

Studies on frequency stability in the Nordic system

The Nordic Transmission System Operators (Energinet, Fingrid, Statnett and Svenska kraftnät) have through the Nordic Analysis Group (NAG) carried out several parallel projects within the domain of automatic frequency control with frequency quality and stability as the main objectives.

The project portfolio has consisted of evaluating the performance of and requirements on

- i. Frequency containment process (FCP)
- ii. System inertia
- iii. Frequency quality
- iv. Under frequency load shedding (UFLS)

with the high level relationship between the projects according to Figure 1. The goals, results and next steps for each of the individual projects are presented in the following sections.

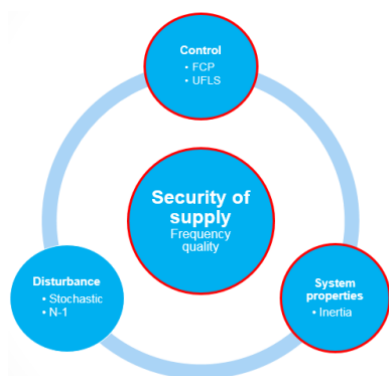


Figure 1: Relationship between the projects

Frequency containment process (FCP)

The main purpose with the project '*Revision of the Nordic Frequency Containment Process*' has been to improve the frequency quality in the Nordic system and make a general improvement of the complete frequency containment process.

The goals with the project was to

- i. review and harmonize the requirements for frequency controlled reserves (FCR).
- ii. define an implementation plan for transition from current to new FCR properties.

The work has resulted in a first proposed draft of a Nordic harmonized requirement specification. The new proposed specification, developed in close cooperation with Nordic stakeholders, state the requirements to be fulfilled for market participants providing FCR in the Nordic system. Analyses show the possible improvement of system dynamics and frequency quality with the developed requirements.

Before the proposed new requirements can be implemented, there is a need for a further fine tuning of the requirements based on feedback from stakeholders. After this work has been performed, planning for an implementation phase will start. This planning will include suitable mechanisms for transition from current system FCR properties to the new FCR properties.

System inertia

The purpose of the '*Future System Inertia project*' has been to anticipate and to avoid the effects of low-inertia situations, by means of proper forecasting tools and mitigation measures.

The main goals of the project was to

- i. Estimate the future inertia variations in the Nordic system.
- ii. Define measures to handle future low inertia situations.
- iii. Improve inertia estimation and operational tools.

The study results show the anticipated variations in system inertia levels for 2020 and 2025. For a certain amount of time, actions will be necessary in order to ensure sufficient system frequency stability margins. A multi criteria assessment has been performed for

different measures that can ensure frequency stability during critical inertia levels. The most promising measures for the system operation in 2020 is the utilization of fast frequency reserves and the usage of HVDC Emergency Power Control. Within the area of fast frequency reserves, it is foreseen that reserves provided by load disconnection will be suitable for this service. The establishment of a market for rotating mass is currently not considered an efficient measure for the Nordic system.

The work will continue with, as a first step, establishing a project for the implementation of inertia forecasting process, as well as implementation of the identified mitigating measures, aiming for implementation before 2020. As a second step, long term development of solutions reaching beyond 2020 is also to be continued with.

Frequency quality

The purpose of the '*Frequency Quality project*' has been to find the link between frequency quality and system security (probability of activating under frequency load shedding, UFLS). The purpose has also been to prepare for the implementation of frequency quality related items defined in Guideline on System Operation (SO GL).

The work has resulted in the establishment of a probabilistic methodology that can be applied to estimate the risk for UFLS activation and exhaustion of frequency containment reserves (FCR). The methodology uses the parameters that have significant influence on the UFLS risk as an input, such as system inertia, FCR response properties, Emergency Power Control on HVDC links, size and probability of disturbances. The methodology estimates the UFLS risk for a single hour or minute, but can also be used for estimating UFLS risk over a complete year, both historical and for future system operation.

The next step will be to utilize the results in the implementation of SO GL.

Under frequency load shedding (UFLS)

The purpose of the project '*Frequency Based Emergency Disconnection – Policy review for the Nordic Region*' has been to

- i. Evaluate the existing and possible UFLS strategies in the Nordic system.
- ii. Fulfil the requirements on UFLS stated in the Network Code on electricity Emergency and Restoration (NC ER).

The goal of the project was to propose a coordinated policy for UFLS that can be implemented by the Nordic TSOs.

The project has reviewed multiple existing UFLS policies from different regions in the world coupled with multiple scenarios developed with market model simulations. The approach has provided the ability to assess which policy scheme is associated with the least risk for disconnection of load and other key performance indices. Based on the studies performed, a new UFLS scheme has been proposed.

The plan for the coming year (2018) is to perform a feasibility study on a Nordic level with the purpose of assessing the way forward towards an implementation of the proposed UFLS policy.

Contact information

For more information, please contact one of the following TSO representatives:

Energinet: Erik Ørum, +4523338691, eor@energinet.dk

Fingrid: Minna Laasonen, +358303955132, minna.laasonen@fingrid.fi

Statnett: Erik Alexander Jansson, +4791002438, alexander.jansson@statnett.no

Svenska kraftnät: Andreas Westberg, +46104758422, Andreas.westberg@svk.se