NBM
Nordic Balancing Model

SVENSKA KRAFTNÄT ENERGINET FINGRID Statnett

Evaluation report for go-live of Nordic aFRR Capacity Market

October 2022

1. Introduction

On 5 August 2020, ACER approved four methodologies for the establishment of a single Nordic Balancing capacity market (CM) for the procurement and exchange of automatic frequency restoration reserves (aFRR CM)[1]. This implies, that the Nordic Transmission System Operators (TSOs) have received approval on how cross-zonal capacity for the procurement and exchange of aFRR shall be allocated and which common procurement rules shall be applied. The ACER decision states, that the TSOs shall implement the Nordic aFRR Capacity Market Rules no later than 12 months after the decision has been made.

By procuring balancing capacity, TSOs acquire the option to activate a generation or demand facility to balancing the electricity system in real time. By organizing this common procurement and exchange of balancing capacity, the Nordic TSOs increase competition between providers reducing the overall cost for TSOs. The TSOs estimated (2019) the benefit to be of 53 million euro per annum on Nordic level.

The introduction of a Nordic aFRR CM can, pursuant to the Commission Regulation (EU 2017/2195) establishing a guideline on electricity balancing (EBGL) Article 38(5), be implemented, when the cross zonal capacity on all bidding zone borders of the capacity calculation region Nordic (Nordic CCR) is calculated in accordance with the capacity calculation methodology developed pursuant to the Commission Regulation (EU 2015/1222) establishing a guideline on capacity allocation and congestion management (CACMGL), i.e. flow-based (FB) capacity calculation methodology (CCM). The national regulatory authorities (NRAs) are legally bound to enforce this requirement.

In October 2020, the NRAs in CCR Nordic, at the request of the Nordic TSOs, provided their guidance on the understanding of the requirement in Article 38(5) in EBGL. The Nordic NRAs write that the FB CCM must deliver appropriate capacity calculation results during the external parallel runs in order to fulfil the requirement in Article 38(5). An evaluation report covering at least three consecutive months of external parallel run should therefore be submitted to the NRAs for assessment. The assessment of the evaluation report will be done within one month after receiving it.

Furthermore, in the guidance, the Nordic NRAs write that the specific requirement to submit an evaluation report to the Nordic NRAs also follow from the Nordic CCR NRA's agreement to amend the TSOs' CCM proposal of 17 April 2020. This evaluation report aims at providing the Nordic NRAs with a basis for assessing the functioning of the FB CCM during the implementation phase. In that respect, the TSO's evaluation report could

[1] ACER decisions no. 19-22/2020.

serve two different purposes, by also serving as a basis for demonstrating that the condition pursuant to Article 38(5) in EBGL is fulfilled. The guidance indicates that the evaluation of the functioning of the FB vis-à-vis the introduction of aFRR CM in the Nordic can be separated from the assessment of whether the FB is sufficiently well-working to go-live.

The external parallel run was launched early March 2022. An evaluation of the external parallel run based on specific assessment criteria (KPIs) has been made.

The report therefore constitutes the basis for a NRAs assessment of whether FB is sufficiently well performing to calculate capacities in order for the TSOs to implement the Nordic aFRR CM.

2. Result of the evaluation

The TSOs have assessed the evaluation results of the external parallel run with respect to the legal requirements in EBGL, ACER decisions no. 19/20/21/22-2020 of 5. August 2020 and with respect to the guidance provided by the NRAs of 14 October 2020.

The TSOs have fulfilled following legal requirements:

- A Nordic common grid model has been established,
- data covering three consecutive months of external parallel run have been produced by the TSOs and Nordic RCC (NRCC), and
- an evaluation report with data covering three consecutive months have been produced (the present).

The use of fallback measures (as described in Article 22 of the capacity calculation methodology) is the relevant criteria (KPI) in the assessment of whether the FB capacity calculation is sufficiently well performing.

The Nordic TSOs have assessed the results of the parallel run of FB covering 5 June 2022 to 4 September 2022 in section 3.3. The data from the parallel runs show that the use of fallback measures is less than 3 % for the 3 consecutive months. The Nordic TSOs thus find that the requirement set out by the Nordic CCR NRAs is fulfilled and that the Nordic aFRR CM can be implemented in December 2022.

Overall, the TSO find that the parallel run has delivered appropriate capacity calculation results, i.e., that the capacity calculation has been sufficiently well performing to be compliant with Article 38(5) in EBGL.

3. Criteria assessment

The assessment presented is this chapter is based on 3 consecutive months of parallel run of FB covering 5. June 2022 to 4 September 2022[2].

The criteria (KPIs) used for assessing the functionality of the CCM, as set out in the agreement of 14 October 2020 by the Nordic CCR NRAs on the implementation of a final checkpoint for go-live of the FB CCM, are:

- *Criteria 1 – Use of fallback measures*
- *Criteria 2 – Structural delays*
- *Criteria 3 – Socioeconomic welfare*
- *Criteria 4 – Effects on intraday market*
- *Criteria 5 – Stakeholder feedback*

In this section the relevance of each individual criteria for the Nordic aFRR CM will be reviewed.

Criteria 1 (as described in Article 22 of the capacity calculation methodology) is the only relevant criteria in the assessment of whether FB is sufficiently well performing to calculate capacities, i.e., the relevant requirement in EBGL 38(5).

For Criteria 1, the TSOs will demonstrate that the TSOs and Nordic RCC (NRCC) are able to provide results of the FB capacity calculation daily.

Regarding Criteria 2, 3 and 4, the TSOs do not find them relevant in order to assess whether FB is sufficiently well performing to calculate capacities since any adjustment on the input to the calculation will have no effect on the TSOs' process and performance with respect to the calculation.

Moreover, it will not be possible to compare the socioeconomic welfare of the current NTC methodology to the estimated results from the new methodology at the current stage, due to the unavailability of the NEMO-owned *'Simulation Facility'* (SF) tool[3]. Awaiting the availability of Simulation Facility tool would result in an unnecessary delay of the implementation of the Nordic aFRR CM.

Regarding criteria 5, stakeholder feedback, the Nordic TSOs believe that this evaluation report does not need to be consulted with stakeholders in order to gather their reflections on the FB functioning and mainly the FB market results. This evaluation report is drafted only for the Nordic CCR

[2] At the time of formalizing this report, EPR has been extended/re-started due to the unavailability of the Simulation Facility tool. However, the three months of EPR covered in this report provide the necessary data for showing the fulfilment of KPIs relevant for Nordic the aFRR Capacity Market.

[3] The NEMO-owned *'Simulation Facility'* tool has been down since 12. June 2022.

NRAs and focus only on whether FB is performing sufficiently well to calculate capacities in order to be able to implement the Nordic aFRR CM. Due to the request from the Nordic CCR NRAs, the evaluation report for go-live of Nordic aFRR Capacity Market will, however, be available for a public hearing. Relevant input from stakeholders will be taken into account before the submission of the evaluation report to the Nordic NRAs.

Thus, Criteria 1, is the only criteria considered essential for this evaluation report.

Criteria 2, 3, 4 and 5 are included as a part of the evaluation report as well, as a general assessment on the functionality and the efficiency of the capacity calculation methodology. They are, however, not relevant in the assessment of whether FB is sufficiently well performing to calculate capacities.

3.1 Status on external parallel run

During External Parallel Run (EPR), the FB capacity calculation is performed by the TSOs and NRCC, alongside the TSO's operational capacity calculation. Where the operational capacity values are used in the day-ahead Market Coupling, the FB parameters are used in a Flow-Based Market Coupling simulation, by using the order books submitted in the Market Coupling. These latter simulations are performed in the Simulation Facility (SF), where the order books are available to be used in simulations after a two-weeks grace period. As such, not only the outcome of the capacity calculation processes can be compared, but also the resulting / simulated market outcome.

The EPR is jointly performed by TSOs, NRCC, and the NEMOs. The TSOs and NRCC operate the capacity calculation process, as described in the CACM and the Nordic DA and ID CCM, whereas the NEMOs perform the FB simulations in the SF.

The market coupling mechanisms (i.e., the DA allocation mechanism), needs a simplified description of the grid in order to optimize the pan-European DA market welfare, by setting the net positions (import/export) and market prices, while respecting the TSO grid constraints. The FB methodology is the better, and more detailed, methodology to describe simplified grid constraints. In FB a capacity split (i.e., what amount of capacity on which border) is not a choice of the TSO, but is market driven (at the time of day-ahead allocation). This should lead to a more efficient and flexible use of the grid, when compared to the NTC methodology:

- FB offers more trading opportunities with the same level of operational security
- More price convergence / smaller price differences

- Higher social welfare
- Income redistribution: Less congestion income and more producer and consumer surplus

This theoretical claim is hard to demonstrate though, as

- The “same level of operational security” is hard to quantify
- The DA market allocation optimizes the pan-EU welfare, so the change from NTC to FB will affect the pan-European welfare and the distribution of it.

Nevertheless, welfare comparisons between the simulated FB and simulated NTC market coupling results can be made. The latter is needed in order to get access to the relevant socio-economic indicators (such as producer and consumer surplus), which are not available from the operational NTC market coupling. Both these simulations, FB and NTC market coupling, require the use of the SF tool. The version 3 of the tool is to be replaced by the new version 4. This migration started on 12. June, and did not end at the time of writing this report. This brings us to a situation where hardly any market simulations could be performed since the start of the EPR.

The EPR started on 7 March 2022. The NRAs have been informed on the EPR status during regular meetings with the Regulatory WG in the CCM project[4].

3.2 Ability to calculate FB capacity daily

In the following section, the Nordic TSOs will demonstrate that:

- The TSOs and NRCC can provide results of the FB capacity calculation on a daily basis.
- That the capacity calculation process has stabilized over the past months.

The demonstration of results hence shows that the TSOs fulfil the requirements set out in Article 38(5). Thus, the TSOs and NRCC are able to provide results of the FB capacity calculation on a daily basis.

The FB capacity calculation is the process where the relevant FB parameters are computed by the coordinated capacity calculator (CCC). In this calculation, the common grid model is the starting point, providing an estimate grid topology and working point for the day of operation. From this starting point, the effects of having imports and exports on the loading of the critical network element monitored under a contingency (CNEC) are

[4] Nowadays: monthly re-occurring meetings.

assessed and captured in the power transfer distribution factors (PTDFs). By computationally removing the imports and exports present in the common grid model (CGM), from the loading of the CNECs, the amount of MWs available on the CNECs for the market are evaluated (i.e., the remaining available margin (RAM)). Both the PTDFs and the RAMs constitute the FB parameters.

The EPR started on March 7, and the performance of the capacity calculation process is summarized in the two bar charts below.

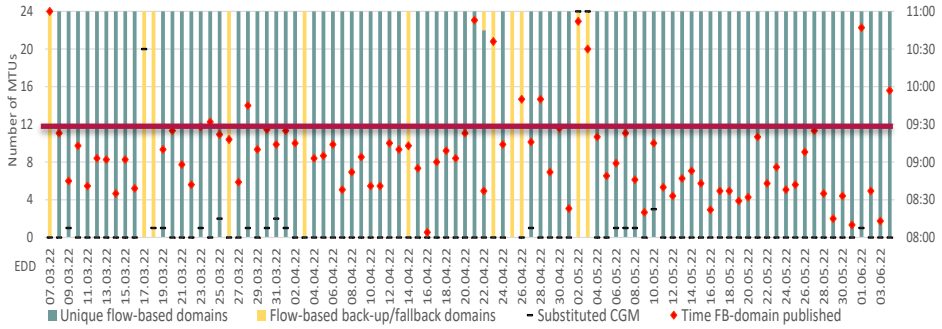


Figure 1 EPR performance in the first three months of EPR

The red bar describes the timing set in TSO/NEMO procedures to provide cross-zonal capacities to NEMOs for allocation purposes.

The figures above focus on the fallbacks that have been applied in the capacity calculation process[5], the CGMs substituted[6], and the time that the domain was available to be shared with the allocation mechanism[7].

When comparing the two figures the performance in the last three months of EPR have significantly improved compared to the first three months due

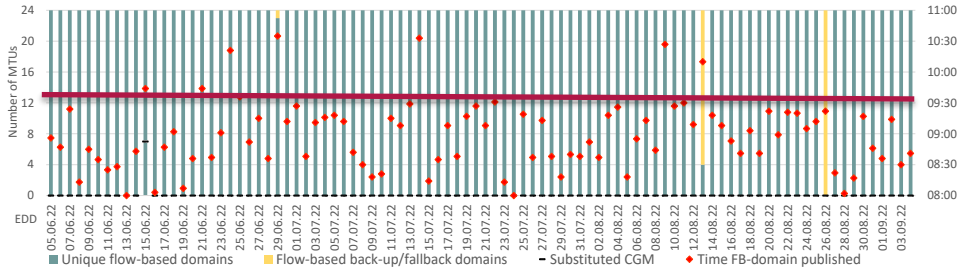


Figure 2 EPR performance in the second three months of EPR

The red bar describes the timing set in TSO/NEMO procedures to provide cross-zonal capacities to NEMOs for allocation purposes.

[5] Art 22 from the CCM, the yellow bars
[6] CGM-related fallback measures
[7] Red diamonds

to less days where fallbacks had to be applied, and less days where CGM substitution was required.

3.3 Assessment of the use of fallback measures

As described in Section 3, criteria 1 is the relevant criteria in the assessment of whether FB is sufficiently well performing to calculate capacities.,

By assessing the use of fallback measures, the TSOs demonstrate that the TSOs and Nordic RCC (NRCC) are able to provide results of the FB capacity calculation daily.

The criteria for the use of fallback measures, is described by the Nordic CCR NRAs as:

- Fallback measures should be used in less than 3 % of market time unit (MTU) covered in the report to consider the methodology to operate sufficiently well concerning this criterion.
- NRAs shall assess the reasons for TSOs use of fallback measures based on the analysis and explanations received from the TSOs.

The number of fallbacks in the last three months reached 2.0 %, which is well below the 3 % boundary value.

NRA KPI	Realized (boundary value)	Status
Use of fallback measures (Art 22, CCM)	2,0% (3%)	0 3%

Reasons why fallback measures had to be applied:

- 29/06 (1 MTU): One TSO provided a too high individual validation adjustment (IVA) and recalculation resulted in one backup MTU.
- 13/08 (20 MTUs): NorCap ran out of disk space.
- 26/08 (24 MTUs): Input file was missing for one TSO.

The fulfilment of this criteria demonstrates that with the input data provided by the TSOs, the TSOs and NRCC can perform the FB capacity calculation process.

3.4 Assessment of additional criteria

As described in Section 3 the TSOs do not find Criteria 2, 3, 4 and 5 relevant in order to assess whether FB is sufficiently well performing to calculate capacities since any adjustment on the input to calculation will have no affect the TSOs' process and performance with respect to the calculation.

However, since the criteria are included as a part of the general assessment on the functionality and the efficiency of the capacity calculation methodology, they are evaluated briefly in the sections below. They are, however, not relevant in the assessment of whether FB is sufficiently well performing to calculate capacities.

3.4.1 Criteria 2 – Structural delays

- The delivery of FB parameters by the CCC to the ENTSO-E transparency platform in accordance with Transparency Regulation is delayed for 2-10 minutes in less than 5 % of the MTUs in the time period covered in the TSOs' report. Any delay exceeding 10 minutes is not acceptable.

- The publication of FB parameters to stakeholders is delayed for 2-10 minutes in less than 5 % of the MTUs in the time period covered in the TSOs' report. Any delay exceeding 10 minutes is not acceptable.

The process timings are monitored by looking at the time that the FB parameters are available to be shared with the allocation mechanism (9.30), and the time that the FB parameters are published on the JAO platform (11.00).

The deadline for the FB parameters to be shared with the allocation mechanism (9.30) has been exceeded on 9 days.

- 2 days were within the 10-minute delay, defined and allowed for by the NRAs.

- 7 days were exceeding the 10-minutes delay, and violating the NRAs' criteria.

    - The NRCC and TSOs will consider the time in between 9.30 and 10.00 as the normal process (as is the case in the operational capacity calculation process, see also below): this covers two days.

    - The remaining 5 days are exceeding the 10.00 deadline as well.

The 11.00 deadline for the publication on the JAO platform/stakeholders has been delayed on 5 days:

- 1 day, was within the 10 minutes delay, defined and allowed for by the NRAs.

- 4 days were exceeding the 10-minutes delay and violating the NRAs' criteria.

Although the late publication should be prevented (and will be with an automatic procedure in place), it does not negatively impact the implementation of the Nordic aFFR CM. When the aFRR CM is implemented, the capacity calculations will be based on NTC values at first. Therefore, a late publication of FB results in external parallel run will not impact the capacities related to the aFRR CM. When FB goes live, the capacity calculations for aFRR CM will be based on FB(ATCE).

In addition, the aFRR CM market is cleared before the day-ahead market. Hence, when FB goes live, the capacities used for allocating cross-zonal capacity to the aFRR CM will be based on the FB capacities calculated for D-1. Also, the gate closure time for the aFRR CM is at 7.30 in order to respect the deadline for publishing cross-zonal capacities to the market participants and sending cross-zonal capacities to NOIS and NorCap. Hence, a late publication of FB parameters does not affect the calculation of cross-zonal capacities for the aFRR CM.

NRA KPI	Realized (boundary value)	Status
Structural delay delivering FBp to the allocation (9.30) • Delayed 2-10 minutes • Delayed > 10 min	• 1,1% (5%) • 7 days (0)	0 5% ✗
Structural delay availability FBp for stakeholders (11.00) • Delayed 2-10 minutes • Delayed > 10 min	• 1,1% (5%) • 4 days (0)	0 5% ✗

Reasons why the 9.30 deadline has been violated:

- 15-6-2022: The domain was first published at 8.20 and back up MTUs were included in it. New files were provided by a TSO leading to results on every MTU. All TSOs validated domain again and a second version was published at 9.44.

- 21-6-2022: One TSO was a bit delayed in the final domain validation.

- 24-6-2022: Some issues with new file formats. The first domain was published with 24 back-up MTUs at 09.03. New IGM files fixed the issue, and a valid domain was published without a TSOs' individual validation adjustment (IVA) at 09.41 and with a TSOs' IVAs at 10.21.

- 25-6-2022: A TSOs' operator password expired.

- 29-6-2022: A spanning domain for MTU 14 has been applied. During the morning validation a TSO mistakenly provided a too large IVA for one MTU, resulting in a failed calculation. After that the UI did not allow to trigger a re-calculation.

- 14-7-2022: A network issue blocked TSOs from performing domain validation during the morning and previous evening. Access was restored shortly after 10.00 and the domain was validated and published.

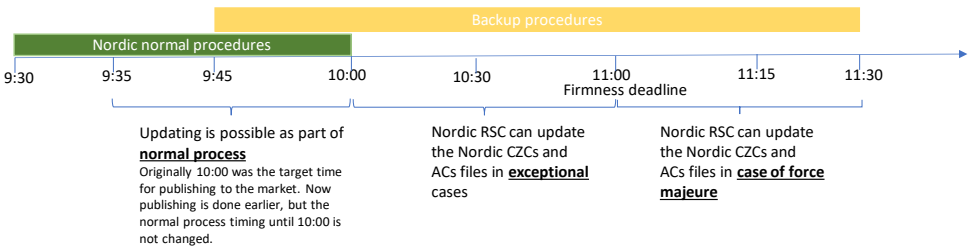
- 9-8-2022: One TSO was unable to access the system; the access problem was shared with the NRCC at 09.20. Another TSO validated the domain on behalf of the TSO with access issues. The domain was published at 10.27.

- 13-8-2022: NorCap ran out of disk space. This lead that a domain with 4 normal MTUs (1,2,3,5), 2 spanning MTUs (0, 4), and 18 back-up MTUs. This domain was published at 10.10 but contained no IVA due to the limited IT resources. TSOs added IVAs and the recalculated domain was published at 11.08 (with same amount of back-up and spanning MTUs).

The main reason why the 11.00 deadline has been violated, is that the manual sending (back-offices task) has been performed too late. An automatic sending has been implemented in the beginning of July 2022 but failed from around 22 July 2022 onwards; the automatic functionality is working again in the meantime.

The TSOs has become aware that the operational process under FB is not yet aligned to the current operational process (under NTC). Indeed, in the NTC operational process, in case no capacity can be shared with the NEMOs at 9.30, zero capacities will be released, with the possibility to have those capacities updated later on the timeline.

A similar process chain is now being developed for the FB capacity calculation process. In other words, when the NRCC is not able to perform or complete the FB capacity calculation process, e.g., in the case that the capacity calculation system is down, a fallback domain will be published at 9.30 at the latest. In this case, being an exceptional case, the Nordic RCC can provide a capacity update until 11.00. The period between 9.30 and 10.00 is considered to be part of the “normal procedure”.



3.4.2 Criteria 3 – Socioeconomic welfare

The FB methodology is the better, and more detailed, methodology to describe the simplified grid constraints used in the allocation mechanism. Indeed, in FB a capacity split (i.e., what amount of capacity on which border) is not a choice of the TSO, but is market driven (at the time of allocation). This should lead to a more efficient and flexible use of the grid, and thereby a higher socio-economic welfare, when compared to the NTC methodology. This theoretical claim / expectation could not be proven yet, due to the absence of market simulation results.

The TSOs are waiting for the SF to be available for the market simulations, so that a timely and regular feedback loop to the operators and the input data can be put in place, to be able to demonstrate a positive socioeconomic welfare difference between FB and NTC.

Although at the current stage, due to the non-availability of the SF, the TSOs are not able to provide quantitative assessments of the socio-economic welfare, this does not change the observation that the capacity calculation engine works – from input data to the FB parameters resulting. Indeed, the socio-economic welfare analysis may highlight room for improvement in terms of input data, or tuning of the engine, yet this does not affect the FB performing sufficiently well to calculate capacities.

3.4.3 Criteria 4 – Effect on intraday market

To assess the effect on the intraday market, the TSOs are asked to compare the operational (“NTC-world”) and “FB-world” intraday (ID) gate opening capacities. The way to make this comparison has been aligned with the NRAs. The “FB-world” ID gate opening capacity can only be determined after the FB market coupling has been simulated. Indeed, it is the DA left-over capacity that is provided to the ID market at gate opening.

In the absence of market simulation (SF) results, the TSOs do not have an evaluation for the effect on the ID market.

3.4.4 Criteria 5 – Stakeholder feedback

The TSOs do not find that the evaluation report, that constitutes the basis for an NRAs assessment of whether FB is sufficiently well performing to DA calculate capacities before the Nordic aFRR CM is allowed to go-live, needs to include stakeholder feedback.

The present report is not the report that the TSOs need to consult with stakeholders in order to gather their reflections on the FB functioning and mainly the FB market results, i.e., side-letter of 14. October 2020.

This report does not serve the purpose on how the cross-zonal capacity will be allocated, but on whether the FB is sufficiently well performing to calculate capacities in order for the Nordic aFRR CM to go live. The TSOs

acknowledge the points made by the NRAs in the side-letter, regarding go-live of FB, i.e., “that this new flowbased methodology will involve significant change in the way the electricity markets work in the Nordics” and that “…stakeholders need to be provided with sufficient opportunity to understand the transition as well as transparency in the introduction of it to establish trust in the functioning of the methodology…” Following this, the TSOs would like to assure the NRAs that they will receive an FB go-live evaluation report that meet the criteria indicated in the side-letter and that the TSOs will carry out a stakeholder consultation and address consultations comments in accordance with the intention of the side-letter.

The stakeholders have already been involved when the methodologies for the aFRR capacity market was drafted. Therefore, they have been consulted on the issues regarding how the cross-zonal capacity will be allocated, i.e., on the process to define the maximum volume of allocated cross-zonal capacity for the exchange of balancing capacity.

Even though the TSOs do not find, that stakeholder feedback should be included in the present evaluation report, a public hearing has taken place due to the specific request from the Nordic NRAs.