangements, the relationship with tight deadband mandatory Primary Frequency Response (MPFR) and observations on the design.

This section explains how AEMO interprets the proposals and the expected benefits.

Amending clause 3.15.6AA (g)(6) requires AEMO to set out in a procedure a method for calculating the requirement for corrective response for the trading interval for use in the frequency performance payments, under clause 3.15.6AA (b)(1).

The purpose of the Frequency Performance Payments is to introduce credits and debits for eligible units' deviation from a base trajectory. Without institution of these performance payments, unit errors will be corrected by the combination of mandated unit primary response[1] and secondary regulating response to supplement the primary response and prevent persisting error, which can arise from units erring from their trajectory, variation of unmetered elements within the trading interval and error in the forecast dispatch. Without performance payments, units causing dispatch errors will not pay for them so, if unchecked, this would encourage worse performance.

Amending clause 3.15.6AA (b)(1) requires a payment for corrective action, separate to the settlement amount for units enabled for Raise or Lower Regulation FCAS. The amount is determined by the Requirement for Corrective Response (RCR), which is a volume being then multiplied by the relevant price for regulation to create a cashflow that is distributed by positive and negative Contribution Factors. The purpose of scaling cashflows this way is to ensure causers of bad deviations are debited and providers of good deviations are credited (like those with good primary and/or secondary regulation response).

After implementing MPFR across the fleet of generators, AEMO accepts it is not possible at a 4-second level, either at a unit or system level, to separate corrective action between primary, secondary (or incidental offsetting error in the "good" direction). Under these proposals this doesn't matter because dispatch deviations are paid for irrespective: a dispatch deviation is good solely by alignment to the 4-sec performance measure and bad if misaligned. Further, the size of the dispatch deviation in proportion to the 4-sec performance measure indicates *how good* (or bad) the deviation is.

Finally, how good the deviation is as a share of all other deviations during the trading interval determines how *valuable* it is. This is because the factor sets the share of the total cashflows available, calculated by the estimate of the requirement for corrective response and the relevant regulation price for that *trading interval*.

In a system with high primary frequency response capability from tight deadband MPFR, the frequency deviation is often small, and deviates only slowly from the frequency deadband. This is because frequency is under control. Although units may be under economic dispatch and AGC, dispatch errors are inherently uncontrolled and inescapable, both in the metered population of units and through central dispatch forecasts.

To account for this, AEMO considers clause 3.15.6AA rightly introduces economic incentives, (to improve dispatch performance and the provision of primary and secondary response), alongside the existing

[1] Or frequency would go awry depending on the primary frequency response capability available on the system – this was the state before implementation of MPFR

requirement to comply with dispatch instructions, and to operate plant in a manner consistent with the primary frequency response requirements.

Amending clause 3.15.6AA(g)(2)(i) requires the 4-sec performance measure to be based on *power system frequency*. The same does not directly apply for the RCR under 3.15.6AA(g)(6), which reads: "a measure of the total volume in MW across the *power system* that contributed to reducing the aggregate deviation in *frequency* of the *power system*".

AEMO considers this point of difference, between the performance measure and the scaling factor, to be the most important aspect of the proposals. The choice of a performance measure derived from frequency deviation is suitable for assessing how good or bad a unit deviation is. Further, the ability for frequency to be expressed in a formula and then mimicked by participants is also useful, as is the knowledge that this performance measure will generally identify corrective response for units operating with tight deadband MPFR.

The rejection of frequency deviation as a method for setting the scale of cashflows is welcome. If frequency deviation had been chosen cashflows would be determined by the deadband setting under MPFR and therefore by an acceptable loss of control rather than the scale of good deviations which is the corrective response on the system. It is useful this dynamic has been revealed by the AEMC's quantitative analysis with IES. A hypothesis of scaling cashflows by the dispatch error (and not frequency error) had earlier been presented in the qualitative AEMO paper[2] that supported the AEMC's Draft Determination. With this being a hypothesis and not supported by quantitative analysis, stakeholders misinterpreted this original thinking behind the scaling of cashflows by assuming it was always going to be less than the regulating FCAS enablement volume (somewhat due to the unfortunate phraseology Regulation Requirement). This led AEMO in submission to the Draft Determination to state:

> Where control of frequency is performed by ubiquitous tight deadband MPFR, the Discussion Paper noted that this has the effect, depending on the performance of AGC-REG, of better aligning dispatch errors to one another, because they can be corrected without noticeable, accumulating deterioration in frequency and accumulation of time error. The implication was that frequency may not be a good measure upon which to credit and debit deviations, and instead deviations could be priced irrespective of frequency.
>
> For these reasons, the recommendations for changes to 3.15.6A in the Discussion Paper were premised on using data to assess dispatch errors (or imbalances) and crediting or debiting these. The credits and debits are indexed to, and scaled against, the prevailing cost of regulation FCAS, a service designed to correct dispatch errors (resolve imbalances). These recommendations were based on the assumption of a high ratio of proportional active power response to changes in power system frequency (MW/Hz) provided by a large proportion of generation plant, not assuming scarcity of primary response.

The important point to note in the excerpt is the willingness to focus on establishing cashflows to pay for dispatch errors rather than any scepticism of the use of frequency deviation as the performance measure. At the time statements tended to assume the performance measure and the scaling factor were one and the same, because this was how it was expressed at the time of the Draft Determination. Since the Draft Determination quantitative analysis has been completed that provides confidence the performance measure and the scaling factor can be different – and for good reason.

[2] Primary Frequency Response Incentive arrangements - Discussion Paper

AEMO expects implementing the proposed amendment further supports the case for retaining tight deadband MPFR, because the amendment, specifically RCR and U, have been designed with it in mind. Subject to AEMO effectively deploying secondary control, the amendment should mitigate economic inefficiencies caused by imposing tight deadband mandatory PFR.

The following figures highlight the dynamic of how the amendment attempts to encompass all good response by fully accounting for all deviations on the system. Figure 1 presents the unit and load deviations above and below trajectory (purples), the unmetered residual deviation (yellow) and net deviation of the metered units (red line). What is interesting is the amount of "netting off" within the metered population of elements. This netting would not be revealed in a simple model looking at frequency deviation or some other measure, like Area Control Error (ACE) or Frequency Indicator (FI).

Figure 1 Schematic of the total deviations across the system

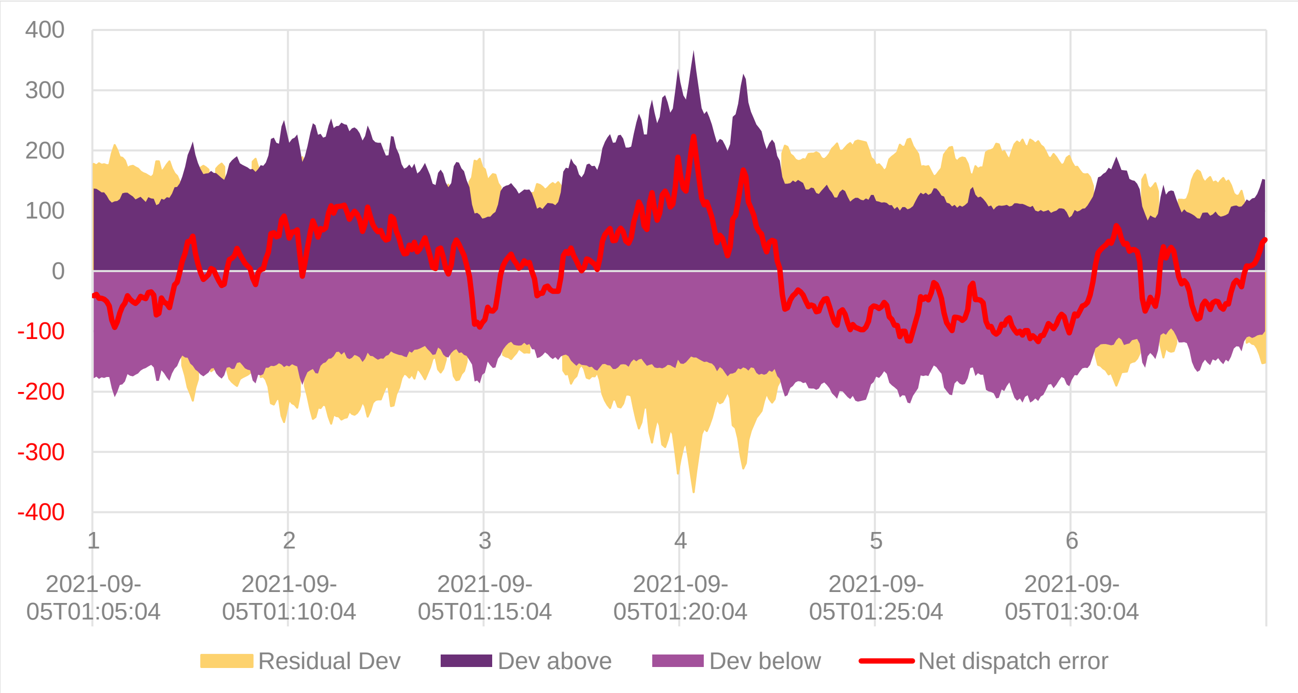
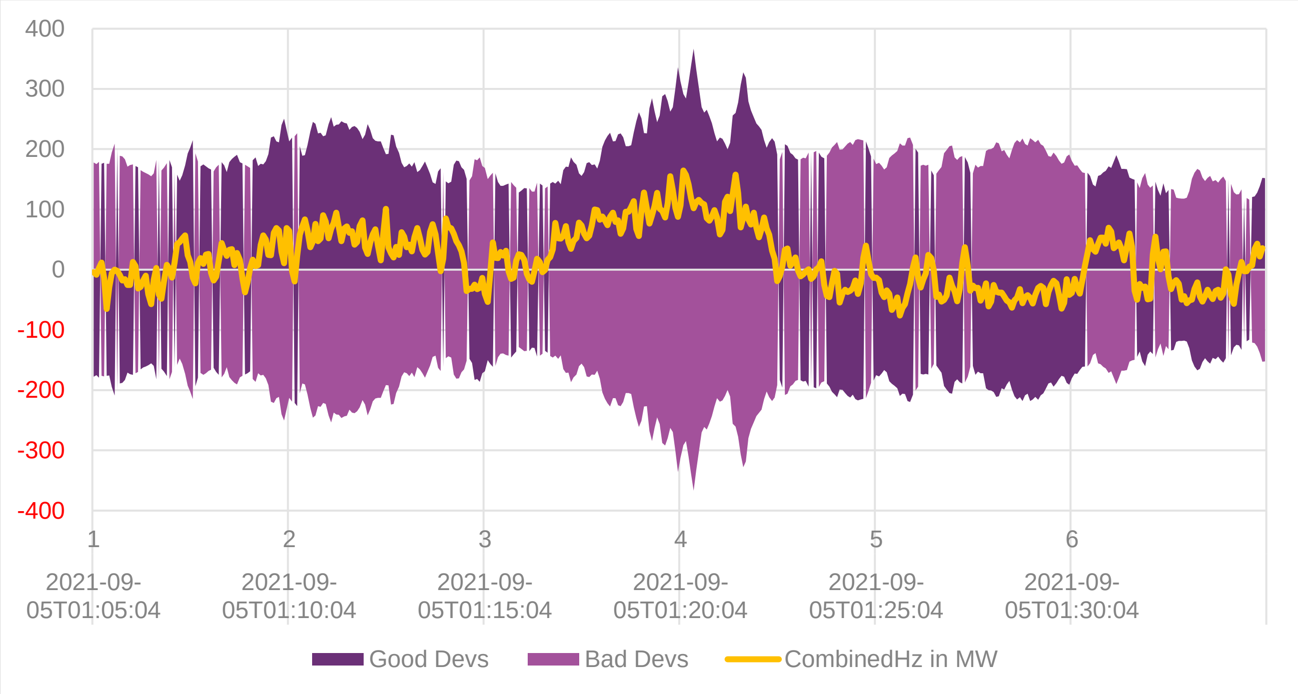


Figure 2 overlays the 4-second performance measure, using a combined Hz metric converted into a MW value for the Mainland by multiplying by the system bias used in AGC, which is approximately 2,800MW/Hz.

The good and bad performance is shaded differently, but it is clear the gross good deviations are more than the frequency error, CombinedHz.

Figure 2 Schematic of the good and bad deviations



The definition of RCR in the draft amendment should provide for the "gross" corrective (good) deviations, (that prevent frequency from deviating significantly by opposing dispatch error), to be used in scaling the cashflows. AEMO considers this important because it should allow the scheme to pay for corrective response (MW) without sacrificing good control of frequency (Hz), and focuses on the original dispatch error. By contrast, the frequency deviation is a "net" system value and would not account the total volume in MW across the power system that contributed to preventing a frequency deviation.

By targeting the gross response, or deviations, the amendment provides a framework for it to be paid for (or avoided should it be in the participants' interest). Hopefully, these incentives should reduce excess netting of performance within the metered population of units, or set it closer to an efficient level, because the units causing these deviations, or dispatch errors, may then be happy to pay for them. For the units providing good deviations, performance will be determined by their quality of MPFR response, their dispatch level and available capacity, and whether they are enabled for regulating raise or lower service. AEMO considers these dynamics to be benefit of implementing the scheme.

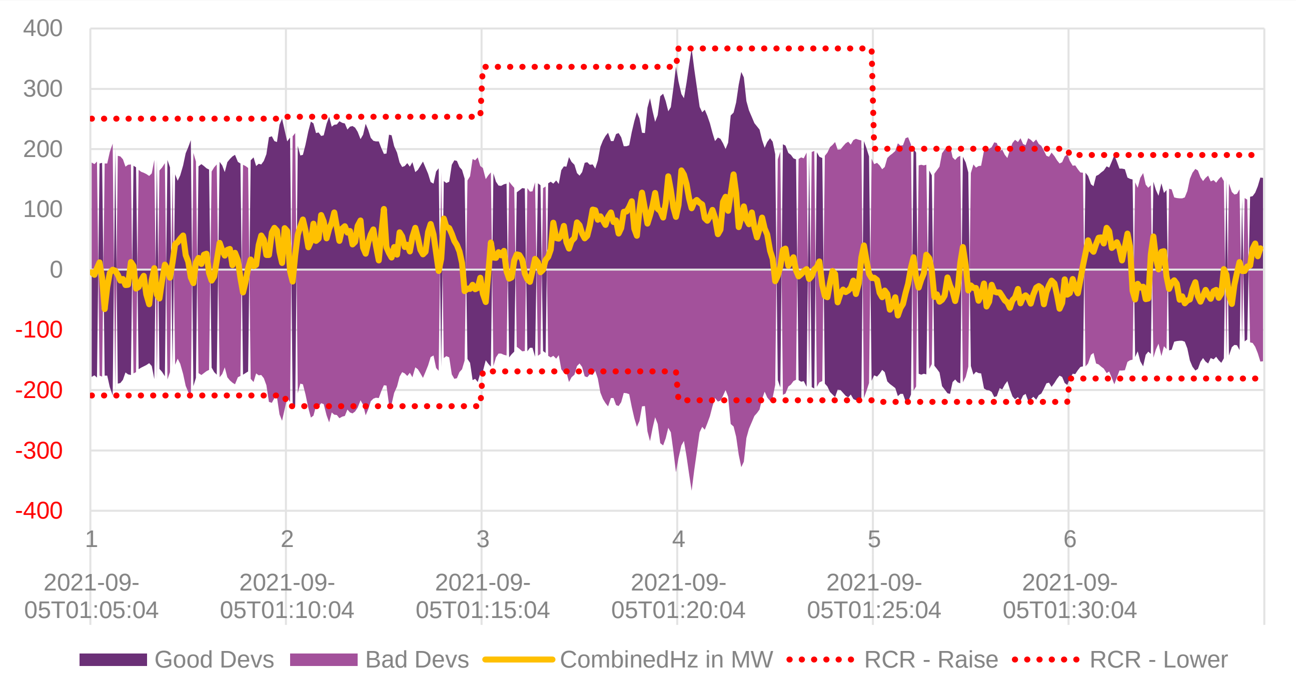
RCR

The requirements for RCR are that it must be calculated every trading interval and, due to the contribution factor being a number from -1 to 1, (as required by subparagraph (b) of 3.15.6AA), the RCR will need to scale cashflows based on the performance within the trading interval. This is because, should the RCR be a fixed in volume, when multiplied by the $P_{regulation}$, this would, subject to the price varying, become a fixed cashflow. Yet if there were little performance within the trading interval for that service, or even none, this could lead to a fixed cashflow being allocated on little data or not allocated at all, for the lack of being able to calculate contribution factors for that trading interval.

There is a need to calculate RCR every trading interval and to establish a relationship with a 4-sec performance measure and contribution factors that are calculated every trading interval. Given the contribution factors are calculated from the deviations within the trading interval it should be possible to calculate RCR similarly. Although this seems challenging compared to the status quo, paying only for performance when it happens should be a clear improvement to the existing marginal price signals.

With respect to the calculation of RCR, the most obvious choice is to use some capacity value such as presented in Figure 3 below, where the maximum values of the good deviations are chosen for the respective regulating raise and lower services.

Figure 3 Schematic of the calculation of RCR



The concept of RCR may need to be refined. It may need to be subject to further trimming or exclusion, such as excluding an RCR when the 4-second performance measure does not move beyond the primary frequency deadband[3] during the trading interval, or there is a small sample of performance data within the trading interval. Further, the smoothing and weighting of the measured dispatch errors may also be considered, to investigate the benefit of aligning the raw data with the treatment of frequency data in the calculation of the 4-sec performance measure.

AEMO would suggest RCR be confirmed during the procedure consultation and be informed further by empirical analysis. The concept and intention of RCR is clear, and from this position AEMO should be able to develop a reasonable approximation to set cashflows in 3.15.6AA (b).

Usage

The amending clause 3.15.6AA requires a method for calculating usage of the regulating service each trading interval to identify the separation of TSFCAS for amounts payable under clauses 3.15.6AA (c) and 3.15.6AA (d). Subparagraph 3.15.6AA (c)(1) defines U as the maximum proportion of the dispatched regulating raise

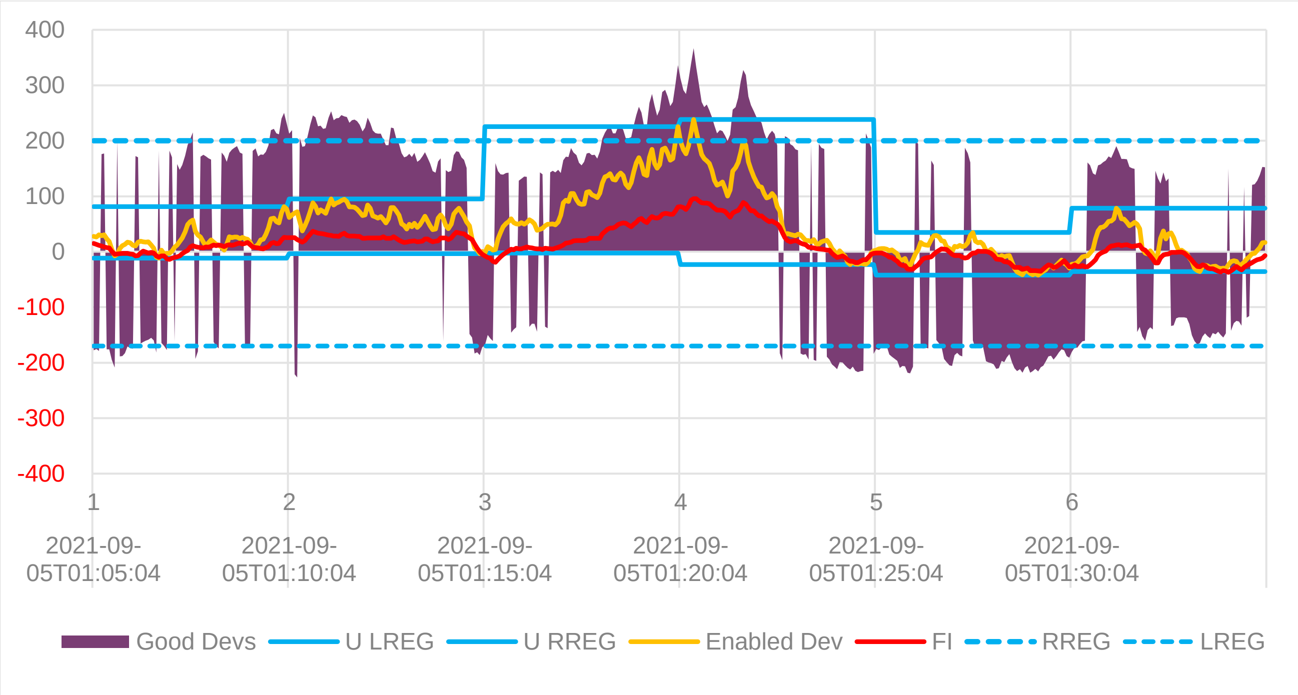
[3] Specified by the Reliability Panel and supported by the Primary Frequency Response Requirements

service or regulating lower service used by AEMO in that trading interval (which is a number between 0 and 1).

Rather than establish U directly from the Automatic Generation Control (AGC) system, using the maximum and minimum values of the Frequency Indicator, U may be better calculated by measuring the deviations of those units enabled for regulation within the relevant requirement.

In Figure 4 the good deviations (purple area), the sum of deviations from the enabled units (yellow line), and Frequency Indicator (red line) are presented. Please note the FCAS enabled amounts are shown as the blue dotted lines – with Lower Regulation FCAS expressed as a negative number.

Figure 4 Schematic of the calculation of Usage of regulation



If U is expressed as the maximum of the good deviations of those units enabled for the service, the stepped blue lines show the usage, set at the maximum or minimum value of the sub of the unit deviations during the trading interval. Please note that where more than the regulation enabled amount, then the usage would need to be capped at 1.

By measuring unit deviations directly, the usage of the regulation units will be better assessed, direct links to AGC will be removed and a better expression of how regulation units operate when also required to operate with tight deadband primary control could be established. Further, improvements to the AGC control of regulation units, such as to correct the dispatch error, and to allow other units providing primary response to move back to their set point, could be established. This could be monitored through the data and financial outcomes of the frequency performance payments 3.15.6AA(b) and the allocation of regulation costs under (c) and (d). Whilst recognizing the procurement of regulating FCAS is to account for a range of possible errors in either direction, hence generally the service should not be fully utilized, increasing the utilization of regulating units to do more work and do it faster could minimize excessive primary response duty on MPFR units. It may be possible that a relationship between RCR and U could develop where regulating units provide a significant proportion of the good deviations. For this reason, it is important the same contribution factors, calculated for the respective trading interval and separately for each service, should be used both for credits/debits under 3.15.6AA (b) in the frequency performance payments, but also for the 3.15.6AA (c), in recovering the “used” proportion of the cost of regulating service. AEMO therefore supports the structure of 3.15.6AA (c) and (d) and the splitting of costs by usage.

Attachment 2

Proposed drafting of the amendment, with reasons to change

This section puts forward some reasons to redraft the amending rule: clarifying the frequency performance payments should be performed by requirement, not region; suggesting clauses that reference electronic signals are unnecessary; and discussing the use of default contribution factors.

Alignment of Contribution Factors, $P_{regulation}$ and RCR

The drafting is unclear as to whether the calculations should be performed at regional or requirement level. It suggests by region for 3.15.6AA (b), yet for (c) and (d) the calculation appears to be by requirement.

3.15.6AA(b) specifies the Frequency performance Payments as :

$$TA = CF \times \frac{P_{regulation}}{12} \times RCR$$

Where:

> Contribution Factors are not in themselves defined by region, with subparagraph (f)(6) being the only reference to region: “a contribution factor must be determined for each eligible unit based on the *power system frequency* measured for that *region*, unless in AEMO’s reasonable opinion it is impractical to do so”. Here the reference to region appears to be in respect to frequency, rather than the resultant Contribution Factors. In any case the reference to system frequency by region appears redundant given (g)(2) sets out the requirements of the formula that determines the 4-sec performance measure, which in themselves include frequency deviation. Rather than specify by region, the purpose of subparagraph (f)(6) may be to set out when factors won’t be calculated.
>
> Further, the Contribution Factors are also used in 3.15.6AA (c), and with this trading amount being calculated at a requirement level, (through the term TSFCAS defined by 3.15.6A (h)(2) which has been clarified to be for each requirement), it seems to imply Contribution Factors should also be calculated at a requirement level.
>
> $P_{regulation}$ is the ancillary service price for the service for that *region*.
>
> The Requirement for Corrective Response (RCR) is not defined by region, instead defined in subparagraph (g)(6) which states: “a measure of the total volume in MW across the *power system* that contributed to reducing the aggregate deviation in *frequency* of the *power system*”.

Under 3.15.6AA (b) if contribution factors are calculated globally or by a group of regions, e.g. Mainland, and there are local requirements that do not match, prices will vary by region and settlement will not balance. For example, there may be more positive factors than negative ones in the region with the highest price, and settlement will be in deficit. Further, if Contribution Factors are calculated regionally and the regional price is used for 3.15.6AA (b), some method of determining RCR by region, or apportioning it, must also be developed.

At a minimum, AEMO considers Contribution Factors, $P_{regulation}$, plus RCR, should span the same geography to ensure settlement balances.

Regional calculations vs requirement calculations

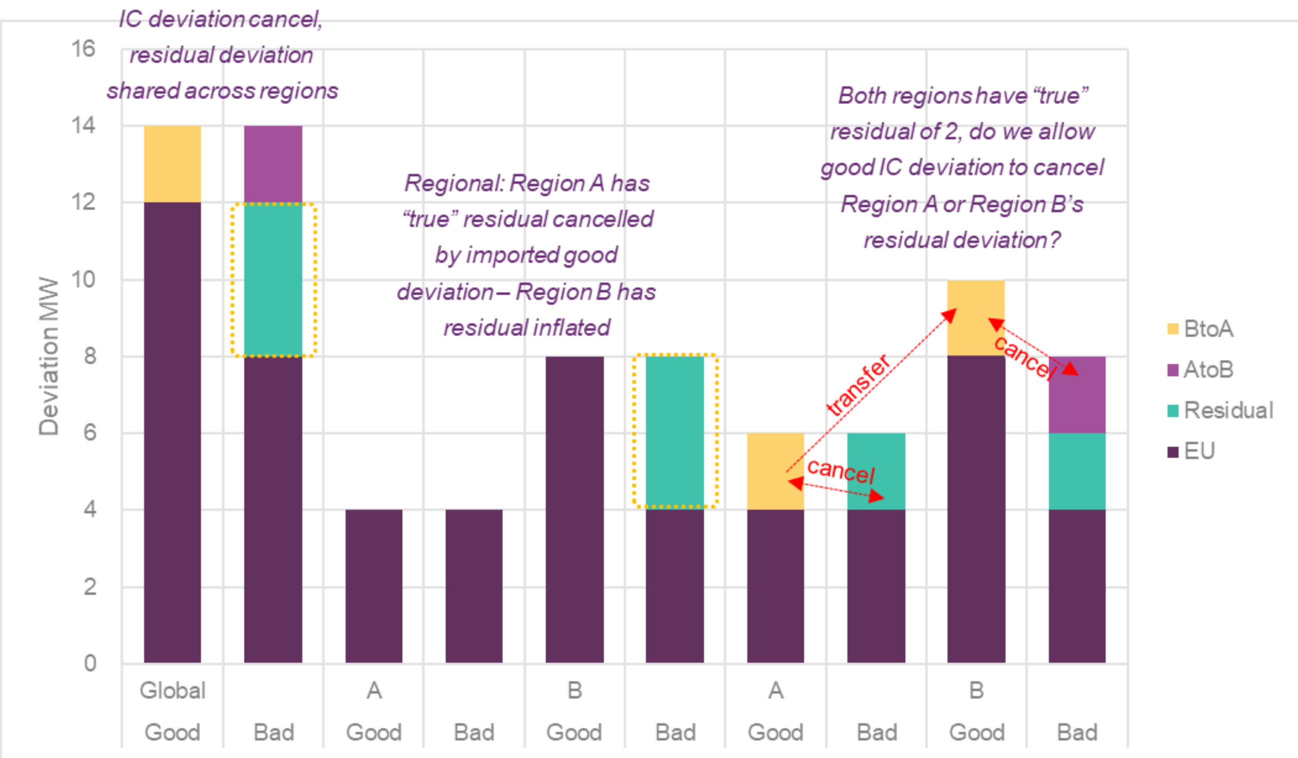
The Amending Rule requires the use of $P_{regulation}$ by region, however aligning the calculation of Contribution Factors and $P_{regulation}$ by region would be inconsistent with 3.15.6AA (c) and (d). These seem to require Contribution Factors to be calculated by requirement to allocate the cost of TSFCAS.

AEMO recommends the most workable way to align Contribution Factors, $P_{regulation}$ and the volume (RCR) is to perform the calculations per regulation FCAS constraint ('by requirement').

The reason for calculating the Contribution Factors by requirement, and not by region, is that recovery occurs from all regions within any given requirement, whether that is one or many. When there is a regulation requirement spanning multiple regions, calculating regional factors would require identifying the residual deviation (which represents the unmetered elements) on a regional basis. To do this AEMO would expect to calculate deviations for interconnectors and use these in the calculation of the residual deviation for a region. Accounting for the interconnector separately could allow for a contribution factor to be calculated for the interconnector; however, an interconnector is not an eligible unit and will therefore not have a contribution factor and settlement amount calculated for it. If there are more good deviations in one region than bad, these must be cancelled by bad deviations in another region. If the interconnector deviation is factored into the calculation of a regional residual deviation, the region with the good deviation may fund the 'exported' good deviations.

The following Figure 5 presents the calculation of the residual deviation for regions A and B. In the example there are eligible units in each region, and they are linked by one interconnector. This is just one 4-second deviation, and so in calculating factors, the multiplication with the performance measure and trading interval aggregation steps are missing, as are later steps, including the application of $P_{Regulation}$ and the Requirement for Corrective Response (RCR). The "true" residual deviation representing unmetered elements is 2 for both regions. There is a global requirement that covers both A and B. The local residual in A and local residual in B have identical performance characteristics, however the eligible units in B are providing good performance which is then exported to offset bad performance from eligible units in A.

Figure 5 Schematic of interconnector deviations and by regional implementation



There are 10 columns.

- The first pair of columns, present the "global" case where regional deviations are combined for the two regions.

- The following four columns show the calculation of the residual deviation by each region. In this calculation the residual deviation is not adjusted by the interconnector deviation, and so the deviations naturally balance within each region, with the residual opposing the sum of the metered eligible unit deviations.
- The last four columns reveal the interconnector deviations, for regions A and B. In this calculation the residual deviation opposes the interconnector deviation, and so to balance, the interconnector deviation is then presented separately with its own deviation.

What figure 5 highlights is that if calculations of factors are done on a regional basis (noting that interconnectors are not 'eligible units') the residual in B attracts all the cost of the good performance because a regional calculation requires it to offset the good performing eligible units co-located in region B, while the residual in region A effectively free-rides on the positive deviations that are imported via the interconnector. It may be possible to recognize effect of the interconnector in, deviations, settlement formulas or through the backdoor via a complex RCR formulation, but this is likely to lead to settlement residues where there is a difference in $P_{regulation}$ between regions and is ultimately more complex than calculating by requirement.

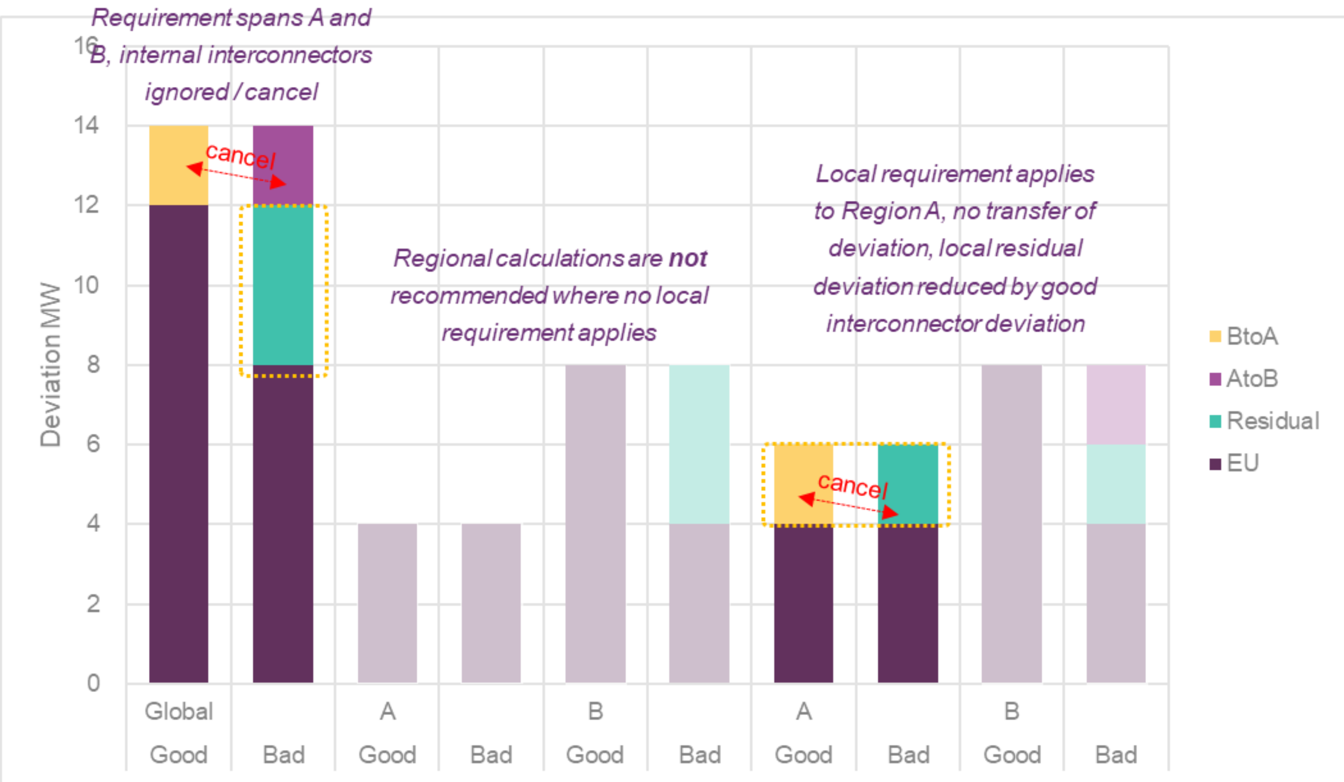
Where the interconnector is between regions that are subject to the same requirement (e.g. a global requirement), and if the calculation for 3.15.6AA (b) were performed regionally, where the same $P_{regulation}$ applies across all the regions (because there is no local requirement), a difference in the per MWh cost of funding PFR for the residual deviation will largely be attributable to the import or export of good deviations across the interconnector and not by difference in price (which are caused by different requirements applying locally). The resulting differences in cashflows for the different regional residual deviations are largely meaningless[4]. Even if the deviation is transferred to the other region, cashflows can become skewed if the interconnector deviations are not fully accounted for in the calculation of the denominator for normalized factors and the setting or apportioning of RCR.

It should also be noted that when a local requirement sets a different price for, say two regions, and the calculation is performed regionally, transferring a deviation would not equalize settlement across the regions. Settlement residues would be created, which could be positive or negative, unlike interconnector settlement residues which tend to be positive. This should be avoided.

The following Figure 6 shows how the calculations in Figure 5 would be performed if a local requirement applied to region A and global requirement applied to both.

[4] The unmetered elements and forecasting may vary by region, so this is excepted.

Figure 6 Schematic of interconnector deviations and by requirement implementation



In figure 6, if we assume a global requirement applies to both regions and a local requirement applies solely to region A, for the global requirement the interconnector deviations are irrelevant and for the local requirement, the residual deviation for region A is reduced by imported good deviations.

Importantly, when performing calculations by requirement the $P_{regulation}$ will need to be the marginal price of the global or local requirement. Please note it is the sum of the marginal prices[5] for all requirements that apply to a region that constitutes the ancillary service price for that region.

AEMO provides the following observations:

(i) to represent unmetered elements by region within the residual deviation the interconnector deviation needs to be accounted for;
(ii) this can separate the interconnector deviation for each region from the residual deviation;
(iii) the interconnector deviation could be assigned to another region, reducing the residual deviation in the other region; and
(iv) deviations would no longer balance in each region.

The following conclusions are reached:

Calculating contribution factors on a regional basis (when a requirement that spans multiple regions is binding) without any transfer of deviations would lead to an unnecessarily high factor if the true residual deviation in one region is better than the other, or more likely, a region has a concentration of good deviations from eligible units. These cashflows should be avoided.

[5] 3.9.2A(b1) of the NER

There seems no pressing reason to design the scheme to allow for the performance of the unmetered elements of the power system (and AEMO's forecasting of it) to be calculated separately and charged so. There is no systematic reason why the unmetered elements in one region will be much better than others, and little likelihood that allocating costs to residual deviations by region will improve performance of those elements.

Transfer of deviations across regions would mean deviations and factors no longer balance by region; the normalization of factors, and application of $P_{regulation}$, apportionment of RCR for different regions, means that cash settlement amounts may not cancel, leading to deficits and surpluses. Therefore, if the AEMC desires any transfer between regions, it should be performed in settlement and not through earlier calculations steps, such as a transfer of deviations, 4-sec performance, or Contribution Factors from one region to another. Irrespective, the draft amendment does not seem to allow this.

Absent any reason otherwise AEMO proposes that, although interconnector deviations would always be calculated, when aggregation occurs per trading interval, performance should be grouped and assigned to the residual deviation at the requirement level, and this will flow through to Contribution Factors and to settlement. Interconnector deviations that are internal to a requirement are irrelevant. This will ensure deviations always balance for each requirement, as do factors, and will avoid any settlement mismatches that could occur between regions.

This means:

- 3.15.6AA (b), $P_{regulation}$ be referenced to the marginal price of each global or local market ancillary service requirement
- 3.15.6AA (g)(6) for RCR be referenced to global or local market ancillary service requirement
- 3.15.6AA (g) be extended with a clause like (g)(6) for the calculation of U and be referenced to global or local market ancillary service requirement
- consideration may need be given to amend 3.15.6AA(h)(7) to specify that Contribution Factors are a number between -1 and 1, and sum to zero.

AEMO notes that clause 3.9.2A (b1) specifies that an ancillary service price for a region is the sum of the marginal price of meeting any global requirement and the marginal price of meeting each local requirement for that service in that region. If $P_{regulation}$ is the marginal price of the requirement, a plant would be exposed to frequency for that region and the regional price for the regulating raise or lower service, consistent with the current drafting and intent of the amendment. If AEMO's recommendation is adopted, it is the calculation of Contribution Factors and RCR that would now be by requirement, rather than possibly by region depending on how one interprets the proposed drafting for 3.15.6AA (b). Further the same factors can be used for 3.15.6AA (c) for the cost allocation of regulating services.

Anomalies

Units can be enabled for regulating service to satisfy a delayed service requirement. In this instance there would not be a binding marginal price for the regulating service. The most obvious answer if the regulating service price is set by the marginal price of a delayed service requirement, is to use it.

A global requirement applies across two AGC areas, Mainland and Tasmania. Given the amendment requires factors to be calculated using frequency for that region, a 4-sec performance measure based on *power system frequency* would be calculated from the local Hz value in AGC, separately for Mainland and Tasmania.

A complication arises in the calculation of the scaling value, RCR, because this may use maximum of the good deviations spanning the global requirement, yet with two performance measures there will not be perfect alignment. The most sensible option appears to be to calculate RCR across both AGC areas by using the Mainland performance measure to judge good performance. Quibbling over the choice of performance measure to calculate a global RCR may be splitting hairs, because the effect of the Basslink frequency controller is largely to align the Tasmanian frequency with the Mainland, and whilst it may be more volatile than the Mainland, it does tend to follow the larger area. Further there is much work to do on RCR and further improvements to the concept may emerge that solve this anomaly

Use of electronic signals

The draft amendment has two references to "electronic signals". The first being associated with the clause, 3.15.6AA (g)(5) that requires AEMO to use measurement data of active power and the second, 3.15.6AA (g)(7), being in relation to the requirements to calculate a trajectory:

- Clause (g)(5)(ii) allows AEMO to possibly adjust the active power by the electronic signals, for example the signals sent to regulating units that have been enabled; and
- Clause (g)(7)(iv) allows AEMO to possibly adjust the trajectory instead.

AEMO is unsure of the need to have either clause.

With respect to (g)(5)(ii), this seems[6] to be an inclusion to allow AEMO to use a unit's specified set point instead of, or to adjust, the active power measurement due to "communication delays in the order of tens of seconds". Communication delays and/or any lags in performance of units caused by this may be a completely different issue and would not be solved by a clause that is only limited to whether the signals are related to a market ancillary service.

For this reason, AEMO considers the real reason for this clause is to adjust the active power measurement by the electronic signal, for units enabled for regulating service. This seems duplicative, because there is no need to adjust the active power measurement (5)(ii) and adjust the reference trajectory (7)(iv) if the purpose is to try to measure the performance of units *excluding* their performance in providing a regulating service. AEMO recommends clause (g)(5)(ii) be removed from the amendment, because it makes more sense to adjust the trajectory rather than active power measurements.

The Directions Paper has commentary and supporting analysis on the effects of 3.15.6AA (g)(7) which could adjust the reference trajectory by electronic signals sent to regulating service units. AEMO considers this option to be challenging due to complexities associated with individual tuning. For example, electronic signals for AGC-regulation are referenced to individual unit basepoint trajectories that are tuned for unit lags and expected performance and not to a linear trajectory. Before even considering the incentive effects of doing this, it runs the risk of setting a trajectory that the unit cannot achieve and measuring regulating units more harshly than others.

AEMO suggests 3.15.6AA (g)(7)(iv) is unnecessary and, should any changes to the trajectory be considered sensible, for any reason, AEMO implements these, subject to consultation in the new frequency factors procedure using the more general clause 3.15.6AA (g)(7)(v).

[6] P33-34, AEMC Directions Paper May 2022

Use of default factors – mean performance and positives

3.15.6AA(g)(4) requires AEMO to determine default contribution factors for the dual purpose of:

(i) 3.15.6AA (b) and (c) when it is impractical for *AEMO* to determine a contribution factor for that unit in a *trading interval* based on the data measured for that *trading interval*; and

(ii) 3.15.6AA(d) allocating the “unused” proportion of costs from the enablement of the raise or lower regulation service in a *trading interval*.

Further, 3.15.6AA(i)(1) requires AEMO to publish a default contribution factor determined under subparagraph (i)(2)(i), 5 days before the *billing period* in which that contribution factor will apply.

Mean performance

Contribution factors are calculated for each trading interval under 3.15.6AA (e) and are used to establish trading amounts for settlement for 3.15.6AA (b) frequency performance payments, and 3.15.6AA (c) cost recovery of used regulation enablement. The contribution factors calculated for a trading interval under 3.15.6AA (e) are numbers between -1 to 1 and sum to zero.

If a contribution factor cannot be calculated for a unit, or a few units, the amending clause requires a default contribution factor to be substituted. This is specified by amending clause 3.15.6AA (g)(4)(i).

If a default contribution factor is substituted for a unit, the contribution factors need to be re-normalized so once more they sum to zero. This ensures settlement balances to zero for 3.15.6AA (b) frequency performance payments, and to TSFCAS in 3.15.6AA (c) and (d) cost recovery of regulation enablement.

Instead of re-normalizing factors it may be simpler to use mean performance over a certain period as the default contribution factor for units.

Further, there is a lack of clarity around what AEMO would publish when it comes to default contribution factors – presumably global but could also be regional or any of 41 combinations of regions. This is another reason to use a mean performance value.

Positive default contribution factors

Default contribution factors could be used in all transactions, under clauses 3.15.6AA (b), (c) and (d). The current drafting identifies the use of *negative* default contribution factors for (d), but AEMO notes a negative default contribution factor could also be used in (c) if it were impractical to calculate a contribution factor during that trading interval for the unit, or subset of units. The reference to negative in 3.15.6AA (d) suggests therefore default contribution factors could also be positive.

With respect to transactions under 3.15.6AA (b), if it is impractical to calculate contribution factors for a trading interval for all units, it is highly likely RCR and U would not be able to be calculated and would default to zero. This would mean clause 3.15.6AA (d) would recover 100% of the cost of the local or global ancillary service requirement, TSFCAS, using the negative default contribution factors.

It must be noted if it were impractical to calculate a contribution factor during that trading interval for a unit, or subset of units, a default contribution factor may be substituted. Under the current drafting this would imply a positive default contribution factor could be used in the frequency performance payments under 3.15.6AA (b). AEMO recommends the AEMC clarify the use of positive default contribution factors, and possibly rule them out.

Attachment 3

Implementation timeframes, cost estimates and coordination with other projects.

Timeline

The updated implementation date of 1 October 2024 is inconsistent with a provisional estimated delivery date of end of Q1 2025, which AEMO has put to the Reform Delivery Committee (RDC). April 2025 accounts for a longer than usual procedure consultation (given the complexity of developing the new procedure), a 12-month build/test, and a period of industry trial before the mechanism goes live. AEMO is presently validating timing against the most current understanding of project scope and complexity, and factoring in dependencies with other reforms affecting common areas (e.g. settlements).

Costing

The information previously prepared reflected the design at the time and hence may be inaccurate or out-of-date.

AEMO has been working on developing a high-level design, and as a first step is building a list of key features and a strawperson of a new Frequency Performance Contribution Factor procedure. The key features have been shared with our IT teams, and so it would be appropriate to revise the ESB NEM2025 costings prior to Final Determination.

Industry trial

The new mechanism has significant commercial implications for participants. AEMO recommends there should be a period of non-financial operation of the new mechanism (like Global Settlement) to allow participants to understand and adapt – this period would also allow AEMO to calibrate the many operational parameters that will be involved with the recovery. Ideally a period for a trial, at least 3 months, but potentially up to 6 months can be agreed and incorporated in the implementation / go-live date.