APCS Power Clearing and Settlement AG

Annex
Management of Imbalance Energy
to the General Terms

V 00.19

Document Management

Document History

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18.00	Approved	6 Dec. 2018	E-CONTROL	Electricity Balancing guideline (Commission Regulation (EU) 2017/2195), hereinafter 'Electricity Balancing Regulation'
0.19	Consultation			AEP Model 2021

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1 Scope of Application and Distinction between Balancing Energy and Imbalance Energy[1]

The following provisions describe the organisation of imbalance energy management.

To distinguish between balancing energy and imbalance energy volumes, the Control Area Manager (CAM) maintains special balance groups per settlement period (1/4h) that break down into the manual frequency restoration reserve (mFRR) energy as well as the automatic frequency restoration reserve (aFRR) energy actually consumed by the suppliers of balancing energy, and the unavoidable, unintentional energy exchange (caused by technical requirements and metering limitations) with the other grids of the European grid association.

2 Balancing

The Control Area Manager determines the necessary capacity bandwidth to compensate the expected imbalance resulting from the sum of the balance groups (BG) in the control area between production and consumption to the extent necessary to ensure compliance at all times with the technical rules for frequency and active power balancing.

The Balance Group Coordinator maintains components on which the balancing energy volumes consumed are recorded, broken down by supplier and direction for the clearing. Balancing energy suppliers must register with the Control Area Manager. The Control Area Manager sends the master data to the Balance Group Coordinator (BGC) to serve as basis for setting up the components.

The settlement of imbalances within a control area consists of three balancing energy components:

1) Automatic frequency restoration reserve energy
2) Manual frequency restoration reserve energy
3) Unintentional energy exchange with other control areas

With respect to the unintentional exchange of power with other control areas, the technical rules specify that the defined quantity of a week (Monday 0:00 hrs to Sunday 24:00 hrs) must be measured by tariff periods and offset in the subsequent week by a compensation programme with corresponding delivery within the bandwidth and within the respective tariff periods. The

[1] "Imbalance energy (*Ausgleichsenergie*): means the difference between the amount of energy scheduled and the amount actually fed in or out by a balance group during each defined measurement period, where the energy per measurement period may be either metered or calculated." (ElWOG Definition) "Balancing energy (*Regelenergie*): means energy used by TSOs to perform balancing." (ENTSO-E Definition).

energy volumes to be made available are either tendered in an international bidding process or procured from a power exchange.

3 Disclosure Obligations and Transparency

According to § 23 (5) 5 Austrian Electricity Act (ElWOG) in conjunction with Article 3 (1) a Electricity Balancing Regulation, the Balance Group Coordinator is under the obligation to provide information to ensure the operation of a transparent, non-discriminatory balancing energy market with as much liquidity as possible.

A basic requirement for complying with this obligation to secure the supply of power and transparency is the transmission of auction data by the Control Area Manager to the Balance Group Coordinator.

The Control Area Manager notifies the tendered frequency containment reserve (FCR), manual frequency restoration reserve and automatic frequency restoration reserve broken down by capacity to be supplied and received to the Balance Group Coordinator. To inform market participants, the Balance Group Coordinator publishes the capacity bandwidths specified by the Control Area Manager for the balancing energy components.

As soon as the bidding procedure, for energy volumes and capacities regarding the balancing energy components of unintentional energy exchange, the frequency containment reserve capacities, the automatic frequency restoration reserve energy volumes and capacities, and the manual frequency restoration reserve energy volumes and capacities is completed and the bids have been awarded, the Control Area Manager communicates the volumes and bid prices per bidder to the Balance Group Coordinator.

Information regarding the energy volumes withdrawn per bidder and bid as well the bids set to "unavailable" are sent by the Control Area Manager to the Balance Group Coordinator on the day following the energy withdrawal.

The Balance Group Coordinator publishes the bidding quantities and prices, and quantities and prices awarded in accordance with § 23 (5) 5 Austrian Electricity Act (ElWOG) in anonymous form.

The Balance Group Coordinator will make the bids it has personally submitted, awarded and withdrawn in the auction procedure available to every balancing energy supplier. In this manner, the balancing energy supplier is provided with a view of its balance data together with its balancing energy bids in a system defined as the "Single Point of Information". To this end, the Control Area Manager is obligated to send the data in non-anonymous form to the Balance Group Coordinator.

The preliminary aggregated system imbalance determined in quarter-hour intervals is sent directly by the Control Area Manager to the Balance Group Coordinator for the purpose of risk management by the Balance Group Coordinator and the market participants.

4 Technical Clearing

"Technical Clearing" comprises data receipt, "first clearing", "second clearing" and any subsequent invoicing.

The data received per clearing period includes, in particular:

- from the Balance Group Representative (BGR): the internal schedules broken down by consumption and supply
- from the Transmission System Operator (TSO): the external schedules broken down by consumption and supply
- from the Control Area Manager (CAM): the withdrawal schedules for the individual balancing energy components broken down by consumption and supply
- from the Grid Operator: the sum of the aggregated load profile metering values (time-series from quarter-hour values) and aggregated synthetic load profiles, broken down by production and consumption, by supplier and balance group as well as the time-series of the grid connecting points which are the responsibility of the Grid Operator.

The Balance Group Coordinator defines the quantity of imbalance energy based exclusively on the schedule values made available by the BGR, Control Area Manager and Transmission System Operator and assigned to the respective balance groups as well as the aggregate volume of the time-series of the actual quarter-hour metered values in kWh and the load profiles per grid operator and balance group, broken down by feed and withdrawal.

The **first clearing** takes place on a monthly basis and determines the quarter-hour imbalance energy per balance group derived from the net balance of the aggregation of the schedules and the sum of the aggregated metered values (time-series from quarter-hour values) as well as aggregated synthetic load profiles in accordance with preliminary consumption values.

Data is delivered by the Grid Operator to the Balance Group Coordinator within 8 (eight) workdays as of the last day of the month for which the data are valid. If the Balance Group Coordinator subsequently requests missing data or erroneous data, the grid operators must send the data subsequently within 2 (two) further workdays.

Subsequent invoicing is done only within six months after the close of the "first clearing" for individual months and individual balance groups upon request of the concerned BGR and serves as correction for quantities in the case of faulty data quality of the basis data (aggregated metering values). Within the scope of subsequent invoicing, it is also possible to change metering values and internal schedules if one of the two market participants concerned (data supervisor) makes a request to APCS and the second market participant consents in writing to this change (fax) within two workdays.

The Balance Group Coordinator is authorized to charge the BGR, on whose request the subsequent invoicing is being done, a fee for the work of the subsequent billing.

The **second clearing** also takes place on a monthly basis like the "first clearing"; however, for each month that is 15 months prior and takes into account actual energy quantities determined when reading the meter. Moreover, the "second clearing" also takes into account any open quantity corrections from the "first clearing" (e.g. replacement values, retroactive switching by customers, changes from switching dates).

At the latest on the last workday of the current month, the data for the month that is 14 months prior must be delivered to the Balance Group Coordinator to the defined data areas. For the data of the "second clearing", the same metering point names and component designations must be used as in the "first clearing".

The close of clearing for the "second clearing" is specified in the clearing calendar published on the website of APCS. After the close of clearing, the market participants have a period for reviewing their data according to the clearing calendar until the cutoff date stated in "quality review by". After the cutoff date, it will no longer be possible to change the data.

Retroactive changes to schedules (these include grid loss schedules) within the scope of the "second clearing" is not permitted. With the second clearing, the entire clearing process is completed. Therefore, subsequent invoicing of the second clearing is not permitted.

5 Invoicing Imbalance Energy

The invoicing of imbalance energy to the Balance Group Representative is done based on the imbalance energy price for the imbalance energy volume computed pursuant to No. 4 (energy supply pursuant to the Austrian VAT Act (UStG).

The imbalance energy price is computed per quarter-hour and is the same for imbalance energy delivered or withdrawn.

5.1 Procedure for Calculating the Imbalance Energy Price

Where V_t is the aggregate system imbalance (with direction sign) of the control area in one quarter-hour t as power.

V_t indicates how much power was supplied or withdrawn on average through balancing measures in the control area through automatic frequency restoration reserve, manual frequency restoration reserve and the unintentional exchange of energy.

V_t is positive when balancing energy must be fed into the system on average, and negative when it must be withdrawn from the system.

5.1.1 Calculating the price of balancing energy

The first step to determine the price of imbalance energy is to ascertain the price for balancing energy for positive and negative imbalances per quarter-hour t.

5.1.1.1 Calculation of the volume-weighted price for automatic frequency restoration reserve energy

The volume-weighted average prices and the volumes of activated automatic frequency restoration reserve energy are made available to the Balance Group Coordinator by the Control Area Manager.

The data is computed separately by the Control Area Manager broken down by positive and negative activation. The calculation takes into account all activation needed to maintain an equilibrium in balancing energy in the APG control area. This includes bidding in third-party control areas that were activated for the control area APG. Bids activated in the APG control area, but destined to a third-party control area, are excluded from the calculation.

5.1.1.2 Calculation of the volume-weighted price for manual frequency restoration reserve energy

The volume-weighted average prices as well as the volumes of activated manual frequency restoration reserve energy are made available to the Balance Group Coordinator by the Control Area Manager.

The data is computed separately by the Control Area Manager by positive and negative activation. The calculation takes into account all activation needed to maintain an equilibrium of balancing energy in the APG control area. This includes bidding in third-party control areas that were activated for the APG control area. Bids activated in the APG control area, but destined to a third-party control area, are excluded from the calculation.

5.1.1.3 Calculation of the volume-weighted balancing energy price

The following values apply to the one "quarter-hour interval" t:

P_{SREpos_t} . . Average price of activated positive automatic frequency restoration reserve energy in the quarter-hour t

P_{TREpos_t} . . . Average price of activated positive manual frequency restoration reserve energy in the quarter-hour t

$P_{SREneg,t}$. Average price of activated negative automatic frequency restoration reserve energy in the quarter-hour t

$P_{TREneg,t}$ . . . Average price of activated negative manual frequency restoration reserve energy in the quarter-hour t

$E_{SREpos,t}$ . . . Volume of activated positive automatic frequency restoration reserve energy in the quarter-hour t

$E_{TREpos,t}$ . . . Volume of activated positive manual frequency restoration reserve energy in the quarter-hour t

$E_{SREneg,t}$ . . . Volume of activated negative automatic frequency restoration reserve energy in the quarter-hour t

$E_{TREneg,t}$ . . . Volume of activated negative manual frequency restoration reserve energy in the quarter-hour t

$P_{SREposMOL,t}$ . . . The lowest price of the local Merit Order List for positive automatic frequency restoration reserve energy in the quarter-hour t

$P_{SREnegMOL,t}$ . . . The maximum price of the local Merit Order List for negative automatic frequency restoration reserve energy in the quarter-hour t

5.1.1.4 Calculation of the positive balancing energy price

The volume-weighted average price for positive balancing energy $P_{REposAkt,t}$ in the "quarter-hour interval" t is calculated as:

$$P_{REposAkt,t} := \frac{E_{SREpos,t} \cdot P_{SREpos,t} + E_{TREpos,t} \cdot P_{TREpos,t}}{E_{SREpos,t} + E_{TREpos,t}}$$

5.1.1.5 Calculation of the negative balancing energy price

The volume-weighted average price for negative balancing energy $P_{REnegAkt,t}$ in the "quarter-hour interval" t is calculated as:

$$P_{REnegAkt,t} := \frac{E_{SREneg,t} \cdot P_{SREneg,t} + E_{TREneg,t} \cdot P_{TREneg,t}}{E_{SREneg,t} + E_{TREneg,t}}$$

5.1.1.6 Calculation of the value of avoided activation

Should there be no activation in one quarter-hour t in the relevant direction for automatic frequency restoration reserve energy and manual frequency restoration reserve energy, the value of avoided activation (VoAA) is computed to determine the balancing energy price.

The value of the avoided activation is determined by the lowest or the highest price on the local Merit Order Lists for positive or negative automatic frequency restoration reserve energy.

$$P_{VoAA,pos,t} := P_{SREposMOL,t}$$
$$P_{VoAA,neg,t} := P_{SREnegMOL,t}$$

5.1.1.7 Calculation of the price of balancing energy

In the activation of automatic frequency restoration reserve energy or manual frequency restoration reserve energy, the price of the balancing energy in the quarter-hour t is the volume-weighted price of activated balancing energy.

If there is no activation of automatic frequency restoration reserve energy and manual frequency restoration reserve energy in one quarter-hour t, the value of the avoided activation determines the balancing energy price.

$$P_{REpos,t} := \begin{cases} P_{REposAkt,t}, & E_{SREpos,t} + E_{TREpos,t} > 0 \\ P_{VoAA,pos,t}, & E_{SREpos,t} + E_{TREpos,t} = 0 \end{cases}$$

$$P_{REneg,t} := \begin{cases} P_{REnegAkt,t}, & E_{SREneg,t} + E_{TREneg,t} > 0 \\ P_{VoAA,neg,t}, & E_{SREneg,t} + E_{TREneg,t} = 0 \end{cases}$$

5.1.2 Exchange price coupling

To avoid incentives detrimental to the system, several exchange indices are considered when calculating the imbalance energy price.

Generally, the spot market prices are used for the calculation.

The primary price P_{ID15} is the ID3 price index of the quarter-hour intraday market of EPEX SPOT.

The secondary price P_{ID60} is the ID3 price index of the hourly intraday market of EPEX SPOT.

The tertiary price P_{DA} is the hourly day-ahead spot market price (Market Coupling Preis) of EPEX SPOT.

To avoid unsuitable price signals from individual market time slots with insufficient liquidity, the prices of the intraday market P_{ID15} and P_{ID60} are volume-weighted with the day-ahead exchange price P_{DA} when volumes are below the volume thresholds.

The hourly prices and the hourly trading volumes in MWh/h apply to all quarter-hours t of the respective hour.

The prices of the respective Austrian pricing zone apply.

The subsequent changes to the day-ahead exchange prices P_{DA} and of the intraday exchange prices P_{ID15} and P_{ID60} are considered in the settlement of the periods, provided the changes are announced within the data deadline for the respective settlement. Changes to the day-ahead exchange price P_{DA} and the intraday exchange price P_{ID15} and P_{ID60} are generally not taken into account in the subsequent settlement and in the final settlment.

5.1.2.1 Calculation of the exchange price index

Additionally, product-specific markups and markdowns for the exchange price indices defined above are determined. The markups and the markdowns are derived from the maximum of an absolute and percentual markup and markdown. The absolute markups and markdowns are given in the Annex.

To avoid major jumps in the exchange price index when there is an aggregated system imbalance close to zero, the prices are corrected for absolute imbalances below the capacity threshold value L_{rampe} by a linear function ("ramp"), depending on V_t.

$$P_{ID15marked,t} := \begin{cases} P_{ID15,t} + \operatorname{sgn}(V_t) * \max\left(P_{ID15,mark};\ 0.1 * \operatorname{abs}(P_{ID15,t})\right), & abs(V_t) > L_{rampe} \\ P_{ID15,t} + \dfrac{V_t}{L_{rampe}} * \max\left(P_{ID15,mark};\ 0.1 * \operatorname{abs}(P_{ID15,t})\right), & abs(V_t) \le L_{rampe} \end{cases}$$

$$P_{ID60marked,t} := \begin{cases} P_{ID60,t} + \operatorname{sgn}(V_t) * \max(P_{ID60,mark}; 0.1 * \operatorname{abs}(P_{ID60,t})), & abs(V_t) > L_{rampe} \\ P_{ID60,t} + \frac{V_t}{L_{rampe}} * \max(P_{ID60,mark}; 0.1 * \operatorname{abs}(P_{ID60,t})), & abs(V_t) \leq L_{rampe} \end{cases}$$

$$P_{DA,marked,t} := \begin{cases} P_{DA,t} + \operatorname{sgn}(V_t) * \max(P_{DA,mark}; 0.1 * \operatorname{abs}(P_{DA,t})), & abs(V_t) > L_{rampe} \\ P_{DA,t} + \frac{V_t}{L_{rampe}} * \max(P_{DA,mark}; 0.1 * \operatorname{abs}(P_{DA,t})), & abs(V_t) \leq L_{rampe} \end{cases}$$

5.1.2.2 Calculation of the weighting factors and of the exchange price index

$$w_{ID15,t} := \min(1; \frac{L_{ID15,t}}{L_{Schwelle,ID15}})$$

$$w_{ID60,t} := \min((1 - w_{ID15,t}); \frac{L_{ID60,t}}{L_{Schwelle,ID60}})$$

$$w_{DA,t} := (1 - w_{ID15,t} - w_{ID60,t})$$

The trade-volumes $L_{ID15,t}$ and $L_{ID60,t}$ are calculated on the basis of the average of the buy and sell orders on the respective market. The capacity thresholds $L_{Schwelle,ID15}$ and $L_{Schwelle,ID60}$ are defined in the Annex as parameters.

The exchange price index $P_{px,t}$ for exchange price coupling is computed as the weighted sum of the "ramped" exchange price index.

$$P_{px,t} := P_{ID15marked,t} * w_{ID15,t} + P_{ID60marked,t} * w_{ID60,t} + P_{DA,marked,t} * w_{DA,t}$$

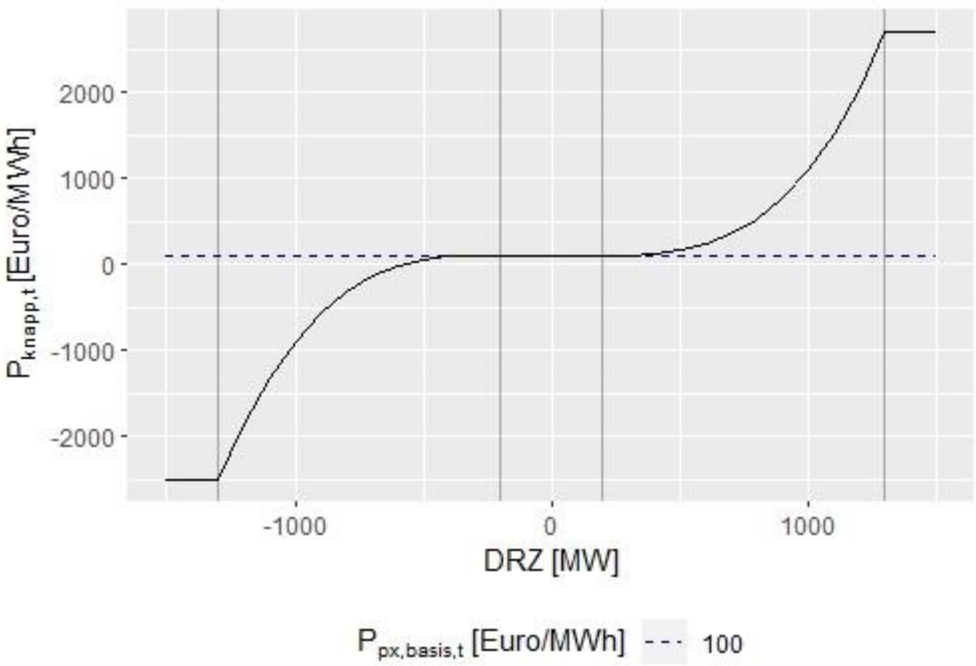
5.1.3 Calculation of the price of the scarcity function

The price of the scarcity function $P_{knapp,t}$ is determined by the underlying exchange price index $P_{px_{basis,t}}$ and a third degree polynomial function, depending on V_t. The polynomial function is valid only within a certain range of V_t. The range is delimited by the deadband (insensitivity range) L_{tot} and the cap L_{kapp}.

The capacity intersection $L_{Schnitt}$ and the price intersection $P_{Schnitt}$ are the parameters of the function.

The underlying exchange price index $P_{px,basis,t}$ is determined by the weighted sum of the (non "ramped") exchange index.

$$P_{px,basis,t} = P_{ID15,t} * w_{ID15,t} + P_{ID60,t} * w_{ID60,t} + P_{DA,pos,t} * w_{DA,t}$$



$$P_{knapp,t} := \begin{cases} P_{px,basis,t}, & \text{abs}(V_t) \leq L_{tot} \\ P_{px,basis,t} + \text{sgn}(V_t) * P_{Schnitt} * \left(\dfrac{\text{abs}(V_t) - L_{tot}}{L_{Schnitt} - L_{tot}}\right)^3, & L_{tot} < \text{abs}(V_t) \leq L_{kapp} \\ P_{px,basis,t} + \text{sgn}(V_t) * P_{Schnitt} * \left(\dfrac{L_{kapp} - L_{tot}}{L_{Schnitt} - L_{tot}}\right)^3, & L_{kapp} < \text{abs}(V_t) \end{cases}$$

5.1.4 Calculation of the imbalance energy price

The imbalance energy price $P_{A,t}$ is computed as

$$P_{A,t} := \begin{cases} \min(P_{REneg,t}; P_{px,t}; P_{knapp,t}), & V_t < 0, \\ \max(P_{REpos,t}; P_{px,t}; P_{knapp,t}), & V_t \geq 0, \end{cases}$$

When all control area imbalances for the preceding month are known and all costs and revenues of the bidding procedure from the preceding month are known, the imbalance energy price is published.

5.1.5 Parameters of the imbalance energy price formula

$P_{ID15,mark}$	5 EUR/MWh
$P_{ID60,mark}$	10 EUR/MWh
$P_{DA,mark}$	15 EUR/MWh
$L_{Schwelle,ID15}$	200 MW
$L_{Schwelle,ID60}$	200 MW
L_{tot}	200 MW
L_{kapp}	1300 MW
$L_{Schnitt}$	1000 MW
$P_{Schnitt}$	1000 EUR/MWh
L_{rampe}	50 MW

5.1.6 Use of replacement prices

If the final data pursuant to 5.1.1 is not available by the day of the plausibiliy check according to the clearing calendar, the Balance Group Coordinator is authorized to use the exchange price indicator P_{px} pursuant to 5.1.2 in the corresponding quarter-hours instead of the imbalance energy price. The Balance Group Coordinator will immediately correct the imbalance energy prices during the subsequent settlement when the final data becomes available.

5.2 Allocation of Balancing Reserve Costs

The proceeds from the invoicing of imbalance energy are netted against the following costs and proceeds of the month:

- Costs and proceeds arising from the energy deliveries bought and sold by the Control Area Manager within the manual frequency restoration process
- Costs and proceeds arising from the energy deliveries bought and sold by the Control Area Manager within the automatic frequency restoration process
- Costs and proceeds arising from unintentional energy exchange from energy deliveries bought and sold by the Control Area Manager
- The costs and proceeds from fines, withheld capacity prices and fee reductions when the activation obligation is not complied with
- Costs and proceeds for cross-zonal balancing energy components for energy deliveries bought or sold by the Control Area Manager
- Costs and proceeds from corrections of the cross-zonal balancing energy components, provided the corrections refer to the settlement periods that are not older than three years
- The costs for imbalance energy volumes that cannot be covered by the realization of the collateral assets of a market participant after termination of the contract by the Balance Group Coordinator. The costs must be distributed over one year pursuant to § 77a (4) Austrian Electricity Act (EIWOG).

Costs and proceeds from the settlement of imbalance energy are netted against the costs and proceeds from the components pursuant to 5.2 and are settled between the Balance Group Coordinator and the Control Area Manager after the close of the month. The proceeds from the settlment of imbalance energy are used to cover the costs of the above list. Any differences in amounts are held in custody by the Control Area Manager until their use is defined by law.

6 Additional Settlement Mechanism (ASM) Invoicing

The costs and proceeds for negative capacity purchased within the manual frequency restoration process are settled separately from the settlement of imbalance energy by applying an additional settlement mechanism (ASM)) pursuant to Article 44 (3) Electricity Balancing Regulation and are invoiced to the balance groups.

For the full month, the constant price of ASM P_{ZAM} (in €/MWh) is defined as

$$P_{ZAM} \coloneqq \frac{K_{TRL}}{E_{E+V}}$$

where E_{E+V} in this formula is the sum of the production and consumption volumes of all balance groups in a month and K_{TRL} are the costs of the auctions for manual frequency restoration reserve capacities.

The additional settlement mechanism price is published when all production and consumption volumes become available, usually after the deadline for the subsequent data delivery for the first clearing.

7 List of Abbreviations

APG	Austrian Power Grid AG
BG	Balance Group
BCO	Balance Group Coordinator
BGR	Balance Group Representative
ElWOG	Austrian Elektrizitätswirtschafts- und –organisationsgesetz 2010, Austrian Electricity Act
EPEX	EPEX SPOT SE
EXAA	EXAA Abwicklungsstelle für Energieprodukte AG
E_{E+V}	Production and consumption volumes of all balance groups in a month
EB Regulation	Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing guidelines on electricity balancing
K_{TRL}	TRL (=manual frequency restoration reserve capacity) costs of the per month
P_{ZAM}	ZAM (=Additional Settlement Mechanism) price for the month
CAM	Control Area Manager
TSO	Transmission System Operator
ASM	additional settlement mechanism (="zusätzlicher Abrechnungsmechanismus für Tertiärregelleistung", ZAM)
aFRR	automatic frequency restoration reserve
mFRR	manual frequency restoration reserve
FCR	frequency containment reserve

$\cdot_{rampe}$	"Rampe", ramp
$\cdot_{Schwelle}$	"Schwelle", threshold
$\cdot_{Schnitt}$	"Schnitt" („Schnittpunkt"), intersection
$\cdot_{kapp}$	"kapp" ("Kappung"), cap
$\cdot_{knapp}$	"knapp" ("Knappheit"), scarcity
$\cdot_{tot}$	"tot" ("Totband"), deadband