

Family definition for PGU certification and acceptance of simulation models for similar gensets for FRT analysis

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The issue to be addressed

According to Regulation 2016/631 (NC RfG), equipment certificates (EqC's) can be used to show compliance of a power generating unit (PGU) against the requirements found in a grid code. Obtaining an equipment certificate from an accredited certification body to demonstrate that a PGU is compliant is an expensive and time-consuming process, involving testing and simulations.

When similar products are produced by a manufacturer, it is impractical to test each generation set within the product portfolio in order to have individual equipment certificates – in many cases, this may require testing a large quantity of units and performing hundreds of tests, with no real added value. Therefore, an approach that would allow testing a representative unit of a product family and applying the results to other units within the family is reasonable and recommended.

While EU Member States do not have a common understanding of a “family definition”, the Grid Connection European Stakeholder Committee (GC ESC) decided to establish an expert group on the Harmonization and acceptance of equipment certificates and product family grouping (EG HCF). The EG HCF delivered its final report¹ on 16/03/2023, which proposes a **family definition for synchronous power generation units (SPGUs)**.

The EG HCF proposal considers the concepts found in the following grid codes and standards:

- Italy: CEI-016;V1 in Nter 1
- UK: G99 engineering recommendations amendment 9 in section 15.6
- Germany: TR8 (Rev 9) in annex D.1 (components of a combustion power engine) of and D.2.3 (power transfer limit rule)
- Spain: NTS in section 4.5
- EN 50549-10 in section 5.13.1

¹ The final EG HCF report can be found at: https://www.entsoe.eu/network_codes/cnc/expert-groups/

Fault Ride Through (FRT) represents the most time consuming, cost intensive and difficult test to perform; therefore, the **use of properly validated simulation models to analyse the FRT behaviour** of the unit is both recommended and desirable, allowing tests to be replaced by simulations. This would allow manufacturers to provide a **compliance report showing FRT behaviour against site specific conditions** (correct cable types and lengths, site specific short circuit power, correct transformer data), which gives confidence to the grid operator that the unit can fulfil the FRT requirements at the point of connection.

The models used would have been validated against tests (depending on unit power as there are size limitations for test containers) through procedures described in documents of recognized organizations (IEC, CENELEC, national regulatory bodies) to guarantee a high level of accuracy and confidence on the results. The applicability of the simulation model would be limited by the family definition and therefore would cover the units within the “family” and within the defined power range.

Other requirements (LFSM, FSM, reactive power capability, etc.) could be covered by equipment certificates or by on-site testing to demonstrate full compliance.

Our proposal

EUGINE members propose to accept simulation reports to show compliance against FRT events when using validated models for units that are within a “family”. Such validated models would be part of equipment certificates issued by accredited certification organizations.

The reports would show actual unit behaviour based on site-specific data. This should prove more representative of the real site conditions than tests performed at a manufacturers site with a testing container.

Regarding the family definition for SPGUs, generating units are considered in the same family if they share the following characteristics:

- Prime mover technology (gas engine, gas turbine, hydro turbine, etc.)
- Control system of the prime mover (governor) brand and model with equivalent control software²
- Alternator type - Synchronous generator³

² Different versions of the control software may be accepted if there are no changes to relevant functions for grid parallel operation that may affect compliance with the requirements; this needs to be described and justified within the manufacturers declaration and will be the certifiers decision to accept or reject.

³ The brand (manufacturer), construction (salient pole or round rotor, pole pitch), excitation method (PMG, auxiliary winding, etc.) if technically equivalent, associated to the synchronous generator are not relevant for this definition because the active and reactive power response of the unit solely depend on the unit’s prime mover controller and AVR.

- Automatic Voltage Regulator (AVR) brand and model with equivalent control software²
- Simulation model structure⁴ (validated) when required (where FRT requirements need to be considered)

The applicability range should be defined as follows:

- Based on the tests done on one representative unit of the family and applied to a range defined by the manufacturer's declaration and in agreement with the certifier. When FRT capability needs to be considered, the unit needs to have undergone a simulation model validation process that includes testing and validating the model against the corresponding measurements. A stability check (by simulation) should be performed for multiple controller settings of the same machine (used to investigate the influence of key settings on PGU performance).

It is recommended not to limit the family grouping to a pre-defined power range because the ratings and capabilities of PGU components, such as the automatic voltage regulator, will already define a natural boundary, without imposing arbitrary limits.

If it is considered mandatory by member states to impose such arbitrary limits, then two proposals for defining a reasonable range are outlined below:

1. Based on the tests done on the smallest and biggest representative units of the family⁵.
2. Based on a range dependent on the tested unit's nominal active power; this can be defined as in Germany ($1/\sqrt{10}$ to $\sqrt{10}$), but never smaller than the range defined by Spain ($\pm 25\%$ of the nominal active power).

On-site testing could cover all other requirements that need to be analysed for compliance and could be defined based on the "EU regulation 2016/631 NC RfG compliance tests and simulations" table found in the IGD for General Guidance on Compliance Verification ⁶ – Compliance testing and application of equipment certificates in the verification process" from 30th July 2021.

EUGINE and its member companies would be pleased to discuss this issue in more details with the relevant European and national organizations.

⁴ Structure of the model cannot be modified, while the parameters of the model can be changed.

⁵ Smaller or larger units than those tested may be included within the family range based on the justification provided within the manufacturer's declaration and it will be on the certifiers judgment to accept or reject.

⁶ Available here [last checked in April 2023]: https://eepublicdownloads.entsoe.eu/clean-documents/Network%20codes%20documents/NC%20RfG/210730_IGD_Guidance_on_Compliance_Verification.pdf

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