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

15 January 2018

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.

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 "Implementation Framework"), required by Article 22 of Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing (hereafter referred to as "GLEB").

1.1. Content of this document

This document is built up as follows. Chapter 2 contains an explanation of the proposal of entity that will perform the imbalance netting process function and the proposal of entity that will perform the TSO-TSO settlement function. Thereafter, chapter 3 includes the explanation of Article 9 of the Implementation Framework. Chapter 4 provides the detailed description of the algorithm for the operation of imbalance netting process function with the examples of calculations, particularly examples for unrestricted optimization (without limits), optimization with ATC-limits and profile-limits and for application of optimization regions.

2. Proposal of entity or entities

2.1. Imbalance netting process function

During developing the Implementation Framework, the following options were examined by all TSOs for the designation of any entity entrusted with operating the imbalance netting process function:

(a) appointing one or more TSOs to operate the imbalance netting process function on behalf of all TSOs; or

(b) creating a new entity to operate the imbalance netting process function as a vehicle of cooperation among TSOs and on their behalf; or

(c) designation of an existing entity to operate the imbalance netting process function as a vehicle of cooperation among TSOs and on their behalf; or

(d) appointing the development and operation of the imbalance netting process function to a third party independent from the TSOs.

Having considered the above options, all TSOs conclude that appointing one TSO to operate the imbalance netting process function is the most efficient and pragmatic approach. All TSOs propose to appoint the host TSO of IGCC, the future IN-platform, due to following reasons:

(a) The imbalance netting process function of IGCC is already implemented and operates the imbalance netting process of 11 TSOs, by this implementation costs can be avoided.

(b) IGCC is in operation since 2010 – the host TSO of IGCC and the TSOs have gained a vast operational experience in operation of the imbalance netting process with an availability higher than 99.9 % of time.

(c) Due to the impact on operational security, implementation of real-time processes and their coordination must be allocated within the infrastructure of the TSOs and fulfil the respective infrastructure security and reliability requirements.

(d) A close interaction with other realtime operational processes is ensured.

2.2. TSO-TSO settlement function

When developing the Implementation Framework, the following options were examined by all TSOs for the designation of any entity entrusted with operating the TSO-TSO settlement function:

(a) appointing one or more TSOs to operate the TSO-TSO settlement function on behalf of all TSOs; or

(b) creating a new entity to operate the TSO-TSO settlement function among TSOs and on their behalf; or

(c) designation of an existing entity to operate the TSO-TSO settlement function among TSOs and on their behalf; or

(d) appointing the development and operation of the TSO-TSO settlement function to a third party independent from the TSOs.

Having considered the above options, all TSOs conclude that appointing one TSO to operate the TSO-TSO settlement function among TSOs and on their behalf is the most efficient and pragmatic approach. All TSOs propose to appoint the host TSO of IGCC, the future IN-platform, due to following reasons:

(a) The proposed TSO-TSO settlement function is already implemented in the IGCC and operates the TSO-TSO settlement of 11 TSOs, by this implementation costs can be avoided. TSO-TSO settlement will be subject to all TSO approval of the proposal according to Article 50.

(b) IGCC is in operation since 2010 – the host TSO of IGCC and the TSOs have gained a vast operational experience in operation of the TSO-TSO settlement function.

(c) Data availability and coordination at the host TSO level is more efficient than a decentralized solution at individual TSOs.

(d) One centralized solution for all balancing products is not seen as beneficial at this point of time. This solution could be revised when other European platforms for the exchange of balancing products will be in operation.

The current host TSO of IGCC is TransnetBW.

3. Framework for harmonisation of the terms and conditions related to balancing

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 product for balancing energy. Furthermore, in accordance with the Article 1 of the Implementation Framework, common settlement rules for the TSO-TSO settlement will be proposed and defined pursuant to Article 50 of the GLEB. Thus, all TSOs consider that there is no need for harmonization of terms and conditions related to balancing for the establishment of the IN-Platform.

4. Description of the algorithm for the operation of imbalance netting process function

The optimization algorithm is part of the imbalance netting process function operated by the host TSO. The imbalance netting process function calculates the corrections in real-time for each LFC area which results in imbalance netting. This chapter describes the basic principles of the optimization calculation.

4.1. Unrestricted Optimization

Figure 1 demonstrates the calculation of the correction values without limits. 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 optimization 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 limits, the optimization target can be reached (the deviation from the optimization target is zero).

LFC Block	A	B	C	D
aFRR-Demand [MW]	200	800	-50	-450
Share of Total Positive Demand [pu]	200/(200+800) = 0.2	800/(200+800) = 0.8	n/a	n/a
Share of Total Negative Demand [pu]	n/a	n/a	-50/(-50+(-450) = 0.1	-450/(-50+(-450) = 0.9
Correction - Optimisation Target [MW]	-0.2·500 = -100	-0.8·500 = -400	0.1·500 = 50	0.9·500 = 450
Correction Value (Optimisation Result) [MW]	-100	-400	50	450
Remaining aFRR-Demand [MW]	200+(-100) = 100	800+(-400) = 400	-50+50 = 0	-450+450 = 0
Deviation from Target [MW]	-100-(-100) = 0	-400-(-400) = 0	50-50 = 0	450-450 = 0
Deviation/aFRR-Demand (Absolute Value) [pu]	| 0/200 |= 0	| 0/800 | = 0	| 0/50 | = 0	| 0/450 | = 0

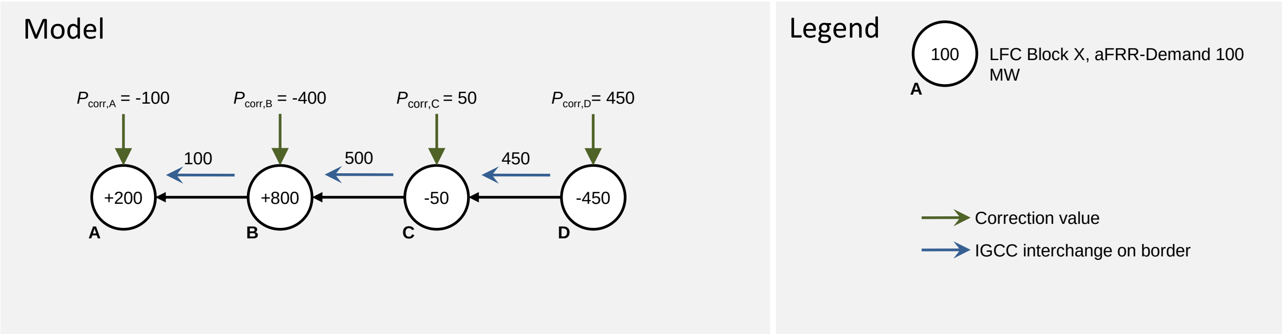

Figure 1: Example without Consideration of Restrictions

4.2. Impact of ATC-limits and profile-limits

The figures 2 to 11 demonstrate the calculation of the correction value for different scenarios with four LFC areas.

Figure 3 shows the same scenario as in Figure 2 but with a limit on the concerned border between B and C. The exchange in the direction from C to B is limited to 2000 MW (this value could represent the free available capacity after intraday market). The limit does not affect the correction value (being higher than the value of 500 MW which is needed to reach the optimization targets).

LFC Block	**A**	**B**	**C**	**D**
aFRR-Demand [MW]	200	800	-50	-450
Share of Total Positive Demand [pu]	200/(200+800) = 0.2	800/(200+800) = 0.8	n/a	n/a
Share of Total Negative Demand [pu]	n/a	n/a	-50/(-50+(-450) = 0.1	-450/(-50+(-450) = 0.9
Correction - Optimisation Target [MW]	-0.2·500 = -100	-0.8·500 = -400	0.1·500 = 50	0.9·500 = 450
Correction Value (Optimisation Result) [MW]	-100	-400	50	450
Remaining aFRR-Demand [MW]	200+(-100) = 100	800+(-400) = 400	-50+50 = 0	-450+450 = 0
Deviation from Target [MW]	-100-(-100) = 0	-400-(-400) = 0	50-50 = 0	450-450 = 0
Deviation/aFRR-Demand (Absolute Value) [pu]	| 0/200 |= 0	| 0/800 | = 0	| 0/(-50) | = 0	| 0/(-450) | = 0

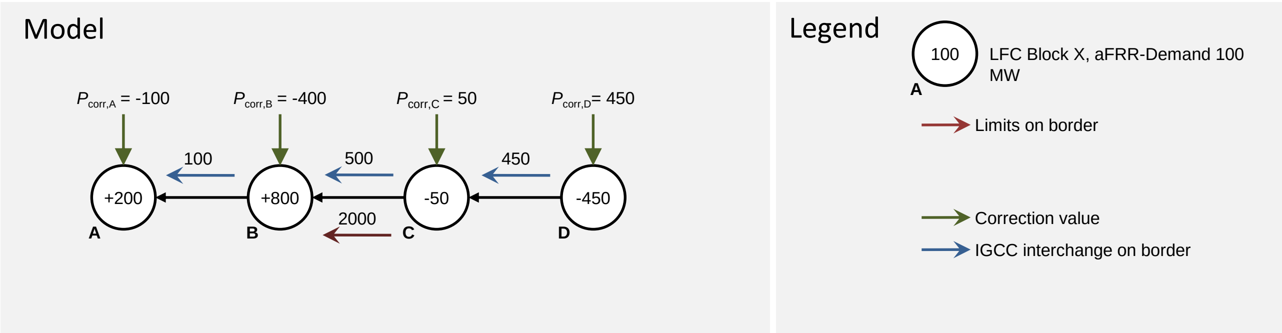

Figure 3: One ATC-limit (not Active)

Figure 4 shows the scenario with a more restrictive limit on the concerned border between B and C. The exchange in the direction from C to B is limited to 100 MW (this value could represent the free available capacity after intraday market). Therefore, only 100 MW can be exported from C and D to A and B and the optimization targets cannot be reached. The impact of the limits is distributed according to the shares used for the calculation of the optimization 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.

LFC Block	A	B	C	D
aFRR-Demand [MW]	200	800	-50	-450
Share of Total Positive Demand [pu]	200/(200+800) = 0.2	800/(200+800) = 0.8	n/a	n/a
Share of Total Negative Demand [pu]	n/a	n/a	-50/(-50+(-450) = 0.1	-450/(-50+(-450) = 0.9
Correction - Optimisation Target [MW]	-0.2·500 = -100	-0.8·500 = -400	0.1·500 = 50	0.9·500 = 450
Correction Value (Optimisation Result) [MW]	-20	-80	10	90
Remaining aFRR-Demand [MW]	200+(-20) = 180	800+(-80) = 720	-50+10 = -40	-450+90 = -360
Deviation from Target [MW]	-100-(-20) = -80	-400-(-80) = -320	50-10 = 40	450-90 = 360
Deviation/aFRR-Demand (Absolute Value) [pu]	| -80/200 | = 0.4	| -320/800 | = 0.4	| 40/(-50) | = 0.8	| 360/(-450) | = 0.8

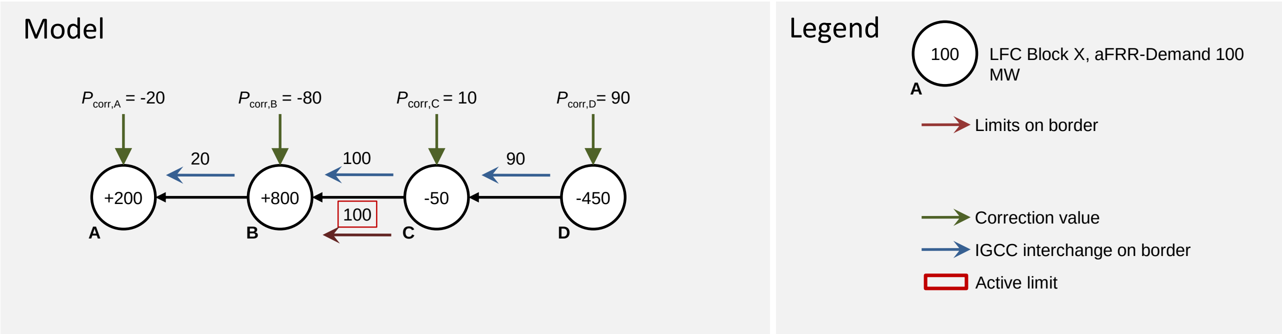

Figure 4: One Active ATC-limit (1st Example)

Figure 5 moves the limit of 100 MW to the concerned 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 demand of 50 MW. A and B receive the respective shares of the overall export of 150 MW.

LFC Block	A	B	C	D
aFRR-Demand [MW]	200	800	-50	-450
Share of Total Positive Demand [pu]	200/(200+800) = 0.2	800/(200+800) = 0.8	n/a	n/a
Share of Total Negative Demand [pu]	n/a	n/a	-50/(-50+(-450) = 0.1	-450/(-50+(-450) = 0.9
Correction - Optimisation Target [MW]	-0.2·500 = -100	-0.8·500 = -400	0.1·500 = 50	0.9·500 = 450
Correction Value (Optimisation Result) [MW]	-30	-120	50	100
Remaining aFRR-Demand [MW]	200+(-30) = 170	800+(-120) = 680	-50+50 = 0	-450+100 = -350
Deviation from Target [MW]	-100-(-30) = -70	-400-(-120) = -280	50-50 = 0	450-100 = 350
Deviation/aFRR-Demand (Absolute Value) [pu]	| -70/200 | = 0.35	| -280/800 | = 0.35	| 0/(-50) | = 0	| 350/(-450) | = 0.78

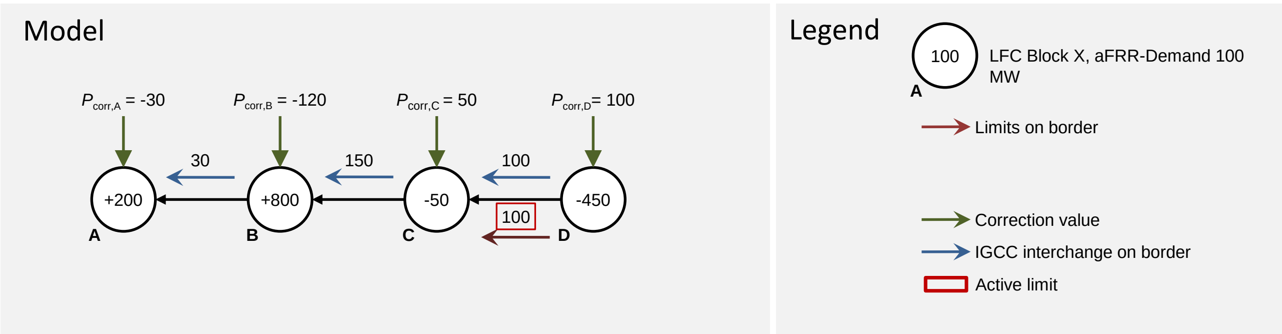

Figure 5: One Active ATC-limit (2nd Example)

Figure 6 introduces an additional concerned border between D and A. Although the limit between D and C of 100 MW still exists, the border between D and A can be used to exchange the aditional 350 MW (no deviation from optimization target).

LFC Block	A	B	C	D
aFRR-Demand [MW]	200	800	-50	-450
Share of Total Positive Demand [pu]	200/(200+800) = 0.2	800/(200+800) = 0.8	n/a	n/a
Share of Total Negative Demand [pu]	n/a	n/a	-50/(-50+(-450) = 0.1	-450/(-50+(-450) = 0.9
Correction - Optimisation Target [MW]	-0.2·500 = -100	-0.8·500 = -400	0.1·500 = 50	0.9·500 = 450
Correction Value (Optimisation Result) [MW]	-100	-400	50	450
Remaining aFRR-Demand [MW]	200+(-100) = 100	800+(-400) = 400	-50+50 = 0	-450+450 = 0
Deviation from Target [MW]	-100-(-100) = 0	-400-(-400) = 0	50-50 = 0	450-450 = 0
Deviation/aFRR-Demand (Absolute Value) [pu]	| 0/200 |= 0	| 0/800 | = 0	| 0/(-50) | = 0	| 0/(-450) | = 0

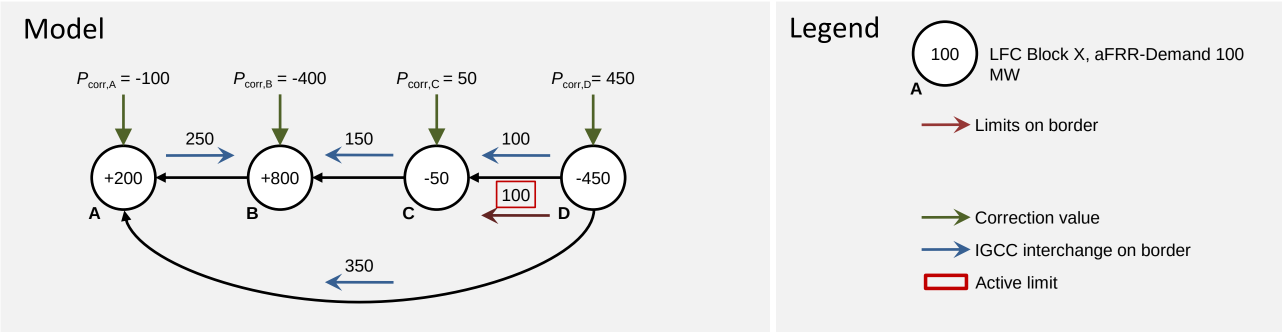

Figure 6: One Active ATC-limit without an Impact on correction Values

Figure 7 shows the example of limits which affect a sum of two concerned borders (profile-limits). The sum of the exchange 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.

LFC Block	A	B	C	D
aFRR-Demand [MW]	200	800	-50	-450
Share of Total Positive Demand [pu]	200/(200+800) = 0.2	800/(200+800) = 0.8	n/a	n/a
Share of Total Negative Demand [pu]	n/a	n/a	-50/(-50+(-450) = 0.1	-450/(-50+(-450) = 0.9
Correction - Optimisation Target [MW]	-0.2·500 = -100	-0.8·500 = -400	0.1·500 = 50	0.9·500 = 450
Correction Value (Optimisation Result) [MW]	-10	-40	50	0
Remaining aFRR-Demand [MW]	200+(-10) = 190	800+(-40) = 760	-50+50 = 0	-450+0 = -450
Deviation from Target [MW]	-100-(-10) = -90	-400-(-40) = -360	50-50 = 0	450-0 = 450
Deviation/aFRR-Demand (Absolute Value) [pu]	| -90/200 | = 0.45	| -360/800 | = 0.45	| 0/(-50) | = 0	| 450/(-450) | = 1

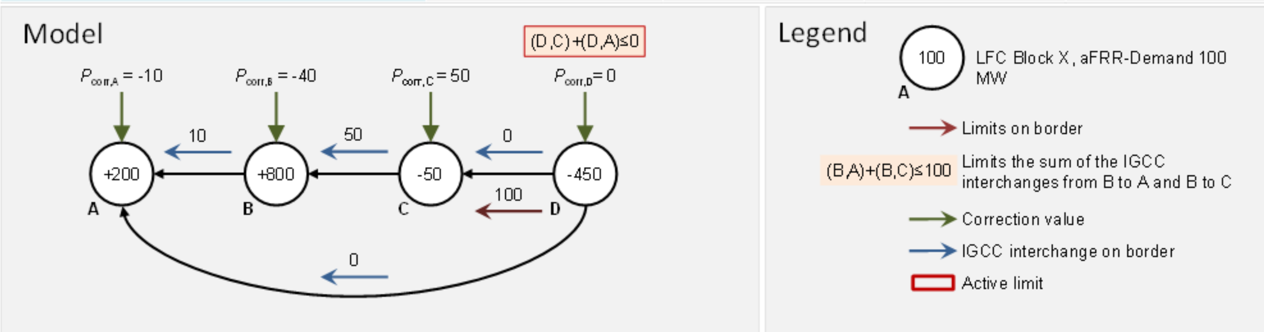

Figure 7: One Active profile-limit

Figure 8 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 ATC-limit from D to C remain inactive.

LFC Block	A	B	C	D
aFRR-Demand [MW]	200	800	-50	-450
Share of Total Positive Demand [pu]	200/(200+800) = 0.2	800/(200+800) = 0.8	n/a	n/a
Share of Total Negative Demand [pu]	n/a	n/a	-50/(-50+(-450) = 0.1	-450/(-50+(-450) = 0.9
Correction - Optimisation Target [MW]	-0.2·500 = -100	-0.8·500 = -400	0.1·500 = 50	0.9·500 = 450
Correction Value (Optimisation Result) [MW]	-200	-100	30	270
Remaining aFRR-Demand [MW]	200+(-200) = 0	800+(-100) = 700	-50+30 = 20	-450+270 = 180
Deviation from Target [MW]	-100-(-200) = 100	-400-(-100) = -300	50-30 = 20	450-270 = 180
Deviation/aFRR-Demand (Absolute Value) [pu]	| 100/200 | = 0.5	| -300/800 | = 0.375	| 20/(-50) | = 0.4	| 180/(-450) | = 0.4

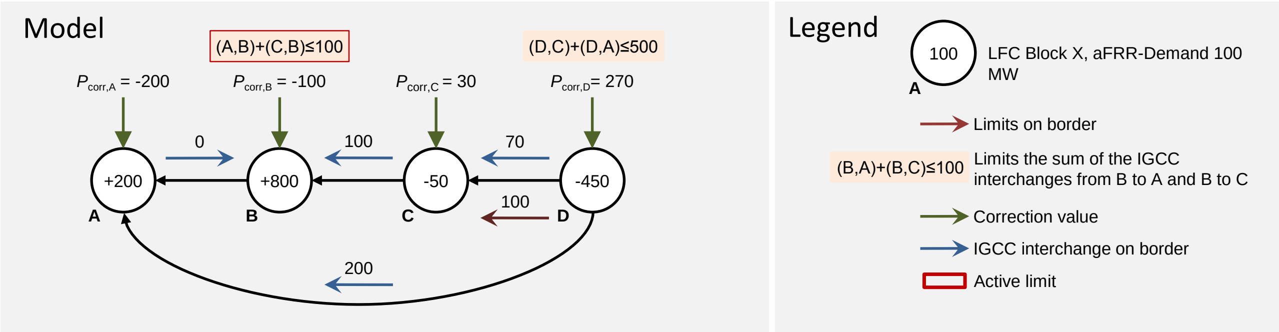

Figure 8: Combination of One Active pprofile limit with Other limits

Figure 9 introduces a further restriction of total exchange taking the scenario in Figure 8 as starting point. The ATC-limit from D to A of 0 MW in combination with the ATC-limit 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.

LFC Block	A	B	C	D
aFRR-Demand [MW]	200	800	-50	-450
Share of Total Positive Demand [pu]	200/(200+800) = 0.2	800/(200+800) = 0.8	n/a	n/a
Share of Total Negative Demand [pu]	n/a	n/a	-50/(-50+(-450) = 0.1	-450/(-50+(-450) = 0.9
Correction - Optimisation Target [MW]	-0.2·500 = -100	-0.8·500 = -400	0.1·500 = 50	0.9·500 = 450
Correction Value (Optimisation Result) [MW]	-50	-100	50	100
Remaining aFRR-Demand [MW]	200+(-50) = 150	800+(-100) = 700	-50+50 = 0	-450+100 = 350
Deviation from Target [MW]	-100-(-50) = -50	-400-(-100) = -300	50-50 = 0	450-100 = 350
Deviation/aFRR-Demand (Absolute Value) [pu]	| -50/200 | = 0.25	| -300/800 | = 0.375	| 0/(-50) | = 0	| 350/(-450) | ≈ 0.78

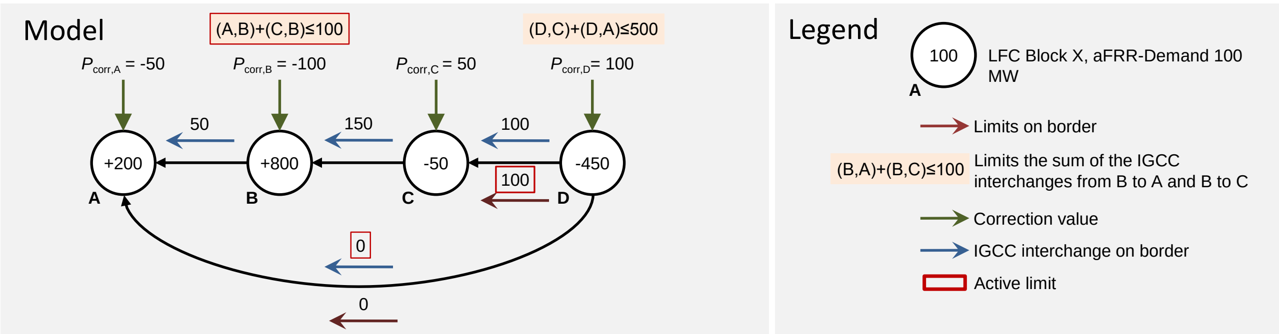

Figure 9: Active profile-limits and Active ATC-limits

Figure 10 demonstrates a different configuration of borders where A and D each have three neigbours. There is one active ATC-limit from D to B limiting the respective exchange to 100 MW. Since there are no other

ATC-limits or profile-limits, this limitation has no impact on the overall imports and exports so that the result corresponds to the result in the unrestricted secenario shown in Figure 1.

LFC Block	A	B	C	D
aFRR-Demand [MW]	200	800	-50	-450
Share of Total Positive Demand [pu]	200/(200+800) = 0.2	800/(200+800) = 0.8	n/a	n/a
Share of Total Negative Demand [pu]	n/a	n/a	-50/(-50+(-450) = 0.1	-450/(-50+(-450) = 0.9
Correction - Optimisation Target [MW]	-0.2·500 = -100	-0.8·500 = -400	0.1·500 = 50	0.9·500 = 450
Correction Value (Optimisation Result) [MW]	-100	-400	50	450
Remaining aFRR-Demand [MW]	200+(-100) = 100	800+(-400) = 400	-50+50 = 0	-450+450 = 0
Deviation from Target [MW]	-100-(-100) = 0	-400-(-400) = 0	50-50 = 0	450-450 = 0
Deviation/aFRR-Demand (Absolute Value) [pu]	| 0/200 |= 0	| 0/800 | = 0	| 0/50 | = 0	| 0/450 | = 0

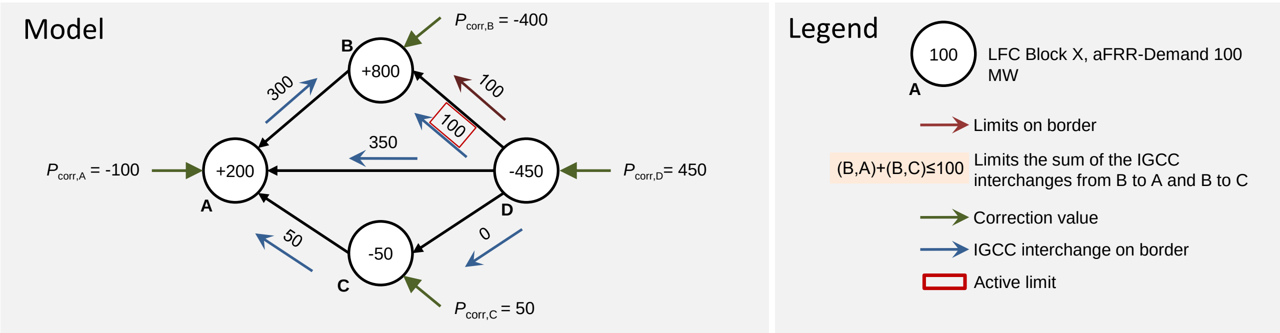

Figure 10: Example for "Triangle"-Configuration (Active ATC-limit)

In Figure 11 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 ATC-limits from D to B is active but does not limit the overall exchange.

LFC Block	A	B	C	D
aFRR-Demand [MW]	200	800	-50	-450
Share of Total Positive Demand [pu]	200/(200+800) = 0.2	800/(200+800) = 0.8	n/a	n/a
Share of Total Negative Demand [pu]	n/a	n/a	-50/(-50+(-450) = 0.1	-450/(-50+(-450) = 0.9
Correction - Optimisation Target [MW]	-0.2·500 = -100	-0.8·500 = -400	0.1·500 = 50	0.9·500 = 450
Correction Value (Optimisation Result) [MW]	-200	-100	30	270
Remaining aFRR-Demand [MW]	200+(-200) = 0	800+(-100) = 700	-50+30 = 20	-450+270 = 180
Deviation from Target [MW]	-100-(-200) = 100	-400-(-100) = -300	50-30 = 20	450-270 = 180
Deviation/aFRR-Demand (Absolute Value) [pu]	| 100/200 | = 0.5	| -300/800 | = 0.375	| 20/(-50) | = 0.4	| 180/(-450) | = 0.4

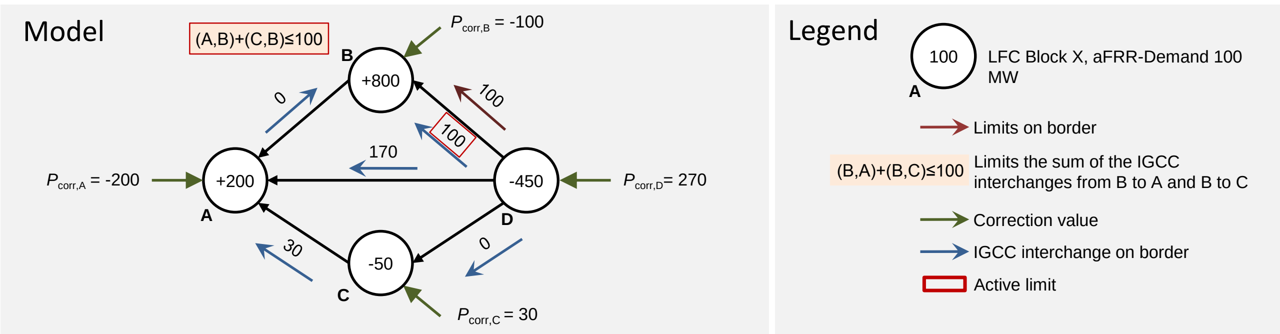

Figure 11: Example for "Triangle"-Configuration (Active ATC-limit and profile-limit)

Figure 12 shows the example with a profile-limit of 200 MW applied in the export direction for D. Moreover, the ATC-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.

LFC Block	A	B	C	D
aFRR-Demand [MW]	200	800	-50	-450
Share of Total Positive Demand [pu]	200/(200+800) = 0.2	800/(200+800) = 0.8	n/a	n/a
Share of Total Negative Demand [pu]	n/a	n/a	-50/(-50+(-450) = 0.1	-450/(-50+(-450) = 0.9
Correction - Optimisation Target [MW]	-0.2·500 = -100	-0.8·500 = -400	0.1·500 = 50	0.9·500 = 450
Correction Value (Optimisation Result) [MW]	-50	-200	50	200
Remaining aFRR-Demand [MW]	200+(-50) = 150	800+(-200) = 600	-50+50 = 0	-450+200 = 250
Deviation from Target [MW]	-100-(-50) = -50	-400-(-200) = -200	50-50 = 0	450-200 = 250
Deviation/Target [pu]	| -50/200 | = 0.4	| -200/800 | = 0.5	| 0/(-50) | = 0	| 250/(-450) | ≈ 0.56

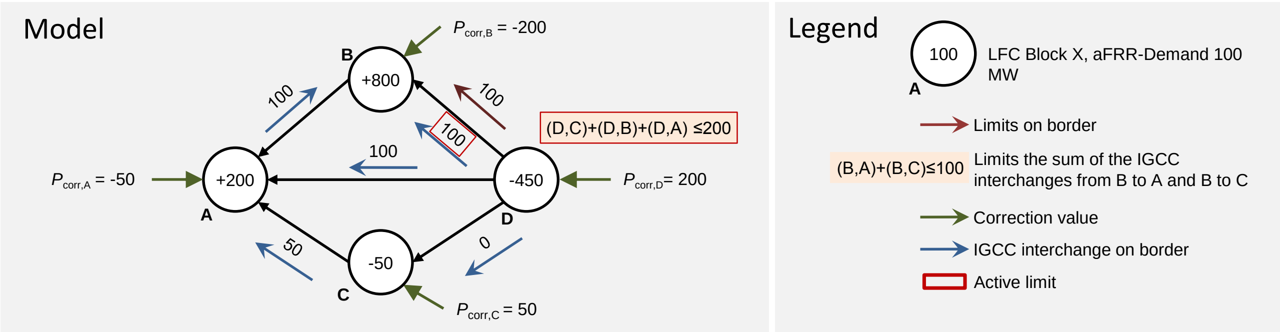

Figure 12: Example for "Triangle"-Configuration (Active profile-limit)

4.3. Impact of Optimization Regions

Figure 14 demonstrates a configuration with two optimization regions, one optimization region based on an aFRR cooperation including B and C ("optimization region 1") and one optimization region between A and D ("optimization region 2"). There is no active limitation in this example. The example in Figure 14 considers the common merit order list of the aFRR cooperation illustrated in Figure 13 for the positive aFRR activation.

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

Figure 13: Common Merit Order List for the aFRR cooperation between LFC Block B and C

Figure 14 shows an positive aFRR demand in A and C and a negative aFRR demand in B and D. The two optimization regions are optimized in a first step. B and C perform, as an aFRR cooperation, implicit pre-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 optimization region 2 performs pre-netting of 250 MW based on their demands. Each optimization region has prior access to the transfer capacity being within the optimization region, i.e. only on the common borders of the TSOs in the same optimization region. The optimization region 1 has prior access to the transfer capacity B-C and the optimization region 2 has prior access to the transfer capacity A-D. Transfer capacities A-B and C-D are only considered in the second optimization step. In the second optimization step all LFC blocks perform netting in one layer. In this layer the remaining demands from the optimization region 1 are netted with the remaining demands from the optimization 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 optimization 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 optimization regions.

LFC Block		A	B	C	D
Optimization Region		1	aFRR cooperation	aFRR cooperation	1
aFRR-demand [MW]	[MW]	+250	-50	+200	-300
Correction Value (Optimization Result) First optimization step	[MW]	-250	+100 Exchange of aFRR + implicit prenetting	-100	+250
Remaining imbalance after first optimization step	[MW]	0	+50	+100	-50
Correction Value (Optimization Result) Second optimization step	[MW]	0	0	-50	+50
Remaining aFRR-Demand	[MW]	0	+50	+50	0

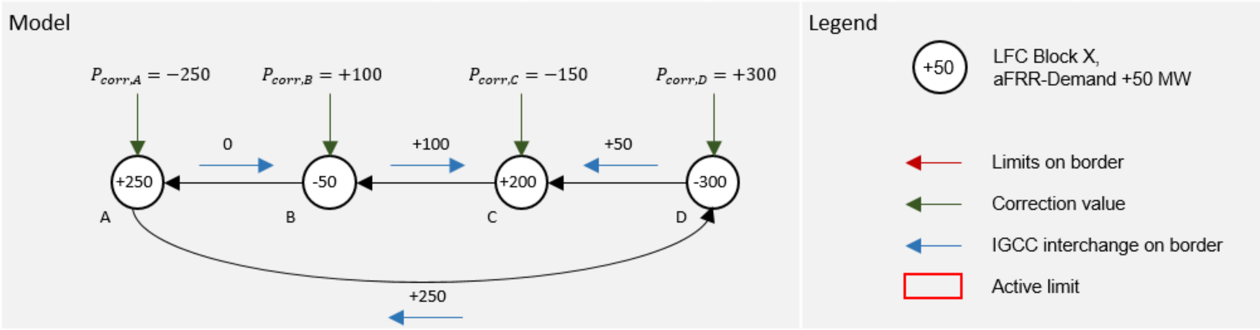

Figure 14: Example for Optimization Regions without limitation

In Figure 15 the same configuration as in the example in Figure 14 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 optimization region 1 has prior access to the capacity B-C. The optimization result of the first optimization step remains unchanged. For the second optimization step only 20 MW of the import possibility of LFC block C remains. Hence, only 20 MW can be netted between LFC block C and D. The remaining 30 MW are netted between B and D.

LFC Block		A	B	C	D
Optimization Region		**1**	**aFRR cooperation**	**aFRR cooperation**	**1**
aFRR-demand [MW]	[MW]	+250	-50	+200	-300
Correction Value (Optimization Result) First optimization step	[MW]	-250	+100 Exchange of aFRR + implicit prenetting	-100	+250
Remaining imbalance after first optimization step	[MW]	0	+50	+100	-50
Correction Value (Optimization Result) Second optimization step	[MW]	0	-30	-20	+50
Remaining aFRR-Demand	[MW]	0	+20	+80	0

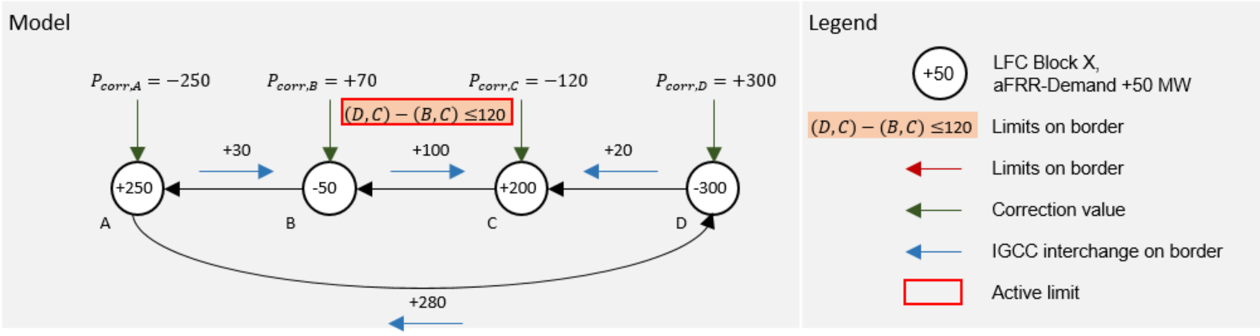

Figure 15: Example for Optimization Regions with limitation

In case of a congestion management which limits exchanges based on an estimation of physical flows (consideration of PTDF based flow estimation and their limitation) the individual optimization regions can no longer be optimized in parallel, hence an optimization order between the LFC blocks, and the optimization regions has to be established.