Nordic Capacity Calculation Methodology Project (Nordic CCM)

Operational learning points during the external parallel run of the Nordic flow-based methodology

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Content

Introduction

External parallel run (EPR) is conducted to ensure a proper implementation of the Nordic flow-based methodology (FB) and an adequate comparison to the current capacity calculation method (NTC). During the EPR, Nordic CCM has ensured and will ensure necessary improvements of our input data, modelling and processes in general. Hence, the EPR should be used as a learning-by-doing experience. This means that during the EPR, the comparison between NTC and FB has at times been affected by issues in either one of the approaches. This should not disqualify the NTC capacities or FB domains, or the market coupling results computed with them. Neither of the processes are able to capture perfectly all possible aspects at all times, and the varying levels of contribution (e.g., primary focus being on the operational issues instead of simulations), differences in process timings, or other mistakes may have affected the comparability of the NTC and FB results. It should be noted that also after go-live, the Nordic TSOs and Nordic RCC will continue to improve the flow-based process as and when needed.

This document aims to collect and explain the operational learning points that the TSOs have encountered during the EPR. The document covers both the KPI reporting period of the NRA report (12 December 2022-12 March 2023) but also new findings that have been encountered after publishing the 3-month NRA report. It should be noted that the SEW impacts of the operational learning points may be either positive or negative, when comparing FB to NTC, and depend on the specific case.

Overview and affected time periods

This section lists all identified operational learning points that are further clarified later in the document. Some items are still ongoing, which is indicated with an arrow at the right end of the time interval. Others only affected the results for a certain time period. Transparent lines indicate that the issue was present, but that it did not affect the results.

Identified operational learning points

Countertrade only included in NTC

Svenska kraftnät has procured production resources in the south of Sweden during the winter 2022/2023, which allow for more capacity in NTC as a larger flow is allowed between SE2-SE3. The procured production resources have not been included in the FB domain. Consequently, the 'missing' production resources in FB contribute to a larger flow being allowed between SE2-SE3 in NTC than in FB. At the time of the FB go-live this is foreseen to be implemented in the flow-based domain in case there are any procured units at that point in time. However, for the winter 2022/2023 it has not been possible to prioritize the inclusion of the countertrade in the FB domain.

The border between SE2 and SE3 is the largest corridor in the Nordic CCR for transporting electricity from North to South. When the grid topology (see also the Section about Series compensator modelling) and countertrade modelling in FB does not match the one in NTC, this has an impact on the cross-border capacity and henceforth on the comparison of prices, congestion income, and welfare distribution between flow-based and NTC.

Modelling of series capacitors on SE2-SE3

Between 12 December 2022 and 28 February 2023, the modelling of series compensators on the SE2-SE3 border had another setup in FB than in NTC. The practice in FB was to have an even distribution of expected flows on the capacitors. In NTC, the operational status of them was adjusted to the expected situation in operation. This resulted in the maximum permissible flow in NTC being higher than in FB, which led to some network elements situated on the SE2-SE3 border being the most constraining network elements in the Nordic CCR. Since 1 March 2023, the management of the series compensators has been improved in FB to fit the expected operational status. This has resulted in a better alignment of the maximum allowed flow between NTC and FB. Note: For a few instances since 1 March, the modelling of series capacitors has again not matched the setup in NTC. This occurred on 21 March, and 3-6 April.

Error in calculation of flow in NTC on SE3-SE4 border

Since the start of the EPR (December 2022), the flow in NTC on the SE3-SE4 border has been calculated incorrectly in the post-market scripts that are used to visualize

the data and create the reports. This flaw in the calculations comes from an error in how the flow on the South West Link is represented on the border, which leads to a too-large flow on the SE3-SE4 border for the NTC data. As this error comes from the visualization of data rather than the market optimization, it does not have an impact on the SEW figures. However, it affects the values of flow on the border for NTC in the Appendices of the weekly market reports. A fix of the flow calculation is underway and expected to be in place in June 2023.

NO4 export is too high in FB

Part of the explanation of why the net position in NO4 is higher in FB than in NTC is more varying, and sometimes higher, capacity between NO4-SE1 in FB than in NTC. The current GSK strategy is not optimal for some production units near the NO4-SE1 border. Svenska kraftnät is assessing how these can be revised and improved.

Another reason for higher export in NO4 in FB is due to wind production in northern Norway. The operational experience indicates that a high wind production in NO3 limits the export on the NO4→NO3 border quite a lot, no matter in FB or NTC. In NTC, the operators limit the NO4→NO3 capacity to avoid overload. In FB, without correct wind prognoses this is difficult to model the wind infeed accurately. Consequently, the EPR results showed a lower capacity in NTC than in FB.

A new version has also been installed to create the IGMs for Statnett, which has increased the estimated production from renewable energy sources (RES).

Capacity on Storebælt

For the entire EPR period the capacity on DK1->DK2 has in flow-based been set to 600 MW instead of the correct 590 MW that is the case in NTC. The issue stems from internal IT programs which complicate the process of setting the correct capacity.

Fenno-Skan (FI-SE3) ramping

Ramping refers to active power flow change of HVDCs between one market time unit (MTU) to another. It has been observed that FB allocated flows on FI-SE3 have had a higher variation compared to NTC allocated flows. Occasionally, ramping has been higher than what is technically possible in the operation of Fenno-Skan. Similar outcome is not observed from the NTC results.

Potentially Fenno-Skan ramping restrictions could be applied in FB go-live. Ramping will be further studied with a 600 MW/h ramping limit. Currently HVDCs within a synchronous area do not have ramping according to Nordic System Operational Agreement (SOA).

Number of polarity reversals

Polarity reversals on HVDCs have been observed to occur quite frequently in FB which is not consistent with the current usage of HVDC equipment in NTC. Further analysis is ongoing.

IT issues affecting allocation constraint

In the process of creating the IGM for 3 April 2023, an allocation constraint on the DK1↔DK2 border was incorrectly submitted. When the error was discovered, it was too late to submit a new allocation constraint through an internal IT system that handles this, and manual editing was not possible. In total this limited the transfer capacity for eight MTUs for both FB and NTC.

Incorrect IVAs

For five hours on 20 March 2023, a CNE which was supposed to be out-of-service due to maintenance was still part of the IGM and market coupling, although it should not have been. In order to avoid this CNE having an impact on the system operation, operators applied IVAs to set the RAM to zero. As the CNE had been part of the optimization it had a PTDF value ≠ 0, and with a RAM of zero the CNE limited the system very much since the NP could not be increased in certain places without violating the limits of this CNE.

Normally, CNEs on lines with maintenance are not part of the IGM, and cannot be constraining (get shadow prices, for example). Instead, the IVAs on the RAM should have been set to a very large number in order not to have this CNE constraining the system. Also, IVAs should have been applied on related CNECs that would have been affected if the CNE had not been part of the IGM.

NO4 export too low in FB

In week 11, there was a software update of the tool creating Statnett's IGMs, to improve the RES modelling. However, there was a bug affecting the first weeks (end of week 11 to mid-week 13), by setting all the RES units to their maximum production

levels. This limited the net position in NO4 too much in this period, resulting in lower prices in FB than NTC.

aFRR capacities not included in FB domain

aFRR capacities were not included in the flow-based domain but were included in NTC due to data processing errors on the following days: 25-27 December 2022 and 14 January 2023. This resulted in slightly larger flow-based domains.

Differences in input due to different timings in FB and NTC

There are two different deadlines for providing NTC and flow-based capacities to the market, and this can result in different transmission capacities if e.g. an interconnector trips between those deadlines. Both capacities are correct, but the different timings led to different transmission capacities and results. An example of this was observed on 8 January on the LT-SE4 border.

RM calculated differently in FB and NTC

In the current implementation of the flow-based approach, the default Reliability Margin (RM) is a fixed number (5% of Fmax) and not yet defined with statistical approach in accordance with approved CCM. In NTC, each TSO defines Transmission Reliability Margin (TRM) as a certain set value in MW for the relevant border. The RM in FB serves the same purpose as TRM in NTC, which is to account for uncertainties in the system.

AC load flow not included in contingency scenarios

The AC load flow is not applied when assessing contingency scenarios, as it has been agreed to be implemented after the flow-based go-live. Instead, DC load flow is used in current implementation. This affects the RAM calculation accuracy as DC assumes voltages on grid nodes to be 1.0 p.u. when contingencies are calculated. In AC load flow the real grid node voltages are defined and applied in contingency calculation.