

Expert group: Advanced capabilities for Grids with a High Share of Power Park Modules

Revision of Draft discussed at the GC ESC on 22 September 2021

Chair: TBD

Vice-Chair: TBD

Problem Statement

For a very high share of power park (PPM) and electricity storage (ESM) modules and less generation based on synchronous power generating modules (SPGM), new challenges evolve to maintain the stability of the European interconnected power system, including challenges regarding system restoration and potential interactions with existing generation. Technical challenges and system needs have been discussed in the previous ENTSO-E technical group on high penetration which presented its results in January 2020¹. Several research projects (such as the “Migrate” project) investigated system aspects and possible solutions for inverter dominated power systems. Meanwhile, technical commercially available solutions, further studies and first approaches for the inclusion of grid-forming capabilities in connection network codes have been published.

The connection codes yet do not reflect many of the needed capabilities for stable and robust operation during normal, alert and system restoration state under the assumption of very high penetration of PPMs and low system strength (inertia and short circuit power). For meeting such future system needs, new capabilities need to be defined and harmonised on the three connection network codes – as already stated in the ENTSO-E position paper². Today, there is also a lack in common understanding regarding the technical capabilities needed for so called “non-frequency related ancillary services”. In parallel, flexibility markets rules, such as Balancing Guidelines, could also provide incentives to such capabilities.

As a first step and starting from the current understanding of future system needs, this Expert Group proposes to map the capabilities provided by different PPMs and ESM modules as well as give an understanding of their maturity. This work will inform the review of the current Connection Network Code and the flexibility markets definition.

Objectives

- The first objective of this Expert Group is to give guidance at EU and national level how power system needs for advanced capabilities should be identified in the different TSO

¹ High Penetration of Power Electronic Interfaced Power Sources and the Potential Contribution of Grid Forming Converters (Technical Report). Available online: https://eepublicdownloads.entsoe.eu/clean-documents/Publications/SOC/High_Penetration_of_Power_Electronic_Interfaced_Power_Sources_and_the_Potential_Contribution_of_Grid_Forming_Converters.pdf

² ENTSO-E Position on Grid-Forming Capabilities: Towards System Level Integration. Available online: https://eepublicdownloads.entsoe.eu/clean-documents/RDC%20documents/210331_Grid%20Forming%20Capabilities.pdf

areas, using as a basis the Report “High Penetration of Power Electronic Interfaced Power Sources and the Potential Contribution of Grid Forming Converters”.

- The second objective is to identify all capability options that could satisfy these system needs and to provide commonly agreed definition about which of these capabilities fall under the “grid-forming category”. In doing so, the Expert Group shall describe the potential interactions with existing synchronous generation³, based on experience and existing work. To prepare a consistent set of capabilities needed in future, the EG should provide the technical input for the capabilities needed to provide “steady state voltage control, fast reactive current injections, inertia for local grid stability, short-circuit current, black start and island operation” paralleling ENTSO-E and national market design/CEP implementation discussions.
- The third objective is to provide an overview on the technology readiness level of the capabilities of power park modules, HVDC-Systems, electricity storage modules and other relevant equipment (such as FACTs / Statcoms / Grid Booster...).
- Finally, the connection network codes serve as a platform for the description and harmonisation of capabilities⁴. The fourth objective of this Expert Group is to technically sharpen the description of such capabilities and recommend their inclusion on the relevant articles of the connection network codes (RfG, HVDC and DC) needed in power systems with a high share of power electronic interfaced resources where the system strength is low (in terms of inertia and low short circuit power). This includes the system’s normal, alert and restoration state. As provided the RfG today, the recommendation regarding the relevant articles in the RfG shall include a classification whether the capabilities can be optional or should be mandatory for Power Generating Modules or Electricity Storage Modules.

Legislative background

Commission Regulation (EU) 2016/631

Commission Regulation (EU) 2016/1447.

Commission Regulation (EU) 2016/1388.

Task description

- Review system needs e. g. building on the work published in the technical report “High Penetration of Power Electronic Interfaced Power Sources and the Potential Contribution of Grid Forming Converters”, and further resources.

³ such as SSTI (Sub-Synchronous Torsional Interactions) according to the results of the Expert Group ISSM (Interaction Studies and Simulation Models) especially under grid conditions of low short-circuit-power.

⁴ Market related aspects on the implementation and costs should not be the focus of this EG.

- Review existing requirements in the implementation of the connection network codes especially for handling electrical power systems with high DER penetration as part of a gap analysis
- Define capabilities needed for grids with a high share of Power Park Modules. The work shall start on the “Class 3” capabilities (suited for 100% inverter based generation) provided in the report of the entso-e technical group on high penetration, but updated with any further relevant input regarding system needs and recommendations on “Class 2” capabilities. In doing so, the EG shall provide an indication on how to verify the compliance of the proposed capabilities either by means of simulation models or tests, preferably based on existing approaches.
- Identify and review publications of relevant technologies (e. g. power park modules, electricity storage modules, other relevant equipment (e. g. fully integrated network components)) and their potential capabilities to serve the system needs identified
- Identify issues, hurdles and work to be done based on the assessment of technology readiness
- Define a road map that will present how various technologies will bring the required technology readiness level (TRL) for such capabilities
- Provide recommendations on future work and - if applicable - propose recommendations on new or existing articles of the NC RfG, NC HVDC and NC DC according to the results and observations of the technical assessment

Deliverables

- Report to the GC ESC on the findings of the group regarding the tasks and – if possible – propose amendments to Articles of the NC RfG, highlighting minimum requirements where necessary

Timing

- estimated 9 months from December 2021.

Team (update XX.XX.2021)

The following nominations to participate in EG XX have been received (name and association):

| <i>Name</i> | <i>Organisation</i> | <i>Representation at GC ESC</i> |
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Estimated workload

- monthly webinars;
- commitment of 10-15 days per member.

Target audience

- GC ESC
- Relevant and/or interested stakeholders on the Connection Network Codes