Position paper

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with the support of EURELECTRIC

Setting Frequency-Related Parameters in Europe.

Proposed guidelines beyond the provisions of the Network Codes, in particular on Requirements for Grid Connection of Generators (RfG code).

French Stakeholders (list on 1st page) wish hereby to emphasize the need for enhanced coordination and collaboration between all relevant stakeholders at EU level (or at least at the synchronous area level) when implementing the frequency-related parameters of the connection network codes, and in particular the RfG code.

In its foreword, the EU 2016/631 Regulation recalls namely that: "*due to its cross border impact, this regulation should aim at the same frequency-related requirement for all voltage levels, at least within a synchronous area. That is primary because, within a synchronous area, a change in frequency in one Member State would immediately impact frequency and could damage equipment in all other states*".

The RfG network code, as well as other codes and guidelines, provide for some mandatory and non mandatory requirements, as well as for some exhaustive and other non-exhaustive requirements, notably regarding frequency.

Frequency is indeed shared all through the European Continental synchronous area and Frequency Containment is to be provided, through a pro-rata principle, by all control areas in order to ensure system stability and security. It is therefore necessary that the rules are fair for all generating/consuming facilities operating within the same synchronous area. To ensure a level playing field, it is hence absolutely necessary to harmonize, or at least coordinate some specific frequency parameters that are presently to be determined at national level for the implementation of the RfG code and other codes/guidelines. The European integration process requires the right balance between the adequate levels of harmonization and of subsidiarity. In the case of frequency, the harmonization of some parameters is not only needed for obvious technical reasons, but also necessary to ensure a level playing field.

ENTSO-E is also developing Implementation Guidance Documents ("IGDs") intended for Transmission System Operators (TSO) to ensure a consistent implementation of the RfG and other codes at national level. A set of documents has been submitted to public consultation during the summer. Two drafts guidance documents are particularly relevant to these frequency issues, namely "*Parameters related to frequency stability*" and "*Rate of Change of Frequency (RoCoF) withstand capability*".

Several other works/projects, with direct impact on frequency parameters, are currently under way at European level: the adoption and implementation of other Network Codes or EC Guidelines (e.g. Guidelines on *System Operation* and *Emergency & Restoration* both already adopted and *Electricity Balancing* currently in comitology, *Demand Connection* and *High Voltage Direct Current* both published) and the initiative of an internal market for primary control of frequency. The harmonization referred to in this paper should be considered taking into account these developments in order to ensure consistency.

The reasoning below is therefore primarily intended to trigger a discussion at EU level, hopefully via an ad-hoc working group under the aegis of the Grid Connection European Stakeholder Committee (GC ESC), for the sake of reliable system operation, fairness across border, and in order to minimize "equipment damage" and maintenance operations.

NB: the figures and references mentioned in this paper do only aim to highlight the need to harmonize the frequency parameters that are mentioned: these figures do not formally represent a proposal.

Philosophy for setting requirements

Frequency being the same on all points of the Continental European synchronous area, it is imperative that, on a synchronous area, identical values are set on some parameters and coordinated values on some others, as described and explained in further details below:

Frequency measurement

To achieve a level playing field for frequency control, equipments and devices of the same synchronous area should be able to measure the same value of frequency at any time. For that purpose, it would be necessary to define common functional requirements to harmonize the performances of the measurement system of frequency (accuracy, measurement period duration, filtering…), to ensure that all frequency control services delivered within the synchronous area are based on the same input data.

Frequency response insensitivity $|\Delta f_i|$ and $\frac{|\Delta f_i|}{f_n}$

Both parameters $|\Delta f_i|$and $\frac{|\Delta f_i|}{f_n}$ reflect the accuracy of the frequency measurement.

Identical values at the synchronous area level are a prerequisite to ensure a proportional response of relevant generators for the most-common small frequency deviation and thereby a level playing field. Conversely, the absence of **identical values** leads to the fact that the less-sensitive units are not perceiving any frequency deviation, and thus not reacting, while the more sensitive units will, on the contrary, react more often and see a *de facto* increase of their equivalent operating hours / maintenance factors, and associated costs.

Rate of change of frequency (RoCoF) withstand capability

This parameter relates to the gradient of frequency experience during generation/demand imbalances, for instance the experience during system split or loss of large generators on small systems.

An **identical value** across a synchronous area is required to ensure system stability during large disturbances. As a matter of fact, if different values are implemented, units with lowest value of RoCoF withstand capability will disconnect first, and will hence jeopardize the reliability of the whole power system.

Identical and technically-justified definitions for detection and measurement mechanisms are necessary, for instance in order to account for the transient disparities of frequency traces and to avoid having some units per region perceiving the high RoCoF event and others not.

Defining the normative incident (for each synchronous area), for which generating units needs to remain connected to the network is the key factor regarding RoCoF withstand capability requirement. It will define the RoCoF value, and the associated time window measurement. Those two parameters need to be checked against power generating units' capability, especially synchronous generating facilities.

Frequency response filtering / deadband

This parameter relates to the intentional filter[1] to smaller frequency deviation around the nominal frequency, which prevents a generating unit from triggering frequency containment services. The number of cycles of frequency containment provided by a unit affects its maintenance programs. Hence, permitting a deadband or not could have a direct impact on the total operating cost of this unit : if the deadband is allowed for some units only, this will lead to increase operating costs for the others.

To illustrate the high sensitivity of this issue, Continental Europe frequency distribution is characterized[2] by a mean value of 50 Hz and a standard deviation of 22 mHz. This means that grid frequency is circa:

- 70% of the time in the [50Hz; ±22mHz] interval
- and 40% of the time in the [50 Hz; ±10 mHz] interval

Even if this frequency quality has been observed thanks to one given set of deadbands in different countries, in particular none in France, an **identical value** must be implemented in all the countries of a synchronous area to ensure a level playing field at cross-border level and avoid that generators from one country react for any frequency deviation and bear the increased associated costs, while generators of another country react only for frequency deviation greater than deadband.

Droop s_1

This parameter, to be determined for LFSM and for FSM, refers to the ratio of a steady-state change of frequency to the resulting steady-state change in active power output, expressed in percentage terms. The lower the droop, the higher the power change, from the same frequency deviation.

This value needs to be **coordinated** on a synchronous area level. The objective is that each member state covers a fair level of regulating energy, but the value of droop may differ between facilities (and countries) as long as the total regulating energy in the country is sufficient. Hence the coordination consists in fixing common rules:

- to share the need of frequency control between countries;
- and to calculate droop value given the actual power generation mix of each country..

Maximum power capability reduction with falling frequency

The capability to maintain output as constant as possible in case of falling frequency contributes to power system reliability, but also results in some technical constrains for some generating units. For instance, combustion turbines need some power compensation measures such as elevated firing temperature that both increase the unit wear and reduce the reliability of the unit.

The RfG code provides therefore the boundaries within which the power reduction can be authorized by each TSO.

This parameter should be **coordinated** since it represents both the level of contribution to system reliability and the financial and operational consequences borne by generating units owners.

[1] Not to be confused with '*Insensitivity*', seen previously, that is the inability to detect measurement variation under a certain threshold and corresponding to the unavoidable lack of accuracy due to whole control system installed.

[2] According to *Swissgrid frequency quality report*