Frequency requirements

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entsoe
Reliable Sustainable Connected

Frequency Ranges – General Principles

Fundamental

The operating frequency of the system is around 50 Hz. However, **an imbalance between generation and demand causes the frequency to deviate** from this target value with an excursion depending on the severity of the imbalance.

- *A predictable reaction of generation and demand facilitates a return of the system to its frequency target value, ensuring stable operation.*

In the future generation is expected to be based on more volatile energy sources, mainly non-synchronously connected and with reduced inertia. This will **increase the frequency sensitivity of the power system to power imbalance.**

Today

Historically large synchronous generation facilities have formed the backbone of providing the most significant system services to the power system

Concerning frequency withstand capability requirements a different approach was usually taken, in grid codes, for Generation and Demand:

Generation: Required the capability to withstand a determined frequency range

- *Maintaining generation service during frequency deviations is indispensable to contribute to preserve system stability (see NC RfG)*

Demand: No specific requirements for frequency withstand capabilities

- *Demand facilities not providing any service have the natural prerogative, unless contractually agreed, to connect or disconnect at any time depending on specific user needs and decisions*

Frequency Ranges – General Principles

Future

Besides large synchronous generation facilities also Renewable Energy Source (RES) generation facilities may provide a significant share of system services to the power system.

Demand facilities providing Demand Side Response (DSR) services are expected to increasingly provide technical capabilities to the power system.

- *Services will have to be provided even during frequency disturbances*

Distribution networks (both DSOs and CDNs) provide a pathway for embedded generation and DSR to contribute to frequency response.

- *Frequency withstand capabilities within prescribed ranges are therefore essential for distribution networks*

General principle set in the NC DCC

In the "Call for Stakeholder Input", ENTSO-E asked for feedback on the need for a frequency withstand capability. The main conclusions after extensive consultation were adopted as general principle in the NC:

- ***Frequency ranges are defined as "design requirements":*** *the facility or network shall cope with them or if it is not possible, they shall disconnect totally or partially their load*
- *Application is limited to* ***Transmission Connected Demand Facilities*** *and* ***all Distribution Networks****.*
- ***Withstand capability are mandatory only for the Demand Facilities or Closed Distribution Networks, which offer DSR services*** *(because it is intended to support the system)*

Frequency Requirements

Changes since the public consultation on frequency requirements:

June 2012

*"**All Demand Facilities** (either connected to the Transmission Network or to the Distribution Network) and Distribution Networks shall fulfil the following requirements referring to Frequency stability"*

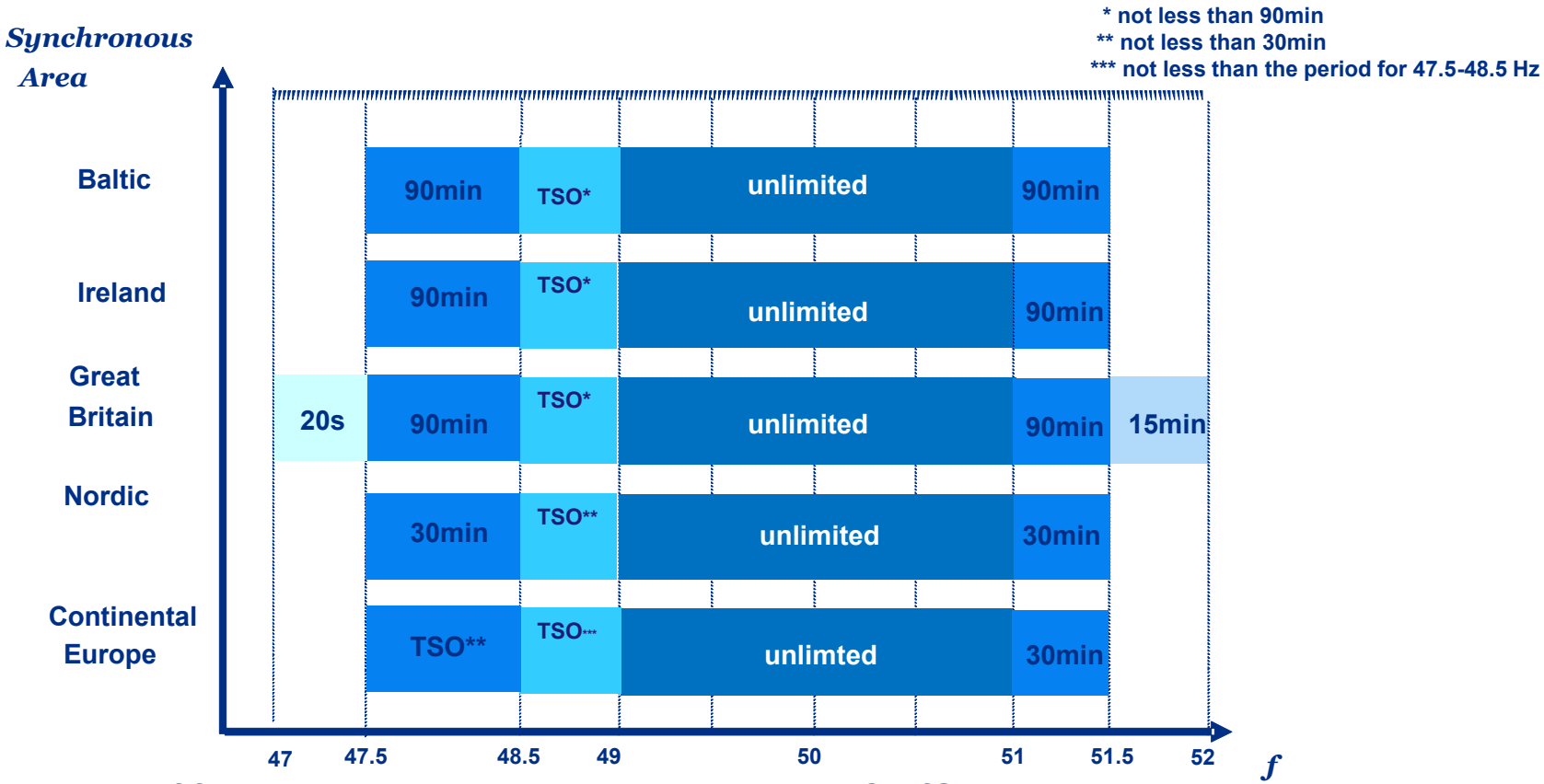
Dec. 2012

"All **Transmission Connected Demand Facilities**, and all Distribution Networks, shall fulfil the following Frequency stability requirements"

*"In case of deviation of the Network Frequency from its nominal value, Demand Facilities and Distribution Networks **will be designed with an expectation of system Frequency** being typically within the Frequency ranges and time periods specified by table 2"*

"A Transmission Connected Demand Facility Owner and Distribution Network Operator **shall use their best endeavours in the design** of its Transmission Connected Demand Facility and Distribution Network respectively **for it to cope with the Frequency ranges** and time periods specified in Table 1"

Frequency Requirements



- The table of frequency ranges remains aligned with NC RfG.
- It is not an expectation for the operational conditions of the system. Connection codes prescribe the needs to cope with extreme system events.

Frequency Requirements

June 2012

*"3) While respecting the provisions of Article 7 (1) a Distribution Network or Demand Facility shall be capable of **automatic disconnection at specified frequencies**, if required by the Relevant Network Operator. The terms and settings for automatic disconnection shall be agreed, with the Relevant Network Operator and the Demand Facility or Distribution Network while respecting the provisions of Article 4 (3)".*

Dec. 2012

Deletion of this paragraph

The requirements are already included in the article concerning « Demand Disconnection for system defence and Demand reconnection »

Frequency Requirements

Many asked for clarifications regarding consistency with standards: IEC-60034 and EN 50160

- There is no withstand capability requirement for frequency ranges in the NC DCC, so the comparison with IEC-60034 and EN 50160 is not easy.
- See FAQ 10 and 19 in DCC supporting documents.

Regarding IEC-60034 (rotating electrical machines)

- The permanently permissible range is between 49 Hz and 51 Hz, as in DCC.
- A limited time duration is possible in the ranges 47.5- 49Hz and 51-51.5Hz.
  As IEC-60034 gives no specific time limitation, the standard in itself is compliant with DCC
- The time range for 47.5-48.5Hz is intended to avoid that in a black-start situation with “unstable” frequency the system is again pushed in a blackout by tripping generators.
- Due to the specificity and the size of a synchronous area, the time limitation is longer in GB than in CE.

Frequency Requirements

- **EN50160** is a **quality of supply** norm, which defines a certain grid quality level to be delivered at the connection point to be measured over a certain period of time. The frequency ranges in RfG and DCC are to cope with extreme system events. Both cover different aspects of frequency ranges.
  - For example, before 47.5Hz is reached on the system, other defence measures should have been initiated (activation of reserves, LFDD) to ensure adequate quality of supply. Still the possibility of extreme events cannot be excluded.
- **Present practices** on this issue vary a lot across Europe (see FAQ10), even if most countries have no explicit obligation to cope with specified frequency ranges. Examples are:
  - France: design requirement with an expectation between [47 – 55 Hz]
  - Ireland: obligation within specified ranges in line with DCC
  - Portugal: no obligation, but the “Quality of Service Code” defines ranges within [47 -52 Hz]
  - Others (see FAQ 10)

➢ Frequency requirements

Thank you all for your attention.

Questions?