Report from the Expert Group 'Requirements for Pump-Storage Hydro modules' (EG PSH)

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13th Grid Connection European Stakeholder Committee Meeting

20 March 2019, Brussels

EG PSH structure

ACER Agency for the Cooperation of Energy Regulators

entsoe

Expert group: Requirements for pump-storage hydro power generation modules (EG PSH)

Approved by the GC ESC on September 14, 2018
Subject to possible updates on the list of members

Chair: ENTSO-E, Ralph Pfeiffer

Vice-Chair: VGB, Klaus Oberhauser

Problem Statement

On 11 June 2018, the Grid Connection European Stakeholder Committee (GC ESC) has decided to establish an expert group on requirements for pump-storage hydro modules (PSH). The creation of this EG was proposed by ENTSO-E to elaborate on connection network code (CNC) issues, which had been raised by stakeholders during the CNC implementation. The ENTSO-E proposal was based on a stakeholder survey to identify priority topics.

Target (objectives)

The objective of the EG PSH is to identify specific characteristics / constraints for this kind of Power Generating Module (PGM) for each operation mode (generation, pumping, synchronous compensation), which may have impact on the connection requirements as defined by Commission Regulation (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators (NC RfG).

Legislative background

NC RfG, Article 6(2) foresees that: "*Pump-storage power-generating modules shall fulfil all the relevant requirements in both generating and pumping operation mode. Synchronous compensation operation of pump-storage power-generating modules shall not be limited in time by the technical design of power-generating modules. Pump-storage variable speed power-generating modules shall fulfil the requirements applicable to synchronous power-generating modules as well as those set out in point (b) of Article 20(2), if they qualify as type B, C or D.*";

Task description

- Discussions with stakeholders / responses received during consultations / stakeholder interventions at the GC ESC / in workshops have revealed that this provision is probably too generic and in its generality lead to requests for derogations or compliance issues. In particular, a better distinction of the applicability of the RfG requirements in the different operation modes (generating, pumping, synchronous compensation) and different types of pump storage facilities needs to be investigated;
- Challenges in complying with the NC RfG requirements shall be identified separately for each operation mode and, if applicable, technology-dependent (e.g. specific peculiarities of variable speed pumps);
- Clarifications shall be provided on technical capabilities of these PGMs to be able to comply with operational requirements from SO GL and NC ER; and

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Public space

EG PSH

Requirements for pump-storage hydro power generation modules.

Annex

EG PSH Reporting 12th GC ESC

Internal EG space

EG PSH

new document or drag files here

All Documents ... Find a file

Name

- archive (non-exhaustive)
- Kick-off meeting_181015
- meeting_190319_Brussels
- Report
- ToR and Annex
- webinar_181113
- webinar_181210
- webinar_190118
- webinar_190207
- webinar_190315
- 180914_GC ESC_EG PSH_notes from preparatory call
- 190118 EG PSH draft table of requirements
- EG PSH reporting_12th GC ESC
- EG PSH_contact list
- READ ME

EG PSH meetings

- 15 October 2018 kick off meeting
- 13 November 2018, webinar
- 10 December 2018, webinar
- 18 January 2019, webinar
- 07 February 2019, webinar
- 15 March 2019, webinar
- 19 March 2019, meeting
- 20 March 2019, joint EGs meeting
- 25 April 2019, webinar

- 16 listed members – no new members, one substitute
- 5 different representative organizations + 1 invited expert
- ~50% participation of members in the web/meetings
- >80% participation of organizations in the web/meetings

- Overall good collaboration among the members, with useful discussions
- Balanced activity and contributions by the active members
- Common space (SharePoint) and emails are used to provide inputs
- The Expert Groups aims at finalizing the work beginning of May to be submitted to GC ESC in June's meeting

Evaluation of RfG requirements for PSH modules

The Expert Group continued working on the template with RfG requirements that was created to assess better the capabilities of the different technologies. The table provides a useful overview but no explanations.

- The different PSH technologies that were considered and analyzed are:
  - Fixed speed pump turbine
  - Single shaft ternary
  - Variable speed pump turbine (doubly-fed induction machine)
  - Variable speed pump turbine (full converter)

- All technologies have been assessed in three operating modes:
  - Generation mode
  - Pump mode
  - Synchronous compensation mode

- The requirements that all technologies in all operating modes were assessed against were:
  - Frequency requirements
  - Voltage requirements
  - System restoration requirements
  - Instrumentation and protection

Snapshot from the template of the requirements - finalized

Generation Technology											
fixed speed pump turbine (generation mode)	fixed speed pump turbine (pumping mode)	fixed speed pump turbine (sync. compensation mod	single shaft ternary (generation mode)	single shaft ternary (pumping mode)	single shaft ternary (sync. compensation mode)	variable speed pump turbine (dfig) (generation mode)	variable speed pump turbine (dfig) (pumping mode)	variable speed pump turbine (dfig) (sync. compensation mode)	variable speed pump turbine (full converter) (generation mode)	variable speed pump turbine (full converter) (pumping mode)	variable speed pump turbine (full converter) (sync. compensation mode)
x	underfrequency limited by system defence plan due to pump disconnection	x	x	underfrequency limited by system defence plan due to pump disconnection	x	x	underfrequency limited by system defence plan due to pump disconnection	x	x	underfrequency limited by system defence plan due to pump disconnection	x
x	x	x	x	x	x	x	x	x	x	x	x
x	N/A	N/A	x	x (N/A if only pump is in operation)	N/A	x	x	N/A	N/A	x	N/A
x	N/A	N/A	x	N/A	N/A	x	N/A	N/A	x	N/A	N/A
x	x	x	x	x	x	x	x	N/A	x	x	N/A
x	N/A	N/A	x	N/A	N/A	x	x	x	x	x	x
x	x	x	x	x	x	x	x	x	x	x	x
x	not possible	N/A	x	x (N/A if only pump is in operation)	N/A	x	x	N/A	x	x	N/A
x	not possible	N/A	x	x (N/A if only pump is in operation)	N/A	x	possible with rather narrow active power range but underfrequency limited by system defence plan due to pump disconnection	N/A	x	possible with rather narrow active power range but underfrequency limited by system defence plan due to pump disconnection	N/A
x	N/A	N/A	x	x in hydraulic short circuit mode	N/A	x	x	N/A	x	x	N/A
no specifications in RfG	no specifications in RfG	no specifications in RfG	no specifications in RfG	no specifications in RfG	no specifications in RfG	no specifications in RfG	no specifications in RfG	no specifications in RfG	no specifications in RfG	no specifications in RfG	no specifications in RfG
x	N/A	N/A	x	x in hydraulic short circuit mode	N/A	x	x	N/A	x	x	N/A
x	N/A	N/A	x	x in hydraulic short circuit mode	N/A	x	x	N/A	x	x	N/A
Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	feasible but no specifications in the RfG yet	feasible but no specifications in the RfG yet	feasible but no specifications in the RfG yet	feasible but no specifications in the RfG yet	feasible but no specifications in the RfG yet	feasible but no specifications in the RfG yet

Final report of EG PSH

- The Expert Group, in line with the recommendation of the GC ESC, has been working on a report to be delivered together with the table of requirements
- The objective of the report is to document clearly the specific characteristics or constraints of PSH power generating modules for each operating mode and the consequences on connection requirements.
- The report enters into more details, clarifying the inputs in the table of the requirements – in general the ones that exclude the compliance with the requirements or meet the requirement conditionally
- The report will wrap up with some recommendations and also highlight some observations that might be interesting for future work or considerations when it comes to capabilities and risks from the PSH technologies

Examples of remarks and open questions

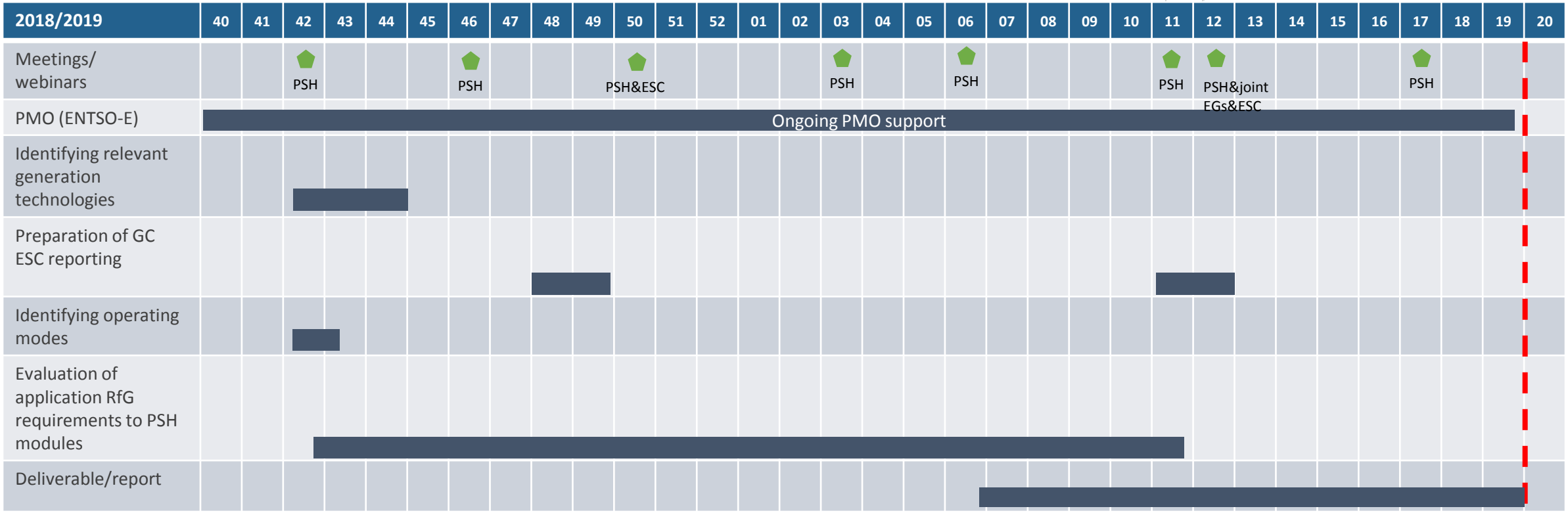
Open questions:

- How to treat low inertia machines such as bulb turbines with regard to FRT?
- Can we utilize capabilities from some PSH technologies for instance “controlled load” to improve the management of low frequency events and give more options to the TSOs
- In a future evolved RfG, should we merge the PSH within the overall storage discussion?
- Should we treat pump mode as demand and therefore exclude them from RfG?

Remarks:

- The hydraulic part has to be considered in every requirement
- Variable speed pump turbines for some voltage requirements stand somewhere in between of SPGMs and PPMs (or SPGMs with exceptions)
  - For voltage ranges and FRT requirement they follow SPGM requirements, while dynamic voltage support by providing a fast reactive fault current they are considered PPM
- All technologies should be considered following the FRT requirements/profile for SPGMs
- ….

Workplan and next steps



- The EG will work on finalizing the report over the next period and before the meeting in April
- In April's meeting, final comments will be addressed and conclusions will be reviewed
- A common format with the rest of the reports from the other EGs will be sought
- The EG will submit both the report and the excel file to the GC ESC – as final deliverable to be published