



# **Explanatory document to the Amendment to the TSOs' Proposal for the establishment of common and harmonised rules and processes for the exchange and procurement of Balancing Capacity for Frequency Containment Reserves (FCR)**

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Explanatory document to the Amendment to the TSOs' Proposal for the establishment of common and harmonised rules and processes for the exchange and procurement of Balancing Capacity for Frequency Containment Reserves (FCR)

## 1. Introduction

The aim of the proposed amendment is to improve the description of the FCR market rules and of the LFC Block for Germany and Denmark West (DKW).

According to SO Regulation appendix VI limits for export and import of Frequency Containment Reserves (FCR) are given per LFC Block. At the same time each TSO is given its own FCR demand. The German TSOs have for many years pooled their demand, core share, and export limit. With the accession of DKW in the procurement and to follow the appendix VI of SO Regulation the LFC Block should still pool the demand, core share, and export limit of DKW and Germany. However, there is also an additional internal limit for export of FCR from the DKW LFC Area to the TTG LFC Area which must be respected. This can be ensured by adding constraints per LFC Area or adding constraints per border.

### Abbreviations

Term	Definition
LFC Block	See SO Regulation.
LFC Area	See SO Regulation.
LFC Area Internal Limit	Limit for the exchange of FCR between two or more LFC Areas within the same LFC Block. For now, it is only relevant for DKW. See SO Regulation Appendix VI
LFC Block Export Limit	Export limit for the LFC Block as per SO Regulation Appendix VI.
DKW LFC Area	The current monitoring area West Denmark which will become an LFC Area expected by the end of 2021.
TTG LFC Area	The current monitoring area of TenneT DE which will correspond to the future LFC Area of TenneT DE once DKW become an LFC Area.
CBMP	Cross Border Marginal Price
LMP <sub>DKW</sub>	Local Marginal Price for the LFC Area West Denmark.
LMP <sub>DE</sub>	Common Local Marginal Price for the four German LFC Areas.
LMP	Local Marginal Price.
Core Share	See SO Regulation Appendix VI
BSP	Balancing Service Provider
CCS	Central Clearing System
GCT	Gate Closure Time
EB Regulation	Guideline on Electricity Balancing
GOT	Gate Opening Time
FCR	Frequency Containment Reserve
LFC block	Load-frequency Control Block
LMPe	Local Marginal Price of exporting LFC Area
LMPi	Local Marginal Price of importing LFC Area
SO Regulation	System Operation Guideline

## 2. Whereas

In this article there are only editorial improvements.

## 3. Article 1 - Subject matter and scope

In this article there are only editorial improvements.

## 4. Article 2 - Definitions and interpretations

In this article the description of paradoxically rejected bids is improved.

## 5. Article 3 - TSO-TSO-Model

In this article there are only editorial improvements.

## 6. Article 4 – Auction frequency and auction timing

In this article the GOT is changed.

### 6.1 Gate Opening Time (GOT)

The FCR TSOs propose to shorten the GOT to D-7 from D-14 for three reasons:

- Historically, the auctions for the daily product were taking place during working days only. For a delivery on Monday and Tuesday, the auction had to take place on the Friday before. In order to cover the Christmas and long holiday periods, which extends the gap between the auction day and delivery day, a GOT at D-14 was deemed necessary to offer the flexibility to the BSPs to participate to the auction. As for 1<sup>st</sup> of July 2020, the auction is performed daily thus the holidays do not influence it any more.
- The lengthy GOT takes away unnecessarily the flexibility for maintenance, patching and releasing of updates or fixes for FCR TSOs' IT systems. Any fix takes effectively 13 days to come in effect, when the last tender at the time of the fix is closed.
- A lead time of 14 calendar days is very unusual. There is no similar design known for a dayahead tender process. FCR TSOs consider there is not much market information 14 days in advance available. So a shortening of a tender should not create worse market results due to lack of opportunities for optimisation by BSPs.

Therefore, the FCR TSOs propose to shorten the GOT to D-7.

The change in the Gate Opening Time may not take place before all TSOs have changed their Terms and Conditions accordingly. After the approval of the Amendment, the GOT shall remain D-14 until all TSOs have amended their T&C. The new GOT at D-7 will be implemented once all TSOs have included this in the national terms and conditions. There will be a 2 months notice before the actual implementation.

## 7. Article 5 – Product

In this article there are no changes.

## 8. Article 6 - Bid design possibilities

In this article there are no changes.

## 9. Article 7 – Auction Allocation algorithm

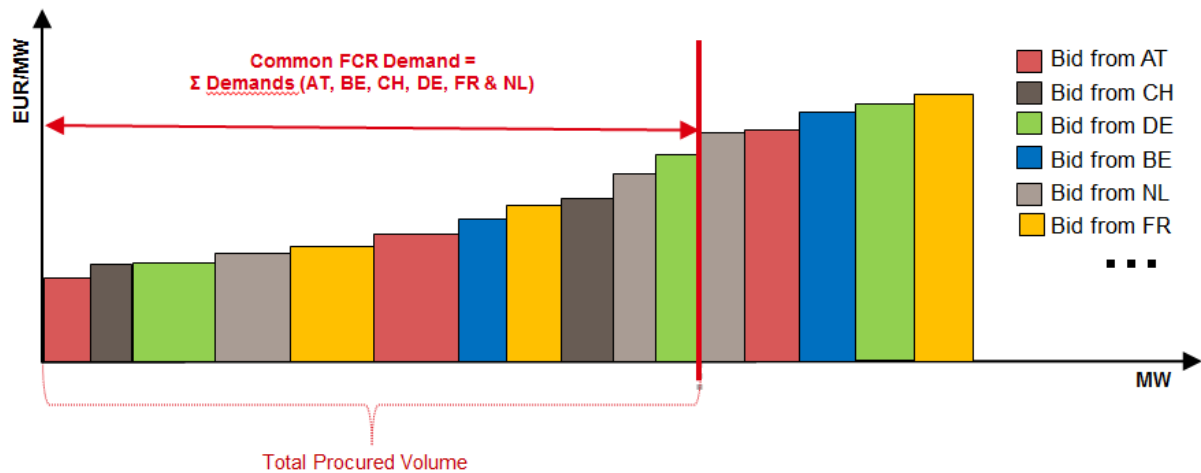
In this article the description of the algorithm is improved with the details about the LFC Block for Germany and Denmark West (DKW).

Below is additional detailed description of the allocation algorithm.

In accordance with SO GL (Annex VI "Limits and requirements for the exchange of FCR"): "Core shares"<sup>1</sup> and "export limits"<sup>2</sup> exist as limitations in the FCR market.

For each LFC Block a core share is defined which represents the minimum volume of FCR which has to be procured from technical units of Balancing Service Providers (BSPs) within the borders of the LFC Block. For each LFC Block, an export limit is defined which indicates how much FCR can maximally be exported to other LFC Blocks of the Cooperation. In addition there can be limits ("internal limits") for the exchange of FCR between LFC Areas of the same LFC Block, which indicate how much an LFC Area can exchange with the other LFC Areas of the same LFC Block.

In this document, the internal limit is considered as an export limit, as it is the applicable case between Germany and WDK. In general, the internal limit can be considered either as an import or an export limit between the LFC Areas of the same LFC Block.



All TSOs procure their required FCR demand in market-based tenders on daily basis. After Gate Closure Time (GCT) of those tenders (daily in D-1 at 08:00 CET), the bids of all TSOs are sent to the common optimisation algorithm. The optimisation algorithm calculates the optimal combination of FCR bids to be awarded under consideration of core shares, export limits of an LFC Block and internal limits for the exchange of FCR between LFC Areas of the same LFC Block with the goal to reduce total procurement cost of the cooperation.

<sup>1</sup> At least 30% of the total combined initial FCR obligations of TSOs of an LFC Block is physically provided inside their LFC Block

<sup>2</sup> Amount of FCR capacity, physically located in an LFC Block as a result of the exchange of FCR with other LFC Blocks.

First goal of optimization is to satisfy the required demand of all participating countries while respecting the mentioned limits. This is true even in some special cases, the combination of the objective function, constraints and the presence of indivisible bids may lead to a solution with overprocurement as described below.

If no export limits or core share constraint are hit, one cross border marginal price (CBMP) will be determined equaling the most expensive awarded bid in the overall cooperation. Every BSP in the cooperation will therefore receive the same settlement price per MW and per duration of product delivery (usually 4 hours) for their awarded bids. Local marginal prices (LMP) of each LFC Area are in this situation equal to the CBMP (Cross Border Marginal Price).

Exceptions from having one CBMP may occur once export limits, internal limits between LFC Areas of the same LFC Block and/or core share constraint of one or more LFC Blocks of the cooperation are hit. In this case, an LMP will be determined based on the local awarded bids within a LFC Block or relevant LFC areas (in case of internal limit).

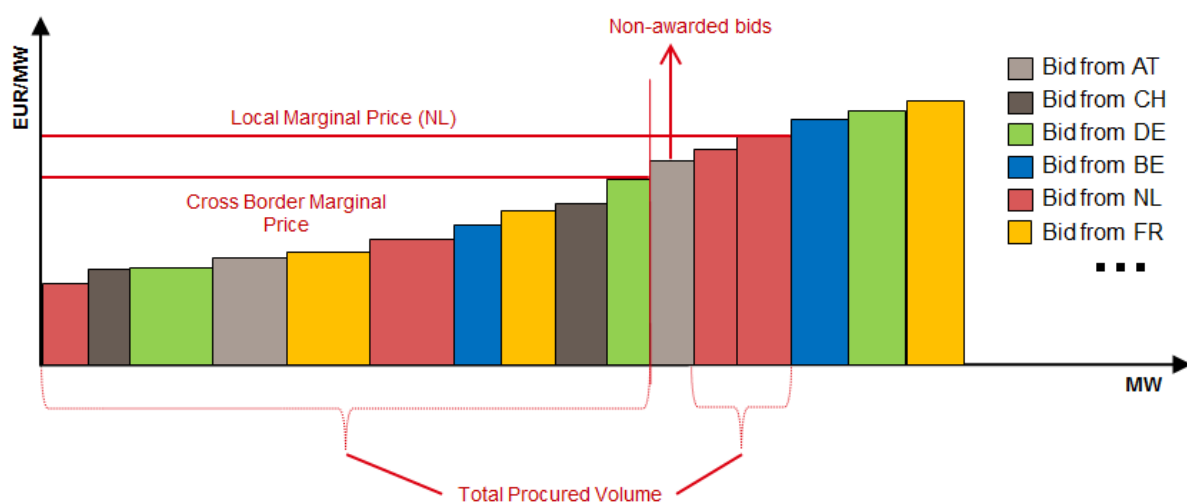
### 9.1 Case of hitting a limit constraint

It is important to understand that an export limit, internal limit or core share constraint is hit whenever it influences the solution and not only when the quantity awarded in an LFC Area or LFC Block is exactly equal to the respective limit quantity of that LFC Area or LFC Block.

#### 9.1.1 Case of hitting a core share constraint

If the core share constraint is hit, then the marginal price of this LFC Block is the price of the highest-priced awarded bid of this LFC Block (LMPi). This LMPi is always greater than or equal to the CBMP.

In the example below, the optimal solution without any constraints would have been to award the highest-priced bid from Austria. The optimal solution with the core share constraint in The Netherlands is to award the Dutch high-priced bids and the LMPi of the Netherlands is therefore determined by the awarded Dutch bid with highest price. In such a situation, there are non-awarded bids from other LFC Blocks with an offered price lower than the LMPi of The Netherlands.



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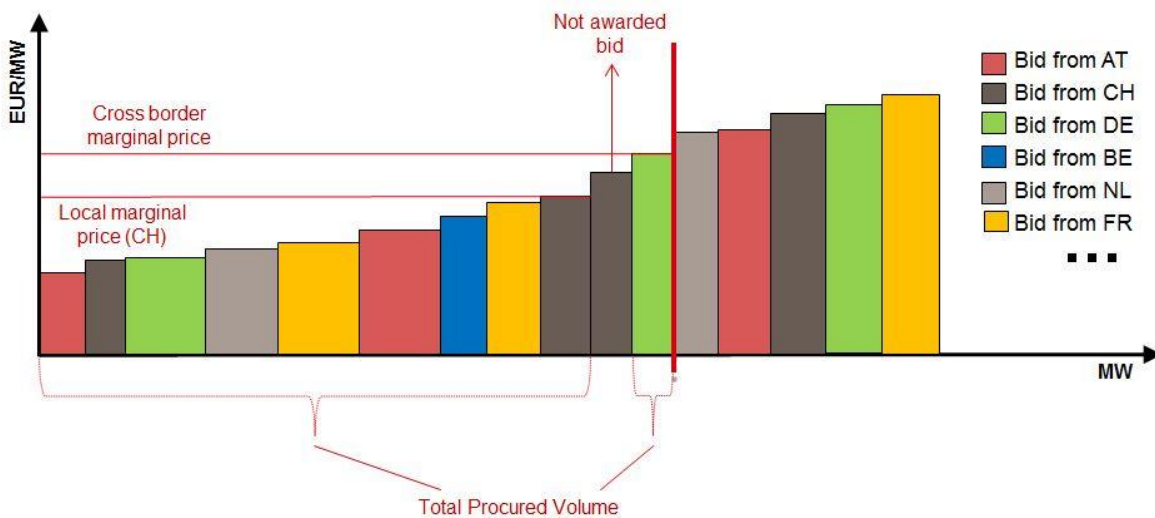
There may also be situation were the awarded capacity within an LFC Block is above the core share constraint of that LFC Block and where the constraint is still considered as hit.

Let’s consider an example of the core share constraint in the Netherlands of 34 MW where there are 33 MW of low-priced bids in the Netherlands and an additional high-priced indivisible bid of 25 MW. The bid with high price would not be awarded if there was not a core share constraint. But with the core share constraint, the high-priced indivisible bid must be awarded and the total awarded quantity in the Netherlands would be 58 MW. The total awarded quantity would be far (24 MW) above the core share but still the core share constraint is hit and influences the solution. The LMPi in the Netherlands is set by the high-priced indivisible bid and is higher than the CBMP.

**9.1.2 Case of hitting an export limit or internal limit for the exchange between LFC Areas of the same LFC Block**

If the export limit of an LFC Block or the internal limit for the exchange between LFC Areas of the same LFC Block is hit, then the LMP of this LFC Block / LFC Area is the price of the highest-priced awarded bid of this LFC Block / LFC Area (LMPe). This LMPe is always lower than or equal to the CBMP.

In the following illustration, high volume of low-priced bids are available in Switzerland, and therefore a high FCR volume is awarded in Switzerland. The FCR volume of awarded bids is higher than local demand and the surplus is exported. However, one Swiss bid is not awarded due to the export limit, even though it is still offered at a lower price than the CBMP. The LMPe of Switzerland is consequently set at a lower level than the CBMP and equals the highest-priced awarded Swiss bid.



The same logic as the core share constraint applies for export limit of exporting LFC Blocks or for the limits for exchange between LFC Areas of the same LFC Block with low LMP while the export limit is not reached (but is hit). The reason for not reaching the exact limit values but still hitting the respective limits is due to the involvement of indivisible bids.



### 9.2 Case of several optimal solutions

If there is a set of equally optimal solutions to cover the demand of a country, the bids belonging to that country (own bids) have an awarding priority to the bids from other countries in order to avoid excessive cross-border exchange under consideration of previous requirements.

If then there is still more than one optimal solution, the bids which have been submitted first are awarded.

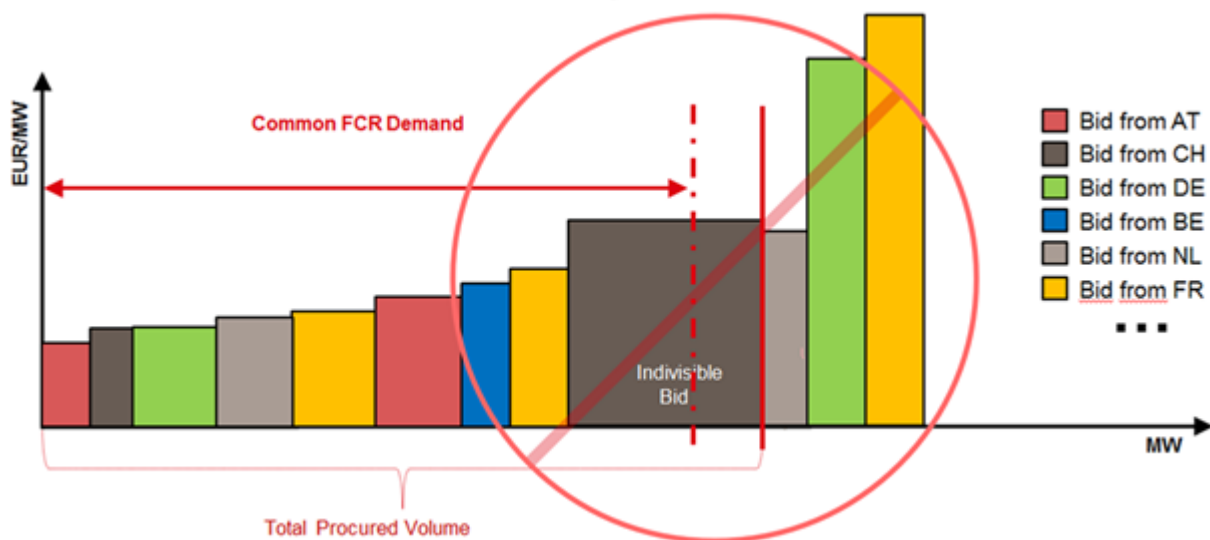
### 9.3 Divisible and indivisible bids

The optimization algorithm allows the declaration of two different types of bids: Divisible and indivisible bids. Indivisible bids can only be fully awarded or not awarded at all. For divisible bids, any quantity between zero and the offered quantity of a divisible bid can be awarded. The resolution of the awarded quantity is always 1 MW.

These two types of bids are treated differently by the algorithm in some special cases. Indivisible bids can be "paradoxically rejected" meaning that an indivisible bid is rejected although the offered price is lower than the LMP of the LFC Area where it is submitted.

This must not happen with divisible bids – divisible bids can not be "paradoxically rejected". As an example, if there are only two bids offered in LFC Block A (with a core share of 20 MW), a low-price divisible bid of 10 MW and an indivisible high-price bid of 20 MW, both bids have to be fully awarded in order to satisfy the core share (and avoid paradoxically rejected divisible bids).

Divisible bids are never paradoxically rejected i.e. divisible bids for which the offered price is lower than the LMP are always awarded (see figure below). The next bid after the indivisible bid cannot be rejected if it is divisible and has a lower price.



To sum up:

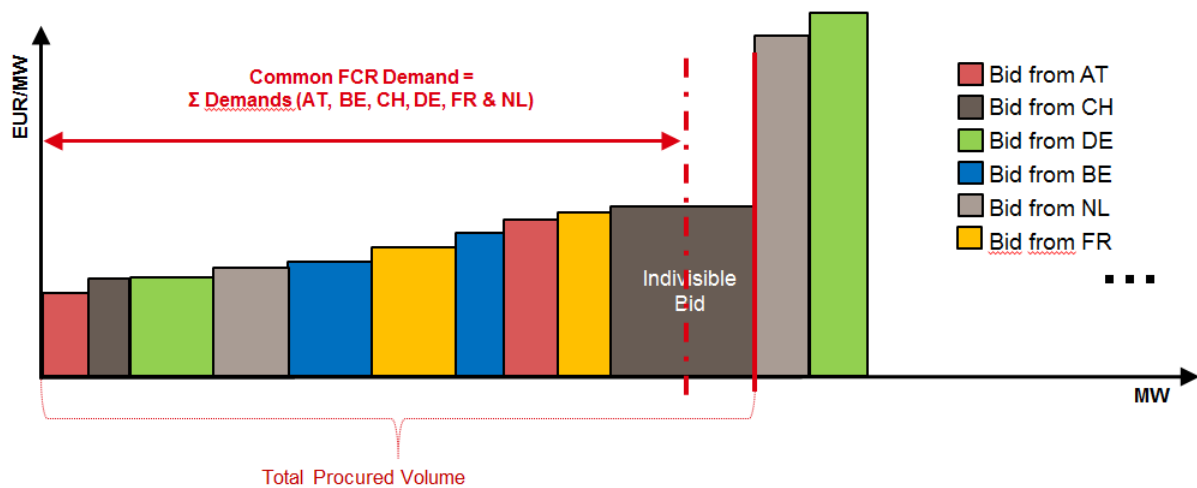
Indivisible bids are only awarded if they improve the overall result of the optimisation outcome. Indivisible bids can be rejected if their awarding would not reduce the overall procurement cost and would lead to paradoxically rejected divisible bids. This rule also holds for bid sizes of 1 MW which are declared as indivisible by the BSP, even though such a bid complies with the minimum bid size and cannot be further divided.

Recommendation:

**Do not declare bids with a size of 1 MW as indivisible!**

### 9.4 Case of over procurement because of an indivisible bid

The occurrence of indivisible bids can also lead to an over procurement of the cooperation. If it minimises total procurement cost (pursuant to Article 58(3) and (4) EB Regulation) the total awarded quantity in an LFC Area can – in exceptional cases – be higher than the sum of its demand and export limit / limit for the exchange between LFC Areas of the same LFC Block. However the quantity exceeding the sum of its demand and export limit / limit for the exchange between LFC Areas of the same LFC Block cannot be used for the coverage of the total demand of the cooperation. In this case, the sum of all awarded volumes over all countries is larger than the total demand (over procurement). This is illustrated in the figure below where the indivisible bid is awarded because this results in lower overall procurement costs.



#### 9.4.1 Special case of not hitting an export limit

An export limit / limit for the exchange between LFC Areas of the same LFC Block may not be hit even if the quantity of awarded bids of a country is equal or above the sum of its demand and export limit / limit for the exchange between LFC Areas of the same LFC Block (due to the acceptance of an indivisible bid). The export limit / limit for the exchange between LFC Areas of the same LFC Block is not active in an LFC Block / LFC Area where all of the offered capacity has been selected (even if the selected capacity is equal or above the sum of its demand and export limit / limit for the exchange between LFC Areas of the same LFC Block) in case the same capacity would be awarded also in case there was no limit. The limit is not active if it does not influence the solution which would be calculated without the limits.

### 9.5 Case of under procurement

#### 9.5.1 Insufficient coverage of core share of an LFC Block

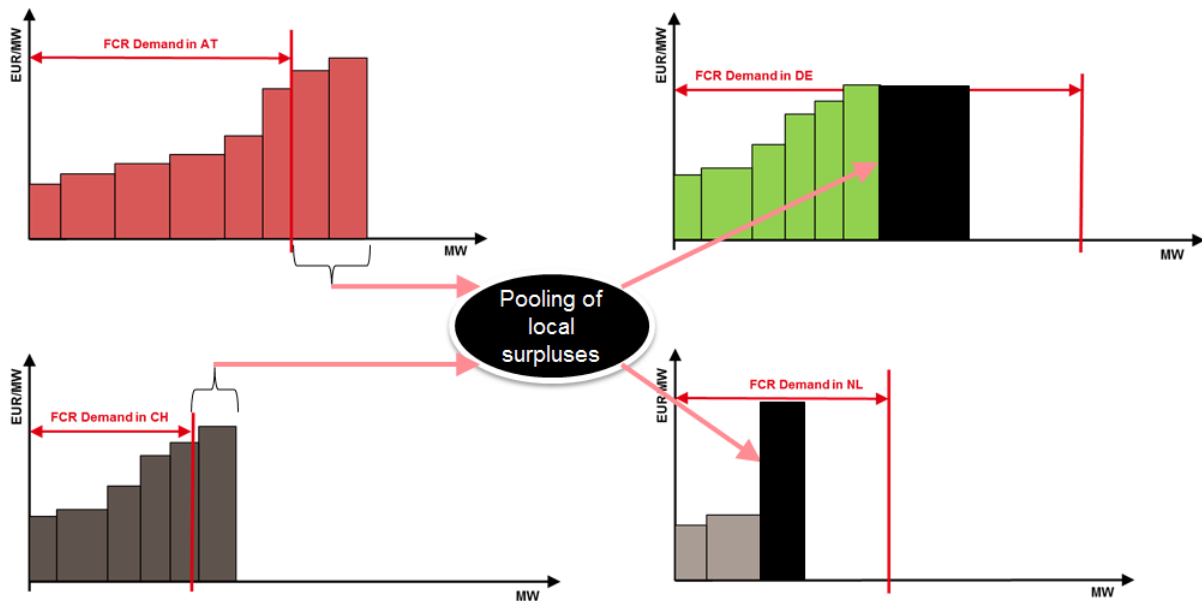
If a core share of an LFC Block cannot be covered by the total FCR volume of own bids, the core share shall be covered as much as possible with own bids. The rest of core share (which cannot be fulfilled by the own bids) remains as the deficit of FCR of that LFC Block.

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Remaining missing demands have to be procured locally and cannot be imported. For this local procedure additional local bids are needed and this local procedure is out of scope of this document.

### 9.5.2 Shortfall of total FCR demand in the cooperation

If the total FCR demand of the cooperation cannot be covered by the total FCR volume of bids, all local bids are awarded to the LFC Block of the connecting TSO. If local surplus exists in some of the LFC Blocks, it is pooled and distributed among the LFC Blocks in deficit within the cooperation, proportionally to their demand. However, export limits, limits for the exchange between LFC Areas of the same LFC Block and core shares must be still respected. Remaining missing demands have to be procured locally.



## 10. Article 8 - TSO-BSP settlement

In this chapter the description is improved with the details about the LFC Block for Germany and Denmark West (DKW).

Given that Denmark West may have a different price than Germany due to the internal limit in the LFC Block. It is clarified that in such as case, the Danish BSPs shall be settled at the LMP of DKW while the German BSPs shall be settled at the LMP of Germany.

When the internal limit is not hit, then the settlement price of German and Danish BSP is the same and is equal to the CBMP if no import or export limit is hit.

## 11. Article 9 - TSO-TSO settlement

In this chapter the description is improved with the details about the LFC Block for Germany and Denmark West (DKW).

Similarly to the TSO-BSP settlement, in case the internal limit is hit, the Danish LFC area shall have a different price than the German LFC areas. The relevant prices shall be used for the TSO-TSO settlement.

Below is additional detailed description of the settlement process.

During the allocation phase of the tendering process each country contracts an FCR amount that may differ from its own demand and therefore incurs costs that deviate from its target costs (as defined below).

After the market clearing of the common call for tenders there is a Local Marginal Price (LMP) for each participating country. These LMPs are used for the calculations described in this document.

The goal of the TSO-TSO settlement is to distribute the costs that arise from the tendering process in a way that each TSO is settled with the local marginal price of its country. In addition and in case of need, importing and exporting countries share an import/export limit pool proportionally to the absolute value of their net position.

This is achieved by conducting the following steps, which are described in detail below:

1. Determination of actual costs per country
2. Determination of target costs per country
  - a. Determination of the net position per country
  - b. Determination of import and export costs per country
  - c. Allocation of cost surplus to countries
  - d. Determination of target costs per country
3. Determination of financial compensation per country

### **11.1 Determination of actual costs per country**

The actual costs for each tender and for each country are determined by contracted FCR bids of the country which arise from the common tendering process and are settled with the respective BSPs based on the respective marginal price. Hence, the actual costs of a country are defined as overall expenses for its awarded offers.

### **11.2 Determination of target costs per country**

#### *11.2.1 Determination of the net position per country*

The net position is determined by the difference between the FCR demand and the awarded volume of the country.

#### *11.2.2 Determination of import and export costs per country*

The import and export costs for country are determined by multiplying the calculated country specific net position with the respective local marginal price (LMP) of the country.

#### *11.2.3 Allocation of cost surplus to countries*

Since the total import and export costs of all countries are unbalanced, the remaining surplus has to be distributed among the participating countries.

The country specific cost surplus is determined by multiplying the country specific allocation key with the total costs surplus.

The country specific allocation key is determined by dividing the country specific absolute value of the net position by the total absolute value of the net position of all countries.

#### *11.2.4 Determination of target costs per country*

The country specific target costs are determined by adding the country specific actual costs to the country specific costs for the exchanged capacity and deducting by the country specific cost surplus.

### **11.3 Determination of financial compensation per country**

Since payment flows are calculated for every month, the country costs per tender determined above are added up to monthly costs. The difference between the monthly actual costs and the monthly target costs of the country determines the payment obligation of the country.

If the compensation amount is positive, the country (respective TSO) has to pay. If it is negative, the country (respective TSO) receives the payment.

## **12. Article 10 - Accession of new parties**

In this Article there are no changes.

## **13. Article 11 - Implementation roadmap**

In this Article, the old implementation roadmap was removed.

## **14. Article 12 - Language**

In this Article there are only editorial improvements.