
Explanatory Document to All TSOs' proposal for the implementation framework for a European platform for the imbalance netting process in accordance with Article 22 of Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing

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DISCLAIMER

This document is submitted by all transmission system operators (TSOs) to all NRAs for information purposes only accompanying the 'All TSOs' proposal for the implementation framework for a European platform for the imbalance netting process in accordance with Article 22 of Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing'.

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1 Introduction

This document gives background information and rationale for the all TSOs proposal for the implementation framework for a European platform for the imbalance netting process (this proposal is hereafter referred to as the “INIF”), required by Article 22 of Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing (hereafter referred to as “EBGL”).

1.1 Content of this document

This document is built up as follows: Chapter 2 gives an overview on the implementation of the IN-Platform including an indicative roadmap for the accession. Chapter 3 contains an explanation regarding Article 10 of the INIF. Chapter 4 provides explanations and examples on the terms ‘member TSO’, ‘participating TSO’, the cost sharing and the decision making. Chapter 5 explains Article 11 of the INIF. Chapter 6 provides the detailed description of the algorithm for the operation of imbalance netting process function with the examples of calculations, particularly examples for unrestricted optimisation (without limits), optimisation with limits and for application of optimisation regions.

2 Implementation of the IN-Platform (Article 1 and 5)

As described in Article 1 of the INIF, all TSOs performing the automatic frequency restoration process (aFRP) are responsible for the implementation of the IN-Platform and to make the IN-Platform operation. The IN-Platform is implemented and made operational when the following conditions are fulfilled:

- The imbalance netting process function of the IN-Platform enables intended exchange of energy for the imbalance netting process between the participating LFC areas;
- the TSO-TSO settlement function of the IN-Platform enables the settlement of intended exchange of energy of the imbalance netting process between the participating LFC areas;
- The established IN-Platform fulfills all requirements of the EBGL and the INIF.

Furthermore, all TSOs performing the aFRP of the synchronous area Continental Europe have to use the IN-Platform one year after the approval of the INIF. According to the definition in the INIF a TSO uses the IN-Platform when the IN-Platform calculates and establishes an intended exchange of energy for the imbalance netting process between the relevant TSO and the other participating TSOs of the IN-Platform.

All TSO agree that the IGCC will become the future IN-Platform. By this, the IN-Platform will be implemented and made operational in the moment, when the IGCC fulfils all requirements of the EBGL and the INIF. The latter means that all TSOs implicitly will have implemented the IN-Platform and will have made the IN-Platform operational, independent if they will use the IN-Platform or not as long as at least two TSOs will use the IGCC.

To further clarify, TSOs performing the aFRP of synchronous areas other than the synchronous area of Continental Europe will implicitly fulfill the obligation to implement and make operational the IN-Platform.

In addition, TSOs performing the aFRP of synchronous areas other than the synchronous area of Continental Europe do not have the obligation to use the IN-Platform but may use the IN-Platform if so required.

A TSO from a synchronous areas other than the synchronous area of Continental Europe, which are connected to the synchronous area Continental Europe only via HVDC interconnectors can access the IN-Platform in the same way as a TSO from the synchronous area Continental Europe with the addition, that the intended exchange of energy for the imbalance netting process between the synchronous areas will be facilitated by adjusting the active power flow over the relevant HVDC interconnectors according to Article 146(5) of the SOGL.

As of February 2019, thirteen TSOs are already connected to the IGCC project and use the platform for intended exchange of energy as a result of the imbalance netting process. Nine additional TSOs have to operationally access the IGCC according to the EBGL. Based on the experience of previous IGCC accessions, all TSOs expect the individual accession process to take between 6 and 12 months, including all technical and regulatory changes. However, most of the necessary national technical changes and all regulatory changes of individual TSOs can be implemented in parallel. To guarantee operational security, all TSOs foresee a sequential testing and go-live of individual TSOs. Figure 1 shows the resulting indicative accession timeline for the future IGCC operational members.

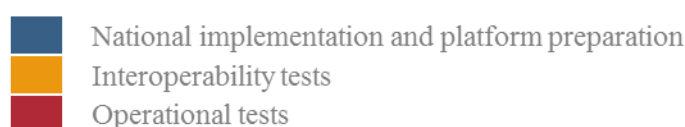
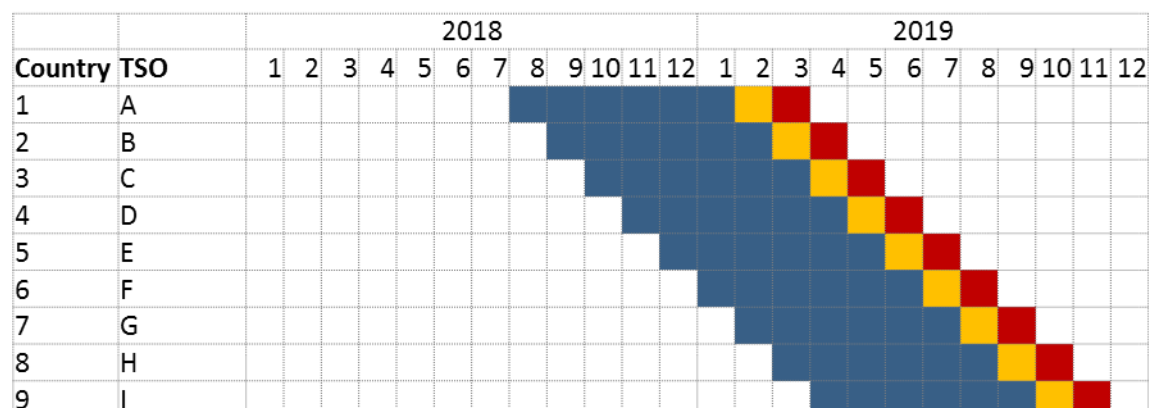


Figure 1: Indicative accession timeline for future IN-Platform participating TSOs

In addition to a public consultation of any modifications to the INIF, stakeholders will be informed of the updates related to the IN-Platform through the IGCC website¹. An accession roadmap with deadlines for individual TSOs will be prepared one month after the approval of the INIF according to Article 5(2)(c) of the INIF.

3 Entities (Article 10)

Article 22(4) of the EBGL requires the designation of entities to operate the business functions of the platform by all TSOs by six months after the approval of the INIF. This will be done through ENTSO-E.

As the balancing processes are real-time processes that are key to a stable system operation, it is important to keep the responsibility for these processes with the TSO. The IN-Platform directly interfaces with the TSO systems operating the load-frequency control and will as such form an integral part of the balancing processes. For this reason the platform functions are required to be operated by TSOs, either directly or indirectly.

The INIF is proposing to have one single TSO as the entity that will perform both the INPF and the TSO-TSO settlement function. The designated entity will enter therefor in a contractual relationship with all the (other) member TSOs, that will grant it a mandate to perform on their behalf all the daily tasks necessary to

¹ https://www.entsoe.eu/network_codes/eb/imbalance-netting/

operate the functions in accordance with operational rules commonly determined and agreed by the steering committee.

Considering a future integration of the IN and aFRR systems, in case all TSOs designate a single entity for the performance of the functions of the European platform for the exchange of balancing energy from frequency restoration reserves with automatic activation pursuant to Article 21(3)(e) of the EB Regulation, the intent is that they shall designate the same entity for the performance of the INP function of the IN-Platform, the AOF of the aFRR-Platform and the TSO-TSO settlement function of both platforms.

TSOs want to state that even though the different functions have to be carried out by the same entity in the platform, the entity can allocate the provision of services and tasks in connection with the functions to different suppliers or contractors.

Therefore, TSOs understand that assigning the functions of the platform to one entity gives the opportunity to investigate and, if proven efficient, to take advantage of synergies between the platforms. This setup apart from being efficient from the scope of each platform allows the mutualisation of tasks or services across the platforms in a flexible way.

This will be the case for a given task (e.g. one or some of the TSO-TSO settlement function tasks) when the entity of every platform is able to allocate this particular task to the same TSO or service provider. This way this task could be mutualised across the platforms.

4 Member TSOs, participating TSOs, cost sharing and decision-making (Article 2, 8, 9 and 12)

As explained in the Article 1 of the INIF, the use of the IN-Platform is compulsory for all TSOs of the Continental Europe synchronous area performing the automatic frequency restoration process. The deadline for implementing and making operational of the IN-Platform is one year after the approval of the INIF. Finally, the deadline for the TSOs in Continental Europe to use the IN-Platform is also one year after the approval of the INIF (subject to derogation of national regulatory authority).

Member TSOs are those TSOs that have joined the IN-Platform. These TSOs participate in the decision-making of the Steering Committee of the platform and are responsible to implement and comply with the decisions made. The TSOs that have the obligation to use the IN-Platform have to become member TSOs by one year after the approval of the INIF.

Participating TSOs are member TSOs that use the IN-Platform for intended exchange of energy, i.e.: they are a subset of member TSOs. The target is that all member TSOs will become participating TSOs by one year after approval of INIF at the latest, subject to national derogation. The only exception would be when an LFC area consists of more than one monitoring area. In such case, only the TSO appointed in the LFC area operational agreement as responsible for the implementation and operation of the automatic frequency restoration process according to Article 143(4) of the SOGL shall use the IN-Platform, i.e.: become a participating TSO. One example for this specific case is the LFC area of Amprion, which consists of the monitoring area of Amprion and the monitoring area of CREOS (Luxembourg). For this LFC area Amprion is appointed as responsible for the implementation and operation of the automatic frequency restoration process according to Article 143(4) of the SOGL. Hence, Amprion and CREOS would become both member TSOs, but only Amprion has to become a participating TSO.

The reason to differentiate between member TSOs and participating TSOs is the following:

- (a) The IGCC project may fulfil the requirements according to the INIF earlier than the deadline of one year after the approval of the INIF, which means that the IN-Platform will be operational before that deadline. Therefore, some member TSOs may become participating TSOs before the deadline to use the IN-Platform, i.e.: one year after approval of the INIF.

- (b) If necessary, a member TSO may apply for a derogation from using the IN-Platform by one year after the approval of INIF. Therefore, a member TSO can become a participating TSOs later than the deadline of one year after approval of INIF, according to granted derogation.

Member TSOs are bearing the common costs of establishing and amending the platform according to Article 12(4) and 12(8) of the INIF. However, any common operational costs according to Article 12(5) and 12(9) of the INIF are being borne only by the participating TSOs since these are using the IN-Platform operationally.

In order to implement and operate the IN-Platform, the member TSOs are required to make decisions through the Steering Committee on a wide variety of topics. In doing so, TSOs will aim for unanimity and will focus on good communication and processes to facilitate that aim. However, in case unanimity shows to be unfeasible (for example, due to conflicting local needs), qualified majority voting will be used. The qualified majority voting principles are modelled after those given in EBGL, although voting is done by member TSOs. This includes member TSOs who are not yet participating TSOs. This also includes non-EU TSOs that are member TSOs.

In case of a vote, a quorum of at least the majority (50 % + 1) of the member TSOs involved in the vote is required. Requiring a quorum ensures that each party is aware of the voting process and that the argumentation of all parties can be taken into account in a proper way in the decision process.

The decision process described above for member TSOs is without prejudice to the provisions of the EBGL. This means that the decisions on the formal deliverables of the EBGL (such as the decision on the aFRRIF) is taken according to the All TSOs' decision process described in the EBGL. All TSOs of the European Union will then take part, whether or not they are members of the IGCC project.

5 Framework for harmonisation of the terms and conditions related to balancing (Article 11)

The imbalance netting process is the process that aims to minimise the amount of activated aFRR, by avoiding their simultaneous counteractivation. The process does not require any activation of standard neither specific products for balancing energy. Moreover, in accordance with the Article 1 of the INIF, common settlement rules for the TSO-TSO settlement will be proposed and defined pursuant to Article 50 of the EBGL. Thus, all TSOs consider that there is no need for harmonisation of terms and conditions related to balancing for the establishment of the IN-Platform.

6 Description of the algorithm for the operation of imbalance netting process function (Article 3, 4, 7 and 13)

The optimisation algorithm is part of the imbalance netting process function. The imbalance netting process function (INPF) calculates the corrections in real-time for each LFC area, resulting in imbalance netting power interchanges on the imbalance netting balancing borders. This chapter describes the basic principles of the imbalance netting process function including the interaction of load-frequency controllers of an individual LFC area with the optimisation algorithm of the INPF, a description of the fallback process in case of an outage of the INPF, the interaction between the aFRR- and the IN-Platform and the congestion management.

The inputs to the imbalance netting process function of the IN-Platform are listed in Article 3(4) of the INIF.

From this list, as further described in chapter 6.1, inputs are directly used by the algorithm on each optimisation cycle aiming at minimizing the counteractivation of aFRR among the participating TSO:

- the aFRR demand of every LFC area of each participating TSO being continuously reported to the IN-Platform by each participating TSO; The aFRR demand is calculated as the sum of the already

activated aFRR and the FRCE of the respective LFC area without the influence of the intended exchange of balancing energy resulting from the cross-border aFRP or INP. The sign convention for aFRR demand is: negative value where the LFC area is in power surplus and indicates that downward aFRR balancing energy needs to be activated; and positive value where the LFC area is in power deficit and indicates that upward aFRR balancing energy needs to be activated. For avoidance of doubt, all aFRR demands are aFRR inelastic demands. The aFRR demand does not consider explicitly any mFRR demand due to the nature of the INP. The INP is a real-time process with continuously changing inputs and outputs whereas in the mFRR process the in- and outputs do not change continuously, hence a consideration of the mFRR demands within the INP is not feasible. However the mFRR activation is implicitly included in the FRCE of each LFC area;

- the imbalance netting cross-border capacity limits for the concerned imbalance netting balancing borders or set of imbalance netting balancing borders being continuously reported to the IN-Platform;
- the operational security constraints provided by the participating TSOs or affected TSOs in accordance with Article 150 of the SOGL, where applicable;

Note: according to the control demand concept described in chapter 6.1 some inputs are continuously updated at every TSO internal control cycle of its LFC (between 1 to 10 seconds). The algorithm uses the last updated input at every optimisation cycle.

The outputs of the INPF are listed in Article 3(6) of the INIF.

6.1 Control exchange model

The control exchange model defines the interaction between the INPF and the load-frequency control loops of the aFRP in each LFC area of a participating TSO. TSOs agreed to use the control demand model for this interaction.

The control demand model is already under operation in IGCC cooperation and German-Austrian aFRR cooperation. It has proven to work stable for ten years. Figure 2 shows the basic interactions within the control demand model at a high-level.

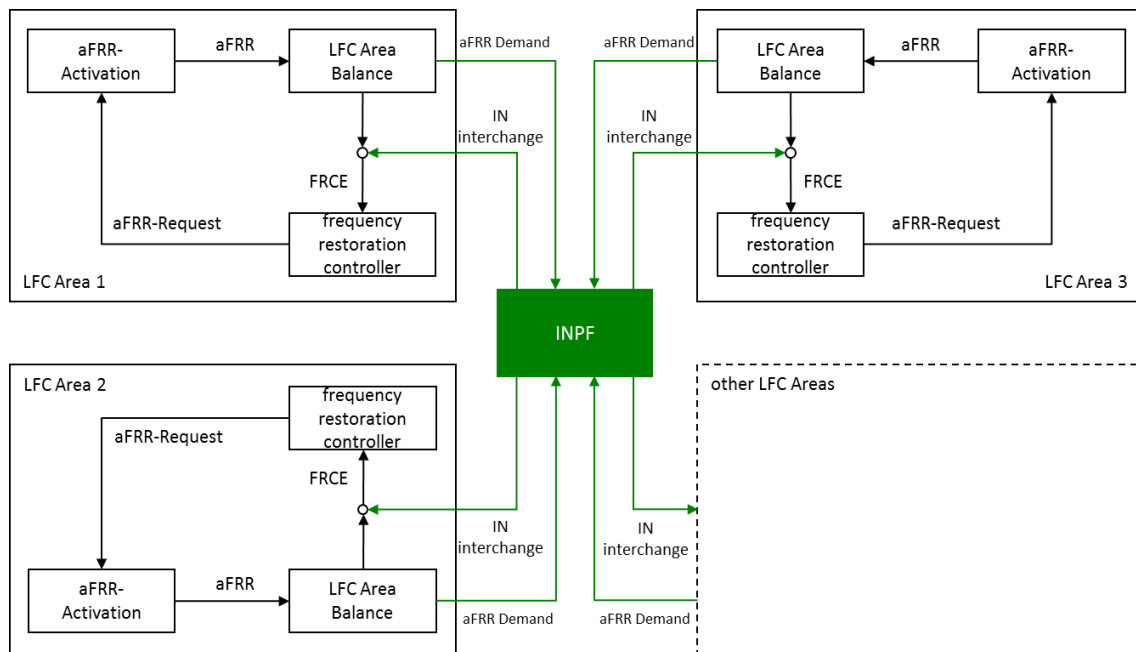


Figure 2: Imbalance netting process function with control demand model

The basic principles of the control demand model are listed below:

- Each TSO calculates in each control cycle the aFRR demand for each of its LFC areas. The aFRR demand resembles the imbalance before any aFRR activation, but taking into account all earlier processes (including activation of mFRR). The aFRR demand cannot be measured directly but must be determined by the addition of the measured, uncorrected FRCE and the already activated aFRR. The amount of already activated aFRR is determined either on the basis of the requested volumes or on measurement. It should be noted that the open loop ACE, the control demand, and the aFRR demand all refer to the same signals.
- The aFRR demand is provided as input to the INPF, which then uses it to determine the IN correction value for each LFC area based on the IN cross-border capacity limits. The IN correction value equals the sum of all imbalance netting power interchanges of the LFC area.
- The IN correction value is directly included within the load-frequency control loop of each participating LFC area (see Figure 3), in accordance with Article 147(4a) of SOGL. Through this, the individual controller input of each LFC area is adapted according to the outcome of the INPF. The sum of the aFRR demand and the IN correction value is the so-called corrected aFRR demand and reflects the amount of aFRR, which the individual LFC area has to provide.
- The correction value from the INPF corresponds to matching of real time imbalances, generally benefiting to all participating TSO in terms of FRCE quality.

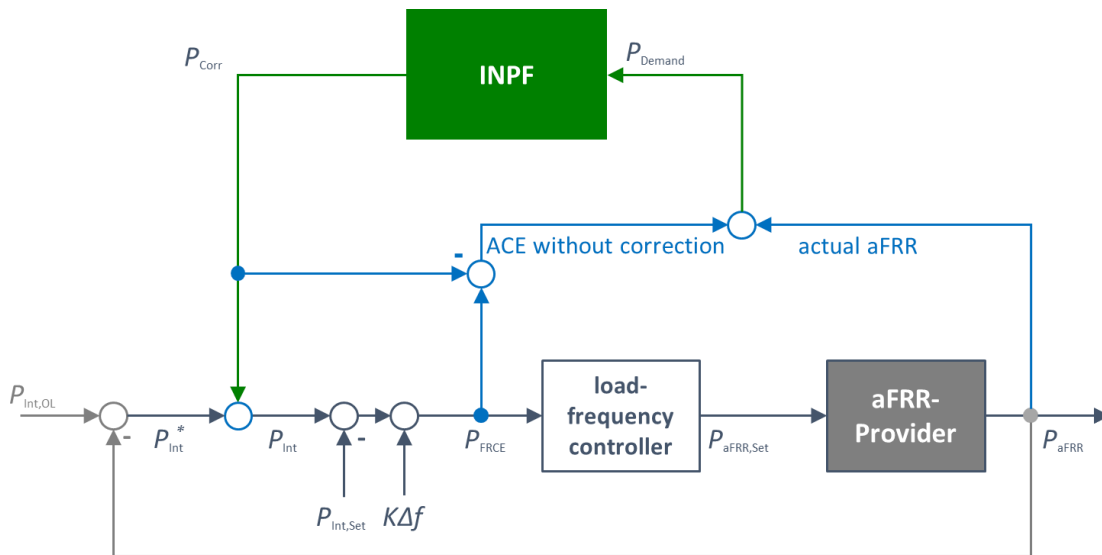


Figure 3: Scheme of the control demand model

The integration of the control demand model in the local control loops and the exchanged signals are illustrated in Figure 3.

6.2 Fallback process

In case of local technical problems with the INPF for one participating TSO or global in the IN-Platform, the aFRP will still continue to work in order to guarantee that the FRCE is continuously regulated to zero. In such case, the concerned participating TSO will stop its participation to the IN-Platform. The corresponding aFRR demand will be removed from the INPF, and the participating TSO will continue the aFRP following its local rules.

As described in the Article 7 of the INIF, the temporary suspension and restoration of a TSO participation in the imbalance netting process shall be published as early as possible. It is the intent of all TSOs to centralise the publication of this information.

In order to ensure that there are fallback solutions in place, on the one hand, the imbalance netting process function via the IGCC project is implemented in two different locations and has at each location a back-up system in operation. Furthermore, real-time communication between the IN-platform and the participating

TSOs is implemented via two redundant communication lines. As a result of these, there is four-time redundancy in the entire system for the sake of avoiding any failure in the operation of IN-Platform.

6.3 Interaction between the aFRR-Platform and the IN-Platform

Due to derogation or regulatory limits it might be that not all TSO, which are participating in the IN-Platform will also participate in the aFRR-Platform, at the beginning. During this period, the consistent usage of available IN cross-border capacity limit for the IN-Platform and aFRR cross-border capacity limit for the aFRR-Platform at the same time has to be ensured. Hence, there is the need to separate the processes into multiple optimisation steps. In this case, the following sequence of steps is proposed:

1. Optimisation of cross-border interchange of aFRR and activation of bids from the common merit order list, including the implicit netting of aFRR demands
2. Netting of all remaining aFRR demands of the IN-Platform in accordance with Article 12 of the INIF, under consideration of the remaining imbalance netting cross-border capacity after the first step
3. Optimisation of the activation of bids from the common merit order list and determination of the XBMP, considering the aFRR interchange and netting determined in the previous steps

This sequence ensures that

- The cross-border capacity between the LFC areas that participate in the cross-border interchange of aFRR are optimally allocated in the first step
- The priority access to aFRR capacity within an LFC block or sharing regions is ensured for aFRR-Platform
- Merit order activation is followed for aFRR-Platform
- XBMP corresponds to the highest price of selected bid for the uncongested area of aFRR-Platform.

The steps in the sequence will be performed each optimisation cycle, which has a fixed interval of less than 10 seconds, using the aFRR demands and constraint inputs received by each participating TSO in real time. The optimisation is performed on each optimisation cycle independently from previous optimisation cycles outputs.

By this all TSOs participating in the aFRR-Platform and also participate in the IN-Platform will form an optimisation region in accordance with the imbalance netting implementation framework.

Nevertheless in order to achieve simplification of the necessary optimisation steps, the TSOs recommend that NRAs incentivise and enable the geographical regions of the participating TSOs in the aFRR-Platform to be the same as the geographical regions of the participating TSOs in the IN-Platform, i.e. all the participating TSOs in the IN-Platform to become participating TSOs in the aFRR-Platform.

6.4 Congestion management and calculation of the imbalance netting cross-border capacity limits (Article 4)

This chapter explains the relation between the cross-zonal capacities between bidding zones used in earlier timeframes and the IN cross-border capacity limits on imbalance netting balancing borders used in the INPF. Article 4 of the INIF describes how to find the limits for imbalance netting power interchange between the LFC areas.

The imbalance netting process is defined between LFC areas, therefore, the IN-platform optimises imbalance netting power interchanges between LFC areas, hence the limits considered in the optimisation have to be defined for the borders between LFC areas, as explained in more detail in chapter 6.4.1. The borders between LFC areas are defined as *imbalance netting balancing borders*, and the maximum limit for imbalance netting power interchange is defined as *imbalance netting cross-border capacity limits*.

Chapter 6.4.2 describes how to find the imbalance netting cross-border capacity limit following the step-wise procedure in Article 4(2). The chapter 6.4.2 also describes how the imbalance netting cross-border

capacity limits will be adjusted due to exchange of balancing energy from other processes, and the relationship with the usage of imbalance netting cross-border capacity limits and the aFRR-platform. Chapter 6.4.3 describes how the imbalance netting cross-border capacity limits are used by the INPF.

The congestion management process will consist of the imbalance netting cross-border capacity limits as described in Article 4 of the INIF. Sometimes the IN cross-border capacity limits will be restricted by other factors such as operational security. This is explained in chapter 6.4.4.

It should be noted that some countries make use of additional limitations such as for instance technical profiles to determine their available cross-zonal capacities. This means that capacities on several borders might be linked together. This is addressed briefly in chapter 6.4.2.1. In the remainder it should be clear that anywhere it reads *border* it could be read as *set of borders*, so as to incorporate these technical profiles.

6.4.1 Cross-zonal capacity and LFC areas

In principle, the balancing platforms, both for exchange of balancing energy and for imbalance netting, make use of all cross-zonal capacity available after the cross-border intraday markets, in accordance with Article 37(2) of the EBGL.

However, the aFRR demand is defined and located per LFC area. For this reason the INIF introduces imbalance netting balancing borders, which correspond to the borders between participating LFC areas. Normally, these imbalance netting balancing borders are the same as the aFRR balancing borders when the participating TSO are participating to aFRR-Platform. Often these imbalance netting balancing borders correspond to the bidding zone borders as well, in which case the imbalance netting cross-border capacity limits are equal to the cross-zonal capacity on the bidding zone border remaining after intraday, corrected for other processes as described in 6.4.2.

There are two situations in which there can be a difference between the imbalance netting balancing borders and the bidding zone borders:

- When there are bidding zone borders inside an LFC area, these bidding zone borders do not correspond to an imbalance netting balancing border.
- When there are LFC area borders within a bidding zone, these are imbalance netting balancing borders that do not correspond to a bidding zone border.

In case of bidding zone borders inside an LFC area it is not possible to determine how capacity on this bidding zone borders is used due to exchange of balancing energy or imbalance netting interchange. The aFRR demand as well as delivery cannot be further specified than the LFC area level. See also the example in 6.4.6.

In the opposite case in which there are imbalance netting balancing borders inside a bidding zone, the algorithm still takes into account the imbalance netting cross-border capacity limits on these imbalance netting balancing borders. For these borders an IT technical limit is defined.

In practice both these situations occur. Figure 4 summarises the potential configuration cases, illustrating the difference between the different types of borders when it comes to the imbalance netting cross-border capacity limits.

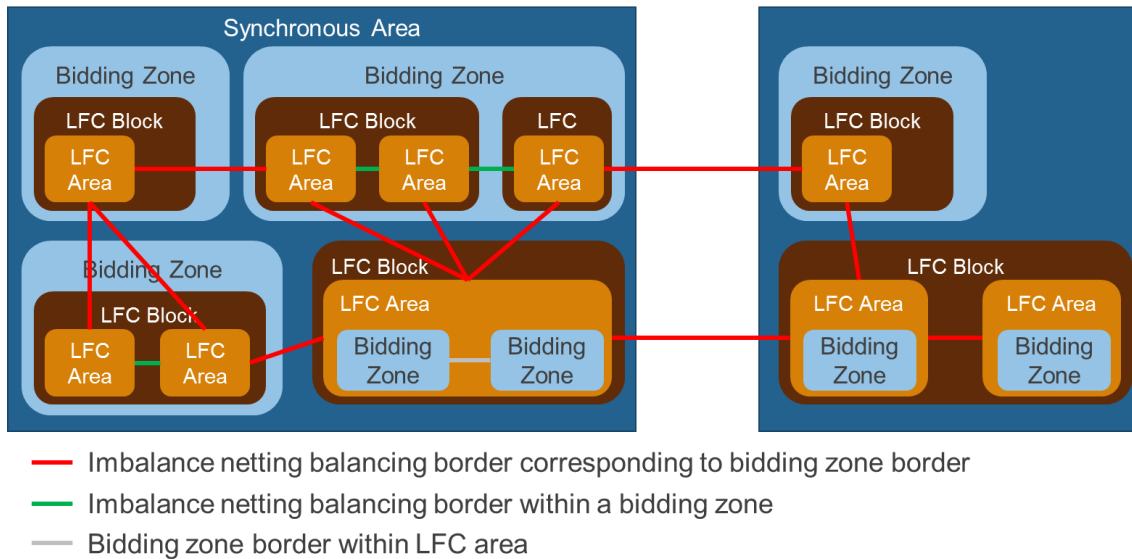


Figure 4: Example LFC structure configuration for participating synchronous areas

These possible configurations include the following:

1. A bidding zone can consist of one LFC block which consists of one LFC area (e.g. France)
2. A bidding zone can consist of one LFC block with more than one LFC areas (Germany after the bidding zone split with AT and neglecting DK1)
3. A bidding zone can consist of more than one LFC block and each of the LFC block can have more than one LFC area (bidding zone of Germany and Austria before the bidding zone split)
4. A LFC block can consist of one LFC area which includes more than one bidding zone (Italy, current Nordic configuration)
5. A LFC block consists of more than one LFC area where each LFC area equals one bidding zone (future Nordic system)

In principle the imbalance netting balancing borders shall be equal to the aFRR balancing borders for the borders also included and used in the aFRR-Platform.

6.4.2 Determination of imbalance netting cross-border capacity limits

In accordance with Article 4(2) of the INIF, each TSO shall be responsible for determining the imbalance netting cross-border capacity limits applicable to each of his imbalance netting balancing borders and providing these limits to the optimisation algorithm. Updated values for imbalance netting cross-border capacity limits will be provided to the IN-Platform in real time on a local control cycle basis. The TSO will do this by following the step-by-step process from Article 4(2) in the IF; First determining the capacity remaining after intraday (step 1). The TSO then updates the limits for interchange in previous balancing timeframes in line with the first-come-first-serve approach (step 2), and for any remedial actions that lead to cross-border exchange on the imbalance netting balancing border (step 3). Finally, additional limitations may be necessary to be taken into account for operational security reasons (step 4). The specific situation of capacity on HVDC borders is accounted for in step 5.

All steps have to be taken but not all of them will lead to a change of the imbalance netting cross-border capacity limits. The order in which these steps are taken can differ.

6.4.2.1 Step 1: Remaining capacity after intra-day

In the first step the remaining capacity on the borders after the energy markets is determined. How this is done varies for the different types of borders presented in chapter 6.4.1.

If the imbalance netting balancing border correspond to a bidding zone border, the imbalance netting cross-border capacity limits are set to be equal to the cross-zonal capacity remaining after the intraday cross-zonal gate closure time in accordance with Article 37(2) of the EBGL. The NTC value, minus the allocation from the day ahead and intraday markets.

For bidding zones which consists of more than one LFC area there are imbalance netting balancing borders between these LFC areas that do not correspond to a bidding zone border. On these borders there is no cross-zonal capacity defined. The main example of this are the imbalance netting balancing borders within Germany. In accordance with the zonal model defined by CACM, the available capacity on these internal imbalance netting balancing borders is assumed to not be limiting the imbalance netting energy exchanges determined by the INPF. For this reason, the imbalance netting cross-border capacity limits on these borders are set to a value that should not be reached as a result of realistic cross-border exchanges. All member TSOs shall agree on the value of this technical IT limitation.

The last type of border is the result of an LFC area covering several bidding zones. Because the imbalance netting process and the aFRR demand is defined on LFC area level, it is not possible to take the cross-zonal capacities in these borders into account. For the INPF these borders are not considered, and thus, in practice, considered as infinite.

If a technical profile on the sum of several borders is defined in the intraday market, such limits will also be taken into account in the INPF. These profiles are used on some borders to limit the sum of cross-border capacity into or out of an area without restricting the individual cross-zonal capacities. Such technical profiles are defined for instance on the borders out of Poland.

6.4.2.2 Step 2: First-come, first-serve

In the second step, the imbalance netting cross-border capacity limits are updated on the basis of earlier balancing processes in accordance with chapter 2 of the EBGL. This is based on a sequential first-come-first serve approach. That is to say:

- The initial imbalance netting cross-border capacity limits are corrected for the replacement power interchanges on the imbalance netting balancing borders. These corrected limits should correspond to the mFRR cross-border capacity limits before any mFRR activation, notwithstanding:
 - any corrections done for purposes of additional limitations in accordance with the next step (reducing limits of both mFRR, aFRR and IN);
 - any corrections done for activated remedial actions (reducing limits of both mFRR, aFRR and IN) in accordance with Article 4(2)(c) of the INIF;
 - any allocation of cross-zonal capacity to the aFRR and IN process (reducing limits of mFRR to keep limits for aFRR and IN high enough), as explained below.
- The aFRR and imbalance netting cross-border capacity limits are also adjusted for mFRR activation, by correcting for the manual frequency restoration power interchanges. This, with the corrections on remedial actions and additional limitation, then defines the aFRR and imbalance netting cross-border capacity limits that are the input to the algorithm of the aFRR-Platform and the IN-Platform.
- These aFRR and imbalance netting cross-border capacity limits are as input to the INPF and the aFRR AOF used for both aFRR balancing energy exchange and imbalance netting energy exchange, as described below.

As indicated some cross-zonal capacity may have been allocated to a specific balancing process in accordance with chapter 2 of the EBGL. This allocation is done for the exchange of balancing capacity or sharing of reserves. In case this allocation is done for aFRR and imbalance netting, the allocation needs to be taken into account in the distribution of cross-zonal capacity between the platforms, and will be taken into account when applying the first-come-first-serve approach to determine the aFRR and imbalance

netting cross-border capacity limits. The aFRR and imbalance netting cross-border capacity limits should always at least be equal to the allocated cross-zonal capacity for those aFRR and imbalance netting balancing borders that correspond to the bidding zone borders on which the allocation for aFRR and IN has been done. This affects the RR and mFRR cross-border capacity limits.

Figure 5 shows a timeline of the different processes which shows the points of attention for the first-come-first serve approach and the distribution of cross-zonal capacity between the platforms in general. Special points of attention for aFRR are the challenging possible overlap between the time in which mFRR can be directly activated, and the time in which aFRR can be activated on the one hand (example – for QH2 the overlap happens from T+15 min to T+17,5 min), and the simultaneous nature of aFRR and IN on the other.

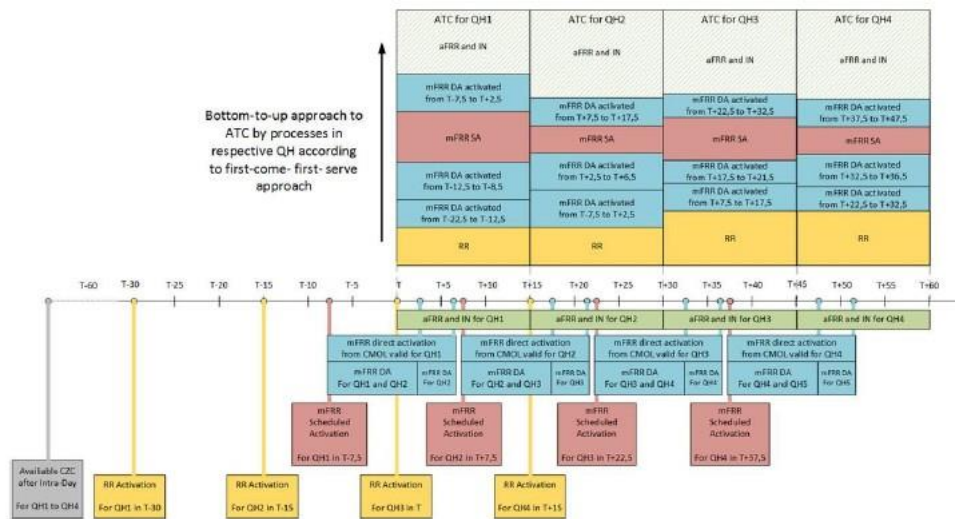


Figure 5: Timeline of activation in platforms with first-come-first-serve approach to capacities

The simultaneous use of aFRR and imbalance netting cross-border capacity limits by aFRR and IN is handled by performing both processes on the same IT-platform. As described in chapter 6.3, both processes are performed in the same optimization cycle but in separate optimisation steps. The cross-border capacity which is used in the aFRR optimisation step is considered in the subsequent IN optimisation step.

6.4.2.3 Step 3: Updates due to remedial actions

Step 3 of the process presented in INIF Article 4(2) handles the case where the cross-zonal capacities are updated after the intra-day gate closure time. The TSO shall according to the EBGL 37(1) update the available CZC "...every time a portion of cross-zonal capacity has been used or when cross-zonal capacity has been recalculated".

Since cross-zonal capacity also can be used for remedial actions, the process for determining the aFRR and imbalance netting cross-border capacity limit must take into account that the cross-zonal capacities can be updated after the intra-day gate closure time whenever remedial actions leads to cross-border exchange.

For example, if a desired flow range for system constraint purposes has been requested in either the RR or mFRR balancing platforms, these limitations must be respected by the cross-border capacity limits for the subsequent processes.

6.4.2.4 Step 4: Operational security constraints

The imbalance netting cross-border capacity limits can be further restricted by operational security considerations. The imbalance netting cross-border capacity limits can be restricted upon request by TSOs participating in the imbalance netting process as well as TSOs that are defined as affected TSOs in accordance with Article 146(3)(c), 147(3)(c), 148 (3)(c), 149(3) and 150(3)(b) of the SOGL. These restrictions can also be applied to imbalance netting balancing borders that are not bidding zone borders and

are therefore usually only limited by IT limitations. Additionally, constraints can be applied through technical profiles that can be defined specifically for the balancing timeframe.

These additional limitations shall be published. If requested by the participating TSOs, the TSO applying these additional limitations will provide a justification. The algorithm is then required to take these adjusted imbalance netting cross-border capacity limits into account in calculating the optimisation result.

Several situations can make such additional restrictions necessary. Some examples can be:

- An affected TSO can experience flows within its area due to imbalance netting power interchange over another area ;
- The total exchange in or out an area can lead to congestions within an LFC area ;
- An outage or another sudden event in the power system can reduce the available capacity out of an LFC area.

6.4.2.5 Step 5: Technical constraints

Step 5 takes into account that not all imbalance netting balancing borders consisting of HVDC interconnectors have the technical ability to exchange IN, or that the technical ability may be more or less limited. HVDC interconnectors vary in technology and specification, and will have different properties affecting their ability to transfer imbalance netting power interchange.

Some connections might not be available for IN at all, while some might have restrictions related to zero-crossings, minimum volumes, maximum ramping rates or other technical restrictions.

6.4.3 Treatment of imbalance netting cross-border capacity limits in the INPF

Imbalance netting cross-border capacity limits on all imbalance netting balancing border will be used as constraints of the objective function of INPF. The INPF will make sure that the imbalance netting power interchange on imbalance netting balancing borders resulting from the optimisation does not exceed the corresponding imbalance netting cross-border capacity limits.

If the imbalance netting cross-border capacity limits do not constrain the optimisation, the entire IN-Platform area will form one uncongested area. On the other hand, if the optimisation problem is constrained, several uncongested areas will be defined and separated at the imbalance netting balancing borders where the congestion occurred. When forming two uncongested areas the power interchange between the areas will always equal the imbalance netting cross-border capacity limits.

When the INPF form several uncongested areas this will influence the proportional distribution of netting potential.

6.4.4 Other measures for operational security

In addition to restricting the imbalance netting cross-border capacity limit, it can be beneficial to provide other kinds of limitations. Article 3(4)(d) of the IF describes as an input to the INPF operational security constraints provided by the participating TSOs or affected TSOs in accordance with Article 146, 147, 148, 149 and 150 of the SOGL.

This can for example be a maximum limit of the net imbalance netting power interchange from one LFC area, or other measures that the TSO finds necessary.

6.4.5 Future development

The TSOs shall within five years after entry into force of the EBGL develop a methodology for cross-zonal capacity calculation within the balancing timeframe. Once the methodology pursuant Article 37(3) of the EBGL is approved and implemented, the imbalance netting cross-border capacity limits shall respect this capacity calculation methodology.

If parts of the whole European intraday market are performed in a flow-based domain, an extraction of available cross-zonal capacity per bidding zone border will be used, comparable to the process between the market coupling in the CWE region and the succeeding intraday market. The part of this available cross-zonal capacity used for the imbalance netting process will take into account previous balancing processes as described in 6.4.2. In any case, only available cross-zonal capacities will be used for the imbalance netting process, the transmission reliability margin of TSOs will not be used by the IN-Platform.

6.4.6 Example

Consider the configuration as in Figure 6, and assume:

- The aFRR demand of LFC area A is -200 MW (downward demand) and the aFRR demand of LFC area B is 200 MW (upward demand)
- There is sufficient cross-zonal capacity between bidding zone 1 and bidding zone 2 but only 100 MW of available cross-zonal capacity between bidding zone 2 and bidding zone 3

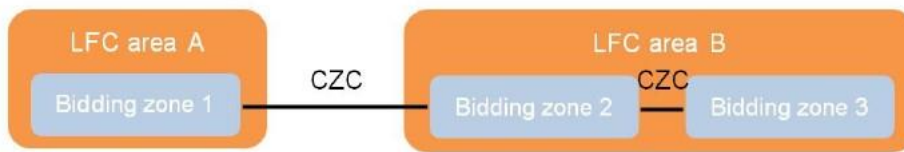


Figure 6: Example configuration of multiple bidding zones in one LFC area

The aFRR demand reflects the real time imbalance of the system in the LFC area. In this case, since the aFRR demand is defined for the complete LFC area B, it is not possible for the INPF to identify which part of the imbalance of LFC area B is located in bidding zone 2 and in bidding zone 3. Whatever the actual situation, the INPF will request an imbalance netting power interchange of 200 MW from LFC area A to LFC area B. Then if at least 100 MW of the 200 MW aFRR demand of LFC area B is located in bidding zone 2, the CZC between bidding zone 2 and bidding zone 3 will be respected. But if more than 100 MW of aFRR demand of LFC area B is located in bidding zone 3, the cross-zonal capacity between bidding zone 2 and 3 will not be respected.

6.5 Calculation of the imbalance netting algorithm

The imbalance netting algorithm will follow the objectives listed in article 13 of INIF:

- (a) First priority: minimise the deviation from the imbalance netting target values;
- (b) Second priority: maximise the satisfaction of the aFRR demand of individual LFC areas;
- (c) Third priority: minimize the deviation from the proportional distribution of deviation from the target value;
- (d) Forth priority: minimize the absolute value of imbalance netting power interchange.

For applying these priorities the imbalance netting target values have to be calculated in a pre-process. The imbalance netting target values reflect the optimal distribution of netting potential in case of no active limitation. The imbalance netting target values are the share of the sum of aFRR demand with the same sign times the total netting potential. In the first example 6.6.1 there is a netting potential of 500 MW. LFC block A has a share of 20 % of total positive aFRR demand, hence its imbalance netting target value is 100 MW.

In case there are no congestions the calculated correction values match exactly the imbalance netting target values. In case of congestions the imbalance netting target values cannot be reached and the calculated correction values deviate from the target values. For these cases the optimisation foresees different objectives within the objective function, which are prioritised by application of different weights.

The practical effect of applying these priorities on the optimisation of the imbalance netting power interchange can be understood as follows:

- Deviations from imbalance netting target values can occur due to the imbalance netting cross-border capacity limits on imbalance netting balancing borders. The deviation from the imbalance netting target values shall be minimized.
- The next priority shall become relevant for the outcome of the algorithm and for the determination of the imbalance netting power interchange between LFC areas if there are multiple solutions possible that fulfill the first priority: for instance, if you can minimize the deviation to the target value of the LFC areas in multiple ways, the satisfaction of demand shall be maximised. This ensures that the netting potential is maximised. However, also with the second priority more than one solutions are possible. To ensure fairness between the LFC areas the third objective strives for proportional distribution of the deviations from the target values.
- The objective of the fourth rule of power exchange minimization is to choose the optimal solution which uses the least cross-border capacity when several solutions fulfil all earlier objectives.

In the following subchapters, examples are provided for better understanding.

6.6 Examples for the calculation of the imbalance netting algorithm

6.6.1 Unrestricted optimisation

Figure 7 demonstrates the calculation of the correction values without limitations. LFC areas A and B are short (1000 MW in total) while LFC areas C and D are long (500 MW in total).

Therefore, the optimisation targets are to fully net the aFRR demand of C and D and to distribute the netting for A and B according to the respective shares of the overall positive aFRR demand. Since there are no limitations, the optimisation target can be reached (the deviation from the optimisation target is zero).

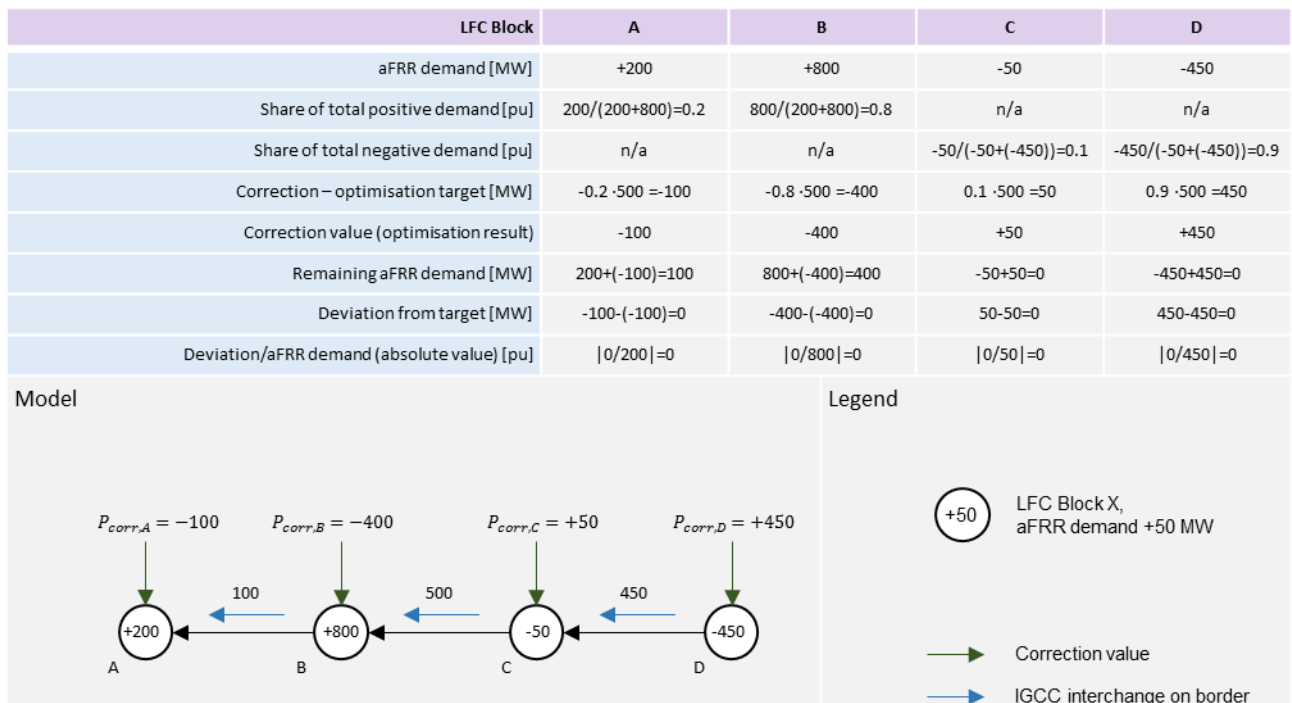


Figure 7: Example without consideration of restrictions

6.6.2 Impact of limitations

In accordance with Article 4 of the INIF, limitations to the calculation of the correction value include available cross-zonal capacity (CZC) calculated in accordance with Article 37 of the EBGL and additional limitations to the available CZC requested by affected TSOs in accordance with Article 150 of the SOGL. However, in case two or more TSOs are exchanging balancing capacity, Article 36(2) of the EBGL provides the possibility to use CZC for the exchange of balancing capacity. If balancing capacity is exchanged or reserves are shared between two or more TSOs, the allocated capacity needs to be taken into account in the calculation of available CZC for the imbalance netting process. No other limitations other than those on the available CZC will apply in normal operation in the IN-Platform. This is different from the current operation of the IGCC, where some TSOs limit the maximum individual import and export to their available aFRR volume.

Figure 8 to Figure 17 demonstrate the calculation of the correction value for different scenarios with four LFC areas.

Figure 8 shows the same scenario as in Figure 7 but with a imbalance netting cross-border capacity limit on the concerned imbalance netting balancing border between B and C. The imbalance netting power interchange in the direction from C to B is limited to 2000 MW (this value could represent the available CZC or a limitation in accordance with the INIF). The imbalance netting cross-border capacity limit does not affect the correction value (being higher than the value of 500 MW which is needed to reach the optimisation targets).

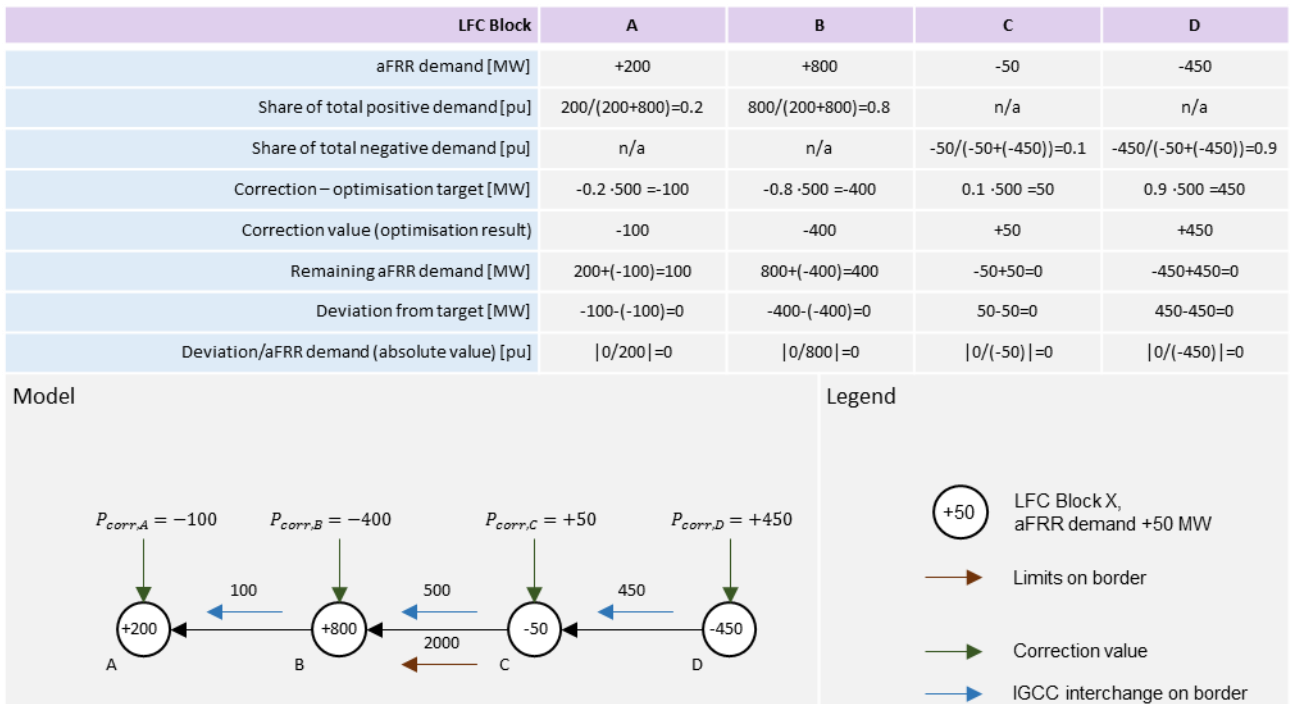


Figure 8: One limitation (not Active)

Figure 9 shows the scenario with a more restrictive imbalance netting cross-border capacity limit on the concerned imbalance netting balancing border between B and C. The imbalance netting power interchange in the direction from C to B is limited to 100 MW. Therefore, only 100 MW can be exported from C and D to A and B and the optimisation targets cannot be reached. The impact of the limitations is distributed according to the shares used for the calculation of the optimisation target, i. e.: A imports a share of 0.2 of 100 MW and B imports 0.8 of the 100 MW. Accordingly, C exports a share of 0.1 of 100 MW and D exports a share of 0.9 of 100 MW. By this the algorithm strives to keep the share defined by the deviation divided by the aFRR demand for all LFC areas of one direction similar.

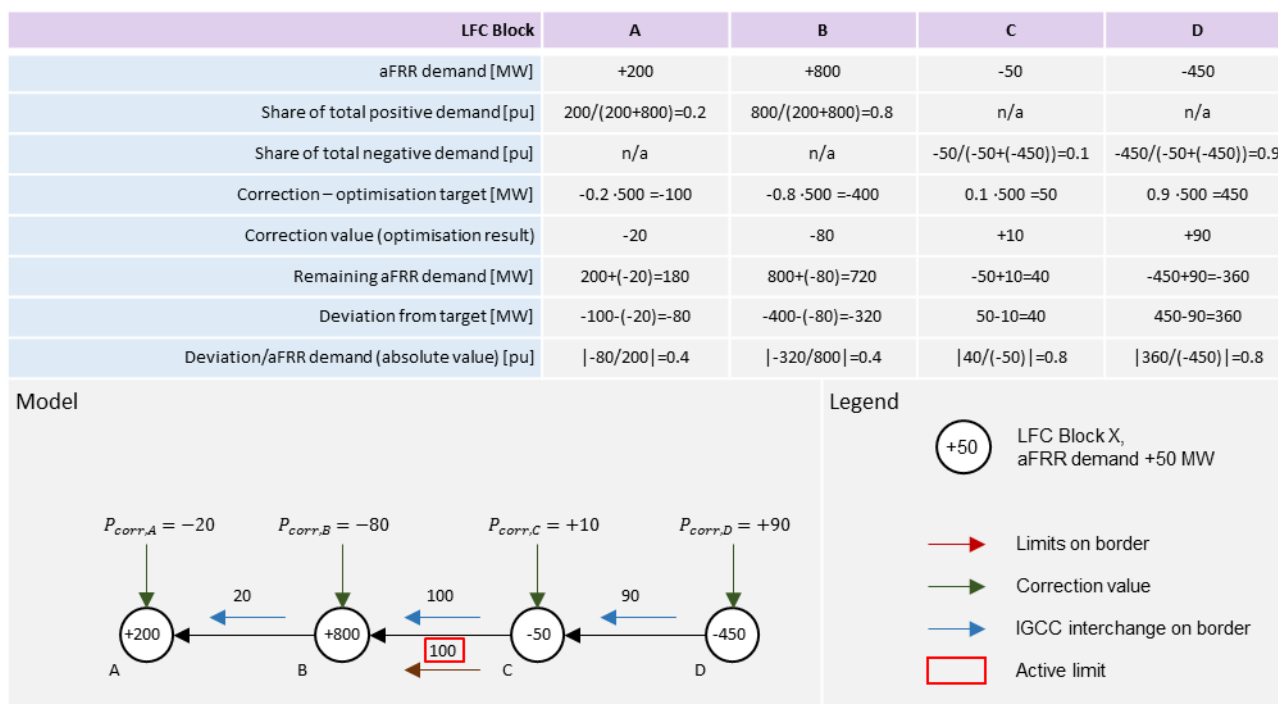


Figure 9: Example with one active limitation

Figure 10 moves the imbalance netting cross-border capacity limit of 100 MW to the concerned imbalance netting balancing border between D and C. Now the export of D is limited to 100 MW. Since the overall amount of short aFRR demand is 1000 MW, C exports its complete long aFRR demand of 50 MW. A and B receive the respective shares of the overall export of 150 MW.

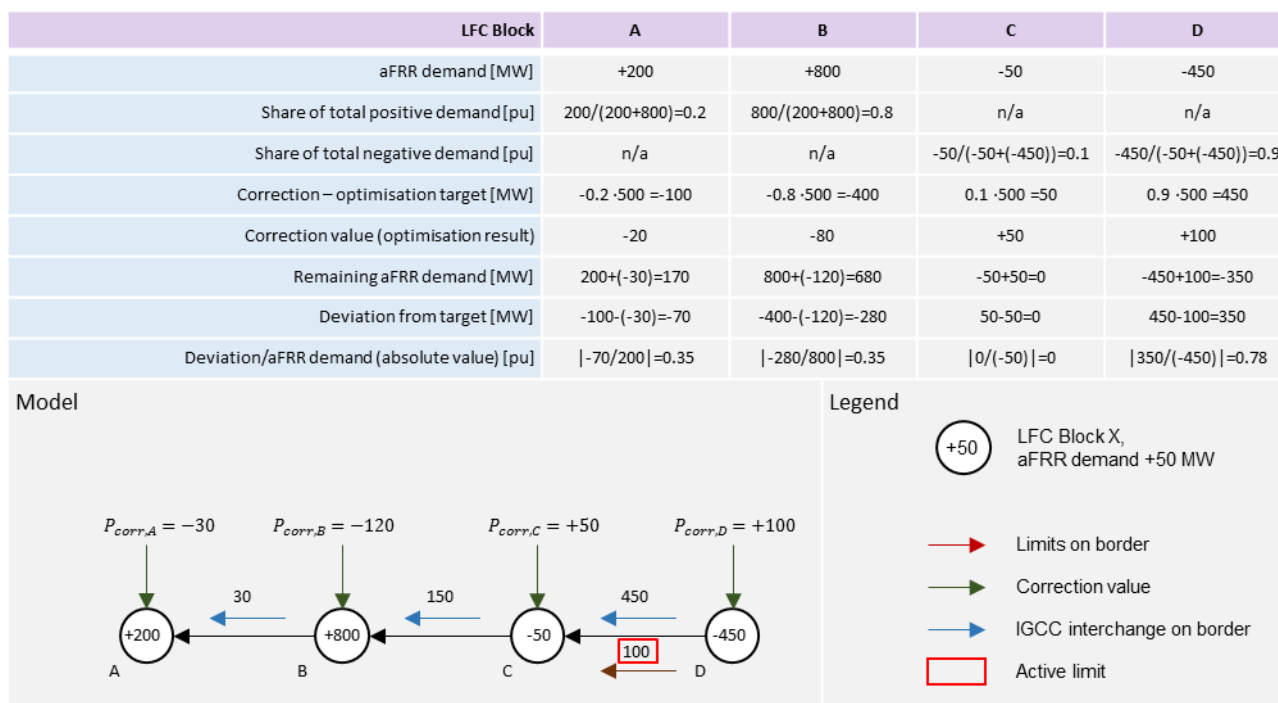


Figure 10: One Active limitation

Figure 11 introduces an additional imbalance netting balancing border between D and A.

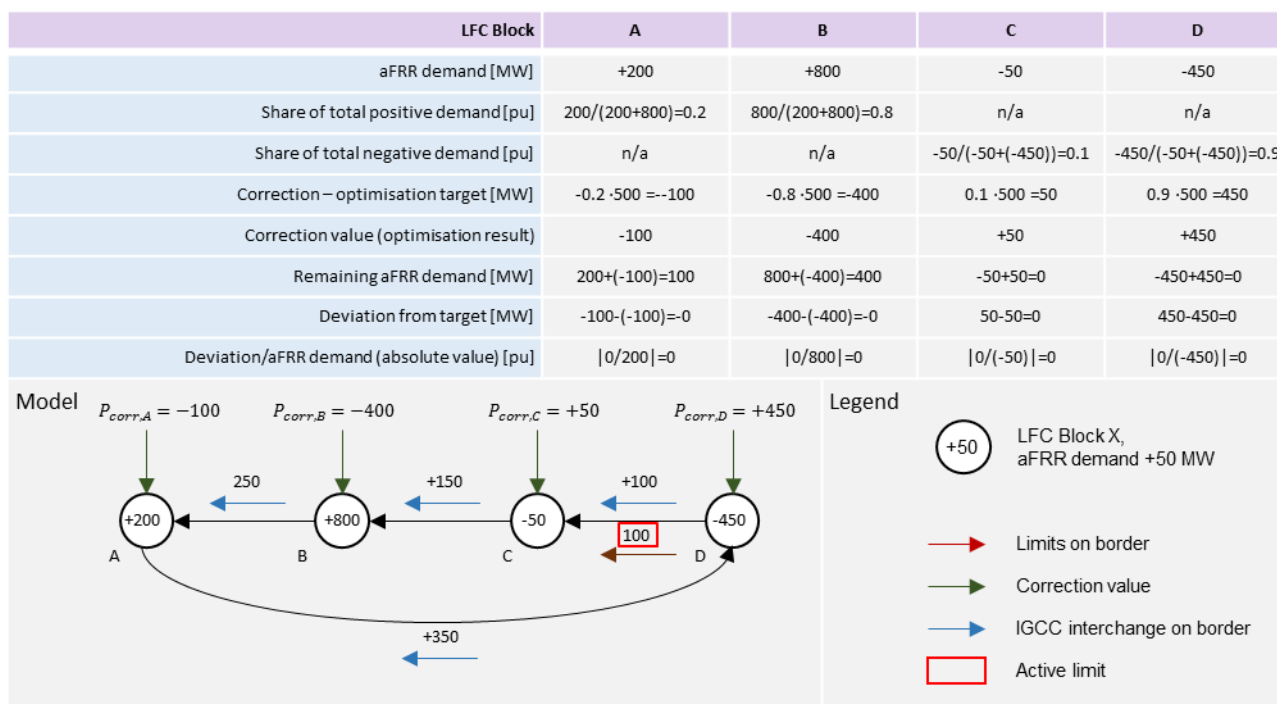


Figure 11: One active limitation without an impact on correction values

Although the imbalance netting cross-border capacity limit between D and C of 100 MW still exists, the imbalance netting balancing border between D and A can be used to exchange the additional 350 MW (no deviation from optimisation target).

A profile limit is a imbalance netting cross-border capacity limit on a set of imbalance netting balancing borders and by this a measure to ensure operational security. Currently applied in IGCC operation, profile limits will be applicable in the future operation of the European platform for the imbalance netting process only in case of operational security, according to Article 4 of the INIF. Figure 12 shows the example of limitations which affect a set of two concerned imbalance netting balancing borders (profile limits). The sum of the imbalance netting power interchange from D to C and from D to A is limited to zero which means that D cannot export its long imbalance. The impact on A and B is distributed according to the shares.

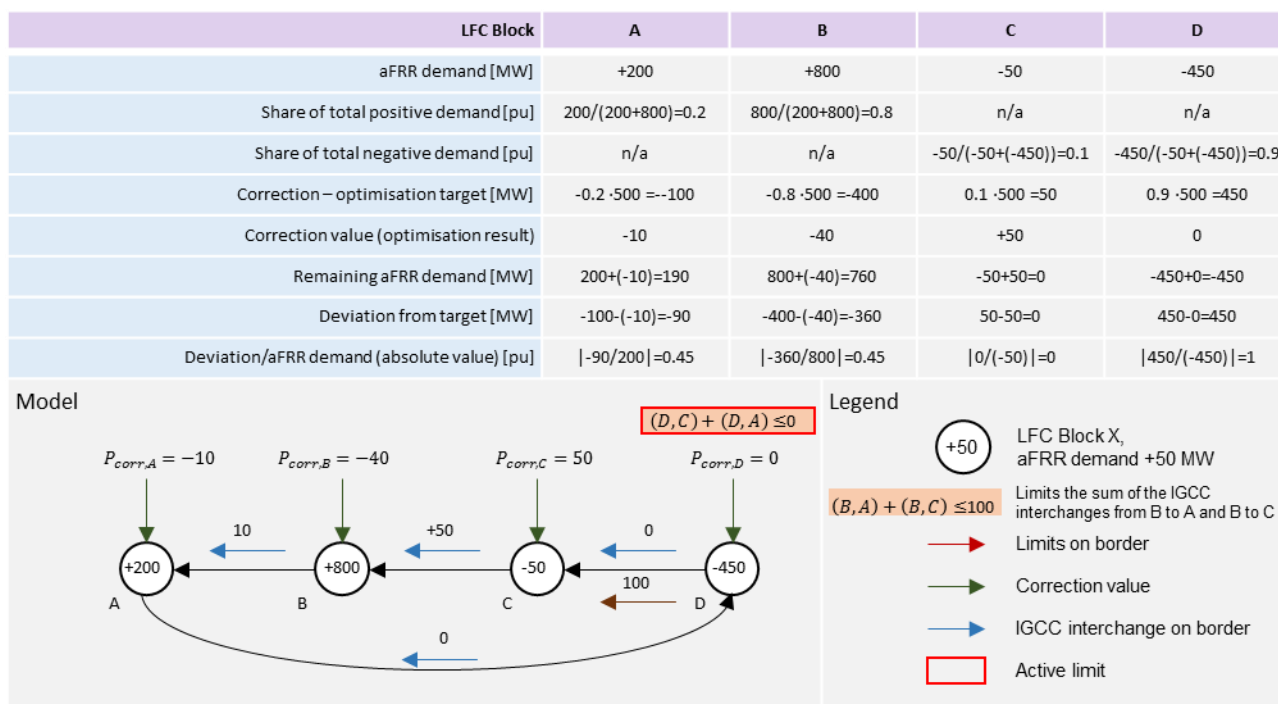


Figure 12: One active profile limit

Figure 13 shows another example of an active profile limit. In this case the total import of B is limited to 100 MW through the restriction of sum of the exchanges from A to B and from C to B. Together with the maximum import of A, which is limited by the aFRR demand 200 MW, the overall import is limited to 300 MW. The impact is distributed proportionally to C (export of 270 MW) and D (export of 30 MW). Due to the restriction of the overall import to 300 MW the profile limit of D and the imbalance netting cross-border capacity limit from D to C remain inactive.

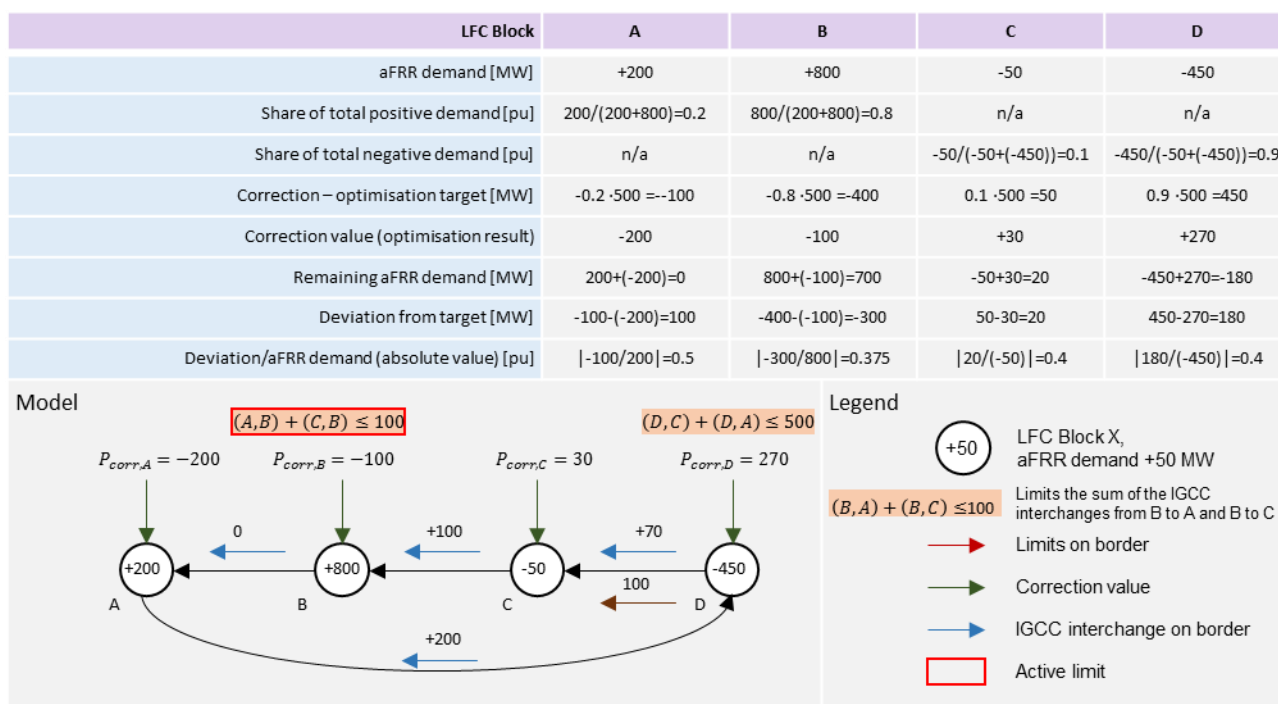


Figure 13: Combination of one active profile limit with other limits

Figure 14 introduces a further restriction of total exchange taking the scenario in Figure 13 as starting point. The CZC from D to A of 0 MW in combination with the CZC of D to C limits the export of D to 100 MW. Therefore, C and D can export 150 MW in total. Following the principle of proportional distribution B would receive 120 MW as import, but the profile limit of B still restricts its import capability to 100 MW. The remaining 200 MW which cannot be imported by B are passed to A.

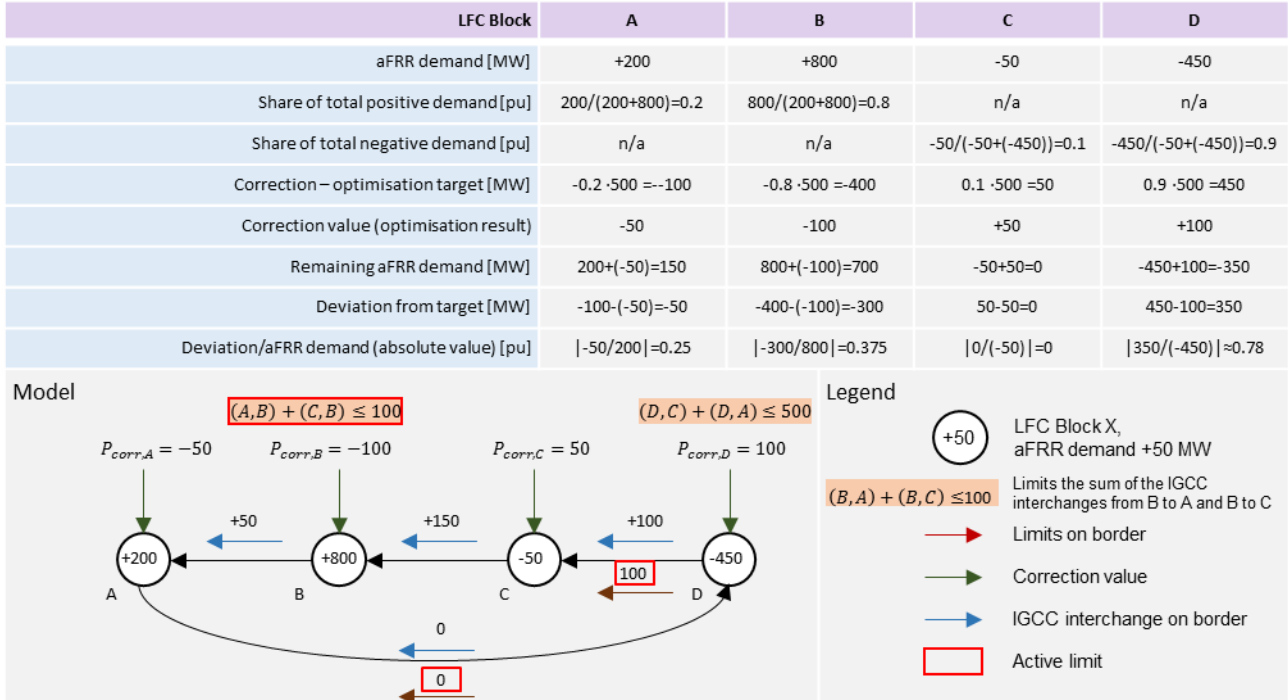


Figure 14: Active profile limit and active limitations

Figure 15 demonstrates a different configuration of imbalance netting balancing borders where A and D each have three neighbours. There is one active imbalance netting cross-border capacity limit from D to B limiting the respective exchange to 100 MW. Since there are no other active limitations or profile limit, this imbalance netting cross-border capacity limit has no impact on the overall imports and exports so that the result corresponds to the result in the unrestricted scenario shown in Figure 7.

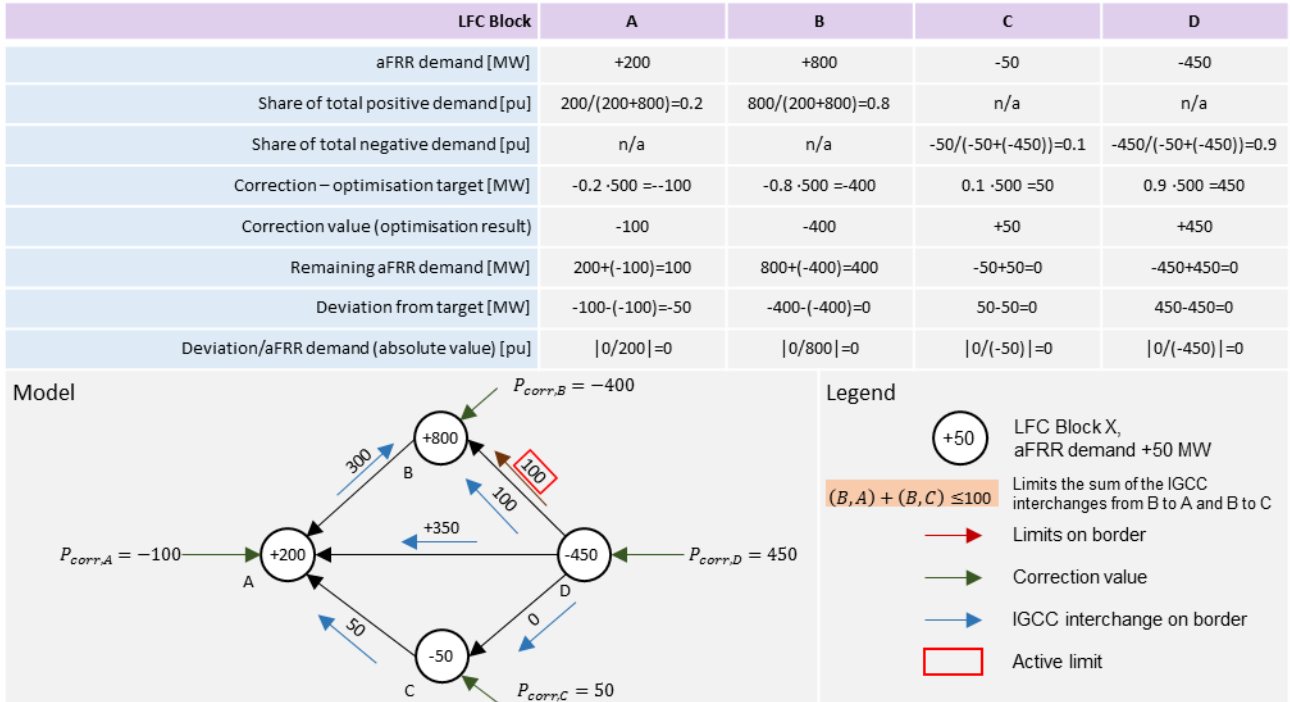


Figure 15: Example for "triangle" configuration (active imbalance netting cross-border capacity limit)

In Figure 16, the import of B is limited by a profile limit to 100 MW. Therefore, the total import potential of A and B is equal to 300 MW which are distributed proportionally to C and D. The imbalance netting cross-border capacity limit from D to B is active but does not limit the overall exchange.

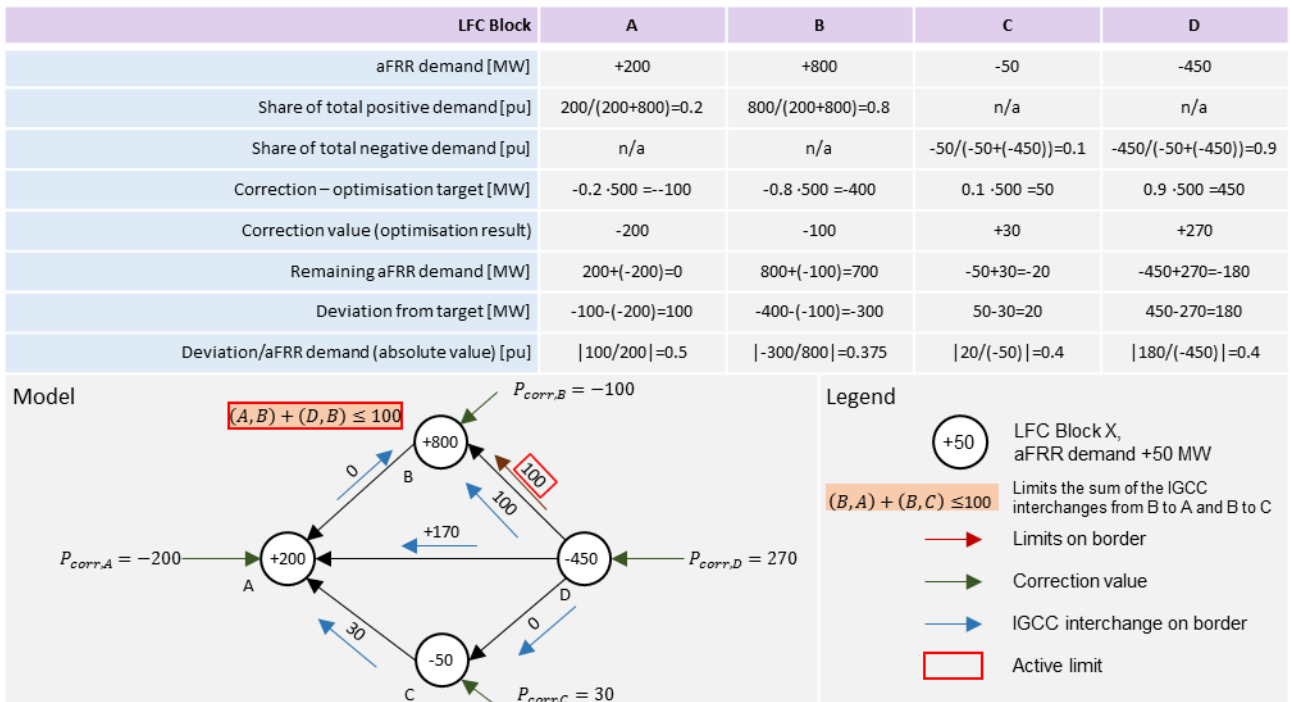


Figure 16: Example for "triangle" configuration (Active imbalance netting cross-border capacity limit and profile limit)

Figure 17 shows the example with a profile limit of 200 MW applied in the export direction for D. Moreover, the imbalance netting cross-border capacity limit from D to B of 100 MW is still active. As a result 250 MW can be exported from C and D to A and B. The impact is distributed proportionally.

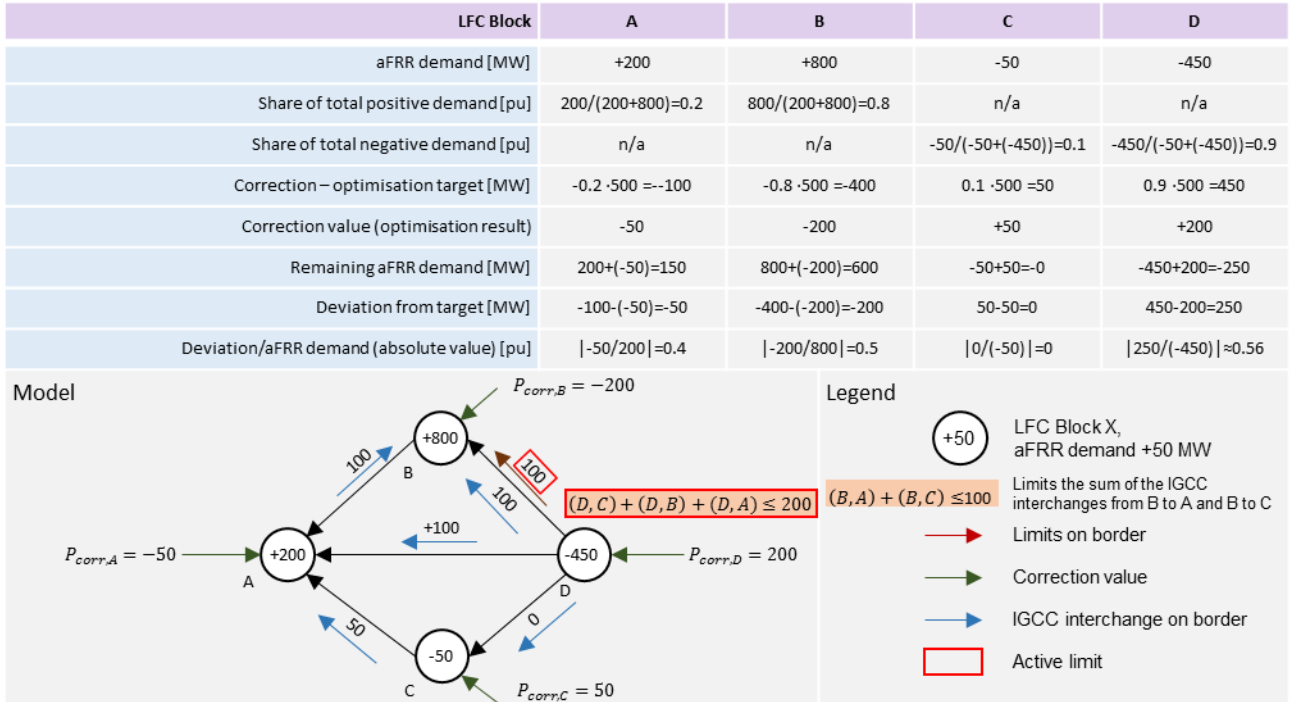


Figure 17: Example for "triangle" configuration (active profile limit)

6.7 Optimisation regions

Article 13(6) of the INIF details the proposal for the formation of optimisation regions. Optimisation regions allow to have an optimisation of the concerned area prior to the global optimisation of all LFC areas in the last step.

The prior optimisation of a specific region including more than one LFC area or LFC block can be beneficial in the following cases:

- LFC block with common aFRR dimensioning according to Article 146(9) of the SOGL;
- Synchronous areas according to Article 146(10) of the SOGL
- LFC areas or LFC blocks exchanging balancing energy from aFRR based on a common merit order list.

In case c), when more than one LFC area or LFC block exchange balancing energy from aFRR based on a common merit order list, the prior optimisation within these regions enables the consideration of prices within the prior optimisation which is beneficial compared to a scenario where no prices are considered. The optimal consideration of the prices of the common merit order list can only be ensured by allowing prior access to the respective transmission capacities of the concerned borders.

Concerned imbalance netting balancing borders of the respective region are the imbalance netting balancing borders which are only shared by LFC areas of the respective region. In the sequential global optimization step, all imbalance netting balancing border are considered with the updated imbalance netting cross-border capacity limit.

Figure 18 gives an example of concerned imbalance netting balancing borders for TSOs forming an optimisation region.

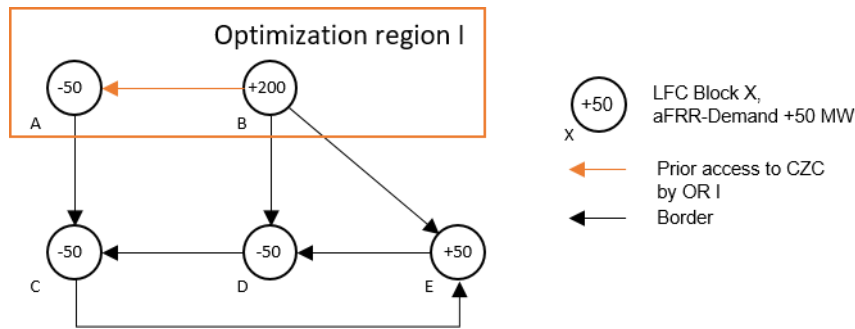


Figure 18: Example of an optimisation region with prior access to concerned imbalance netting balancing borders

If an optimisation region due to TSOs exchanging balancing energy from aFRR exists, all the remaining LFC blocks not being part of the optimisation region of the TSOs exchanging balancing energy from aFRR shall have the right to participate in an optimisation region for imbalance netting, preceding the imbalance netting among all LFC blocks of the IN-Platform and therefore have prior access to the transmission capacity of imbalance netting balancing borders which are shared by two TSOs of the respective optimisation region. By this, every TSO has the right to be part of one optimisation region and has prior access to a specific set of transmission capacities. This rule ensures equal treatment and non-discrimination.

Figure 19 shows a possible example with two LFC areas (A and B) forming one optimisation region due to the exchange of balancing energy from aFRR and the remaining three LFC areas (C, D and E) forming an optimisation region for imbalance netting.

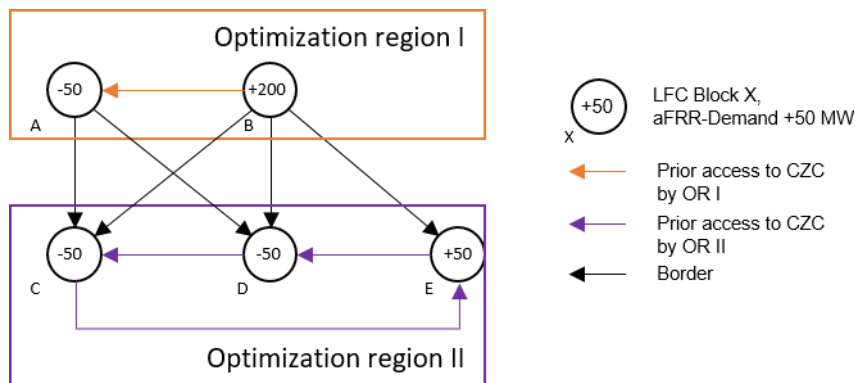


Figure 19: Example of two optimisation regions with prior access to concerned imbalance netting balancing borders

In the first optimisation step, the optimisation region I (A and B) and optimisation region II (C,D, and E) are optimised in parallel. A and B have prior access to the transmission capacity on the imbalance netting balancing border b_{AB} . C, D and E have prior access to the transmission capacities b_{CD} , b_{CE} and b_{DE} . The transmission capacities b_{AC} , b_{AD} , b_{BC} , b_{BD} and b_{BE} are only used in the second optimisation step, the “global” optimisation step.

In the global optimisation step, the resulting aFRR demands and updated CZC of the first optimisation steps are used.

The formation of optimisation regions does not have an impact on the global netting volume. But it might have an impact on the distribution of the netting volume amongst all participating TSOs.

However, all TSOs consider the implicit usage of prices for TSOs exchanging balancing energy of aFRR based on a common merit order list and by this the optimal usage of the available CZC as beneficial for the efficiency of the European balancing market. By usage of prices for TSOs where comparable prices are available, for example in case of a common merit order list, the proposal ensures that the most expensive bids in this region are netted. Hence, based on the available information, the most efficient netting of

imbalances is performed, however deviating in this region from the proportional distribution of netting potential.

Nevertheless, all TSOs strive for a minimisation of total numbers of optimisation regions. Hence, according to Article 13(6)(c) of the INIF the number of possible optimisation regions shall not exceed the sum of the number of aFRR areas of participating TSOs, number of by LFC blocks of participating TSOs where the reserve capacity on FRR as well as the reserve capacity on RR is calculated based on the LFC block imbalances and number of synchronous areas of participating TSOs by more than one. An aFRR area is defined as an area where two or more TSOs exchange aFRR between their LFC areas. Figure 20 shows a practical example of application of this criteria for the transition period when not all TSOs are part of the IGCC and not all TSO are part of the PICASSO platform. Germany including Denmark and Luxembourg form an LFC block with a common dimensioning and by this an optimisation regions. Also Slovenia and Croatia as LFC block form an optimisation region. In this example the German LFC block, Austria, RTE, Belgium and the Netherlands already exchange aFRR via the PICASSO platform and by this form an optimisation region. Due to fairness reasons all TSOs not part of the PICASSO platform form another optimisation region (green area). Resulting in the shown layers of optimisation regions. In the first layer all LFC blocks are optimised, in the second layer all aFRR areas and the fairness region are optimised. In case a second synchronous area would be connected, a third layer of optimisation regions with the synchronous areas as optimisation regions would be added.

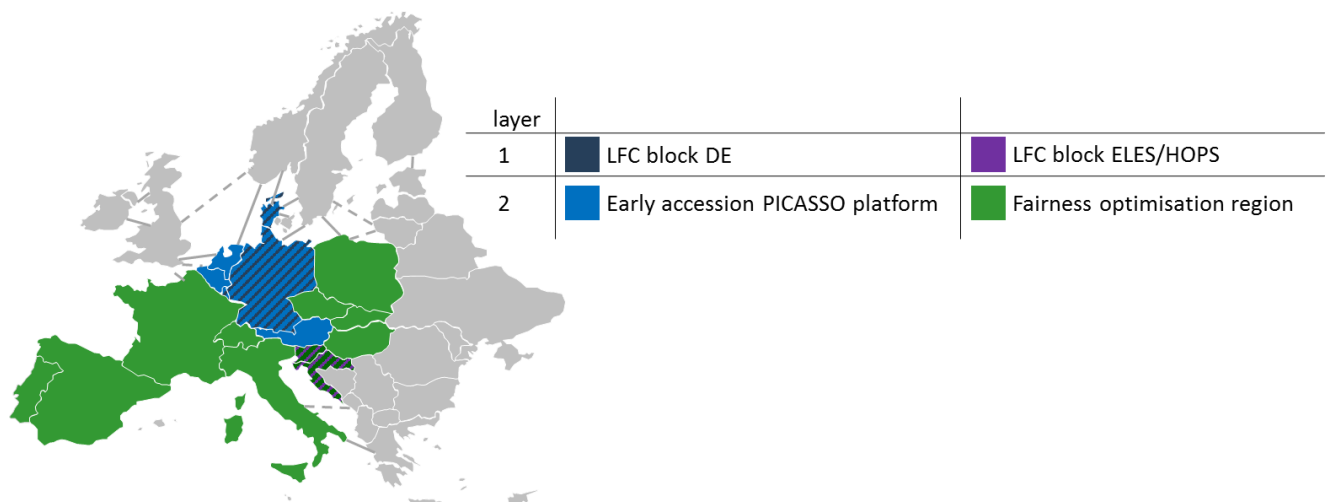


Figure 20: Possible configuration of optimisation regions in the transition period

6.7.1 Numerical examples

Figure 21 demonstrates a configuration with two optimisation regions: one optimisation region based on an aFRR cooperation including B and C (“optimisation region 1”) and one optimisation region between A and D (“optimisation region 2”). There is no active imbalance netting cross-border capacity limit in this example. The example in Figure 18 considers the common merit order list of the aFRR cooperation illustrated in Figure 21 for the positive aFRR activation.

Position in CMOL	LFC Block B	LFC Block C
1	50	-
2	-	150

Figure 21: Common merit order list for the aFRR cooperation between LFC blocks B and C

Figure 22 shows an positive aFRR demand in A and C and a negative aFRR demand in B and D. The two optimisation regions are optimised in a first step. B and C perform, as an aFRR cooperation, implicit netting

of 50 MW and due to the CMOL an additional exchange of 50 MW of aFRR from B to C. B provides 50 MW of aFRR towards C. In parallel, the optimisation region 2 performs implicit netting of 250 MW based on their aFRR demands. Each optimisation region has prior access to the transfer capacity being within the optimisation region, i.e.: only on the common imbalance netting balancing borders of the TSOs in the same optimisation region. The optimisation region 1 has prior access to the transfer capacity B-C and the optimisation region 2 has prior access to the transfer capacity A-D. Transfer capacities A-B and C-D are only considered in the second optimisation step. In the second optimisation step, all LFC blocks perform netting in one layer. In this layer the remaining aFRR demands from the optimisation region 1 are netted with the remaining aFRR demands from the optimisation region 2 considering the result of the aFRR cooperation. By this, the most expensive bids of the aFRR cooperation are netted. In this example, 50 MW between LFC block C and D are netted in the last optimisation step leading to a remaining aFRR activation of 50 MW in B and C. The total netting volume of 350 MW is independent from the configuration of optimisation regions.

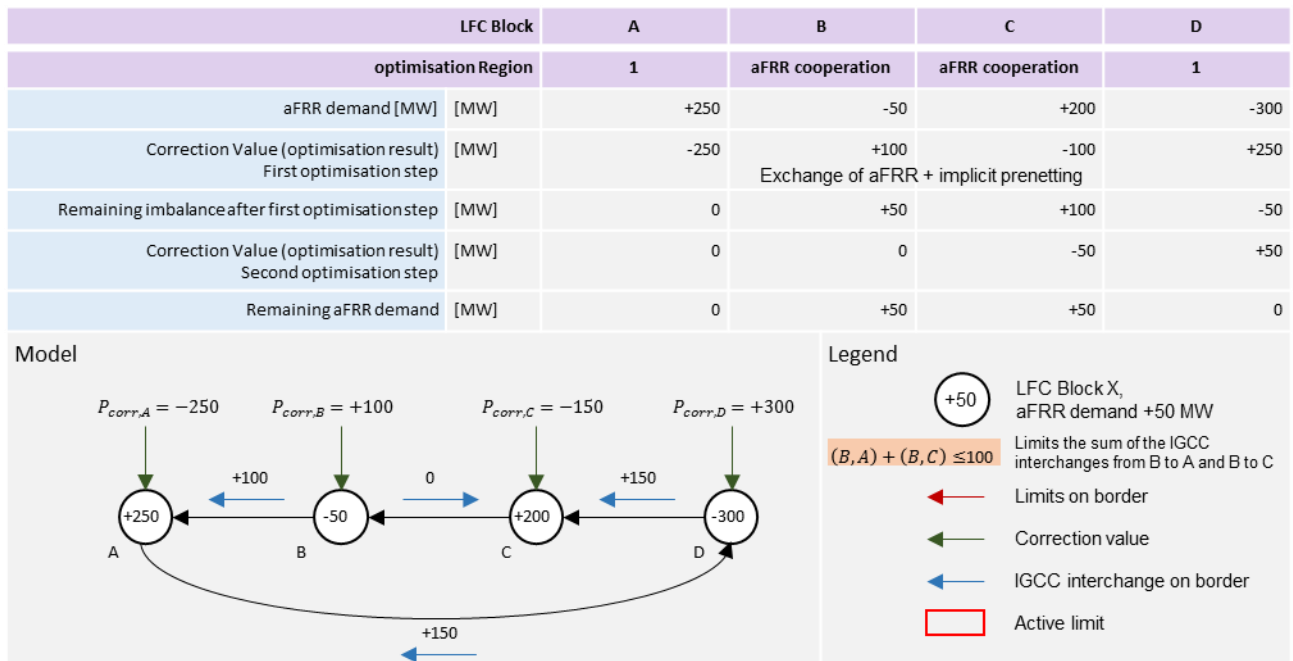


Figure 22: Example for optimisation regions without limitation

In Figure 23, the same configuration as in the example in Figure 22 applies. Additionally, the import of LFC block C is limited to a value of 120 MW. Hence, as LFC block C is part of the aFRR cooperation, the optimisation region 1 has prior access to the capacity B-C.

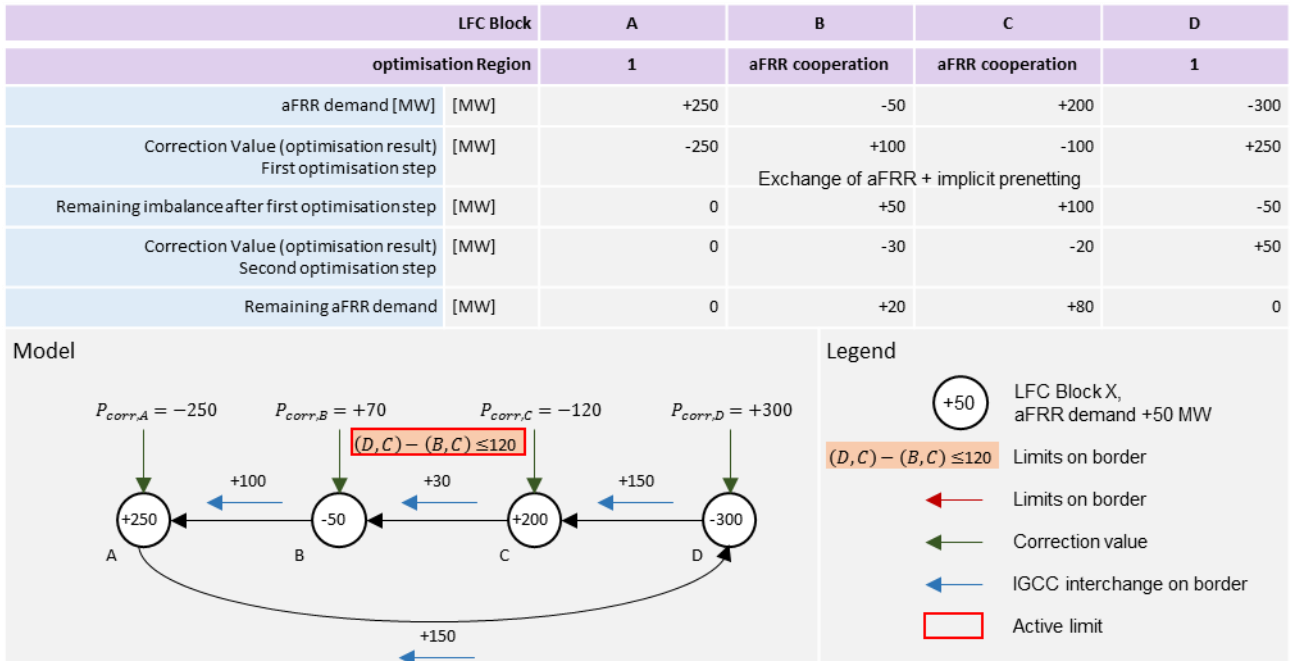


Figure 23: Example for optimisation regions with limitation

The optimisation result of the first optimisation step remains unchanged. For the second optimisation step, only 20 MW of the import possibility of LFC block C remains. Thus, only 20 MW can be netted between LFC block C and D. The remaining 30 MW are netted between B and D.

In Figure 24 the same configuration as in the example in Figure 23 applies with the difference, that no optimisation regions are foreseen and the imbalance netting process is optimised in the first optimisation step and the aFRP is optimised in the second optimisation step. This example does not reflect the proposed structure, but is included to compare the two different scenarios.

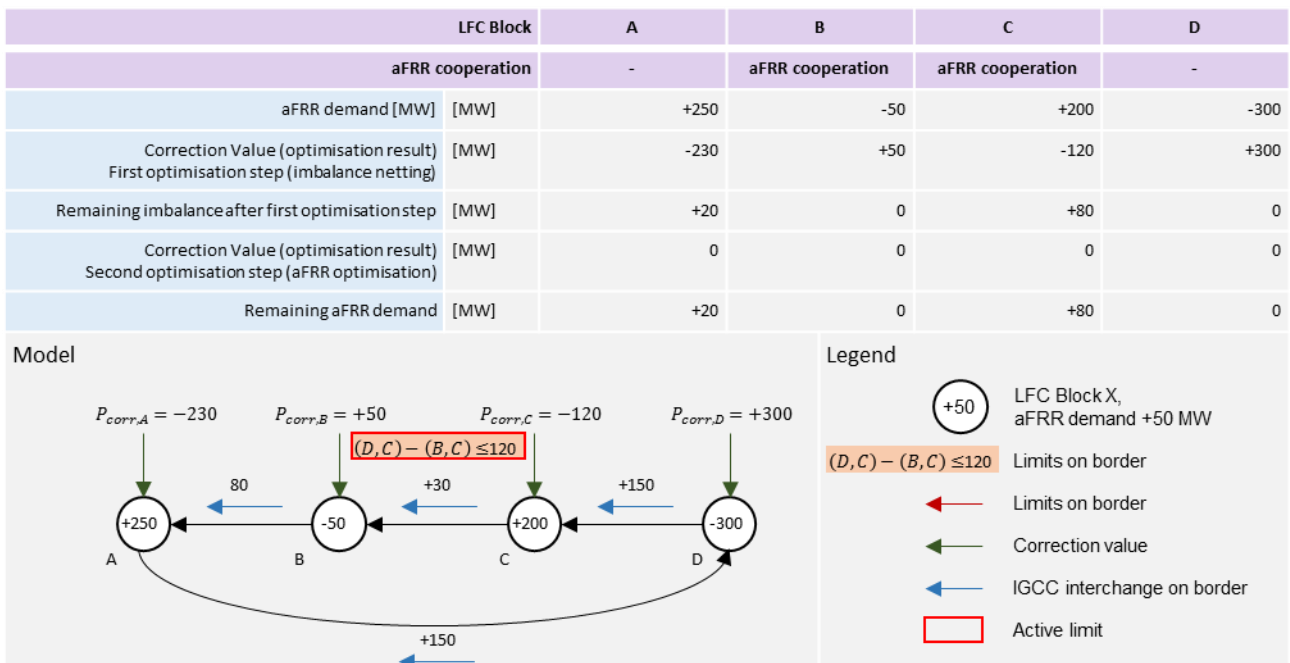


Figure 24: Example for no optimisation regions and a priority of imbalance netting before aFRR optimisation with limitations

Due to the profile limit in LFC area C the optimisation of the imbalance netting process deviates from the optimisation target. LFC area A receives a higher share of the total netting potential. In the second optimisation step no aFRR optimisation can be performed as the updated profile limit of LFC area is zero and by this LFC area C can no further import. Hence, the available price information cannot be used to improve the optimisation result. The overall netted volume of 350 MW is the same as in the example before.

7 Publication of information and reporting

Pursuant to Article 12 of EBGL, there is no specific requirement to publish the intended exchanges of energy as a result of the imbalance netting process. However, TSOs plan to keep the current practice of publishing this information and to continue publishing the social welfare reports on the ENTSO-E website².

In accordance with Article 12(3)(k) of EBGL, in case there is any amendment of the algorithm of the imbalance netting process function, the requirements shall be published at least one month before the application.

Considering Article 12(3)(l) and Article 59(3) of EBGL, ENTSO-E shall publish a European report which, amongst others, shall describe the status of implementation projects and also assess the compatibility between the implementation projects. These reports shall be published online.

² https://www.entsoe.eu/network_codes/eb/imbalance-netting/