Renewable electricity sources and System Stability
Network codes: New responsibilities for Power Park Modules
1. INTRODUCTION TO NETWORK CODES
General information
Grid connection Network codes (focus RfG)

2. RFG : MAIN TECHNICAL REQUIREMENTS FOR POWER PARK MODULES
General information
Frequency stability
Voltage stability
Robustness

3. WHAT’S NEXT
Introduction to Network Codes
General information

Principle

A set of rules applying to one aspect of the energy sector

Which are developed by ACER, ENTSO-E & market participants

And become legally binding after the Comitology process

Hence they will have the same status as any other Regulation

3 Connection Network Codes
set requirements for
- Generators
- Demand-side
- HVDC connections

3 Market Network Codes
set market rules for
- Day ahead/intraday & Capacity calculation
- Long-term timeframes
- System balancing

4 Operational Network Codes
set common rules for
- Assessing adequacy
- Planning outages
- System security
- Emergency situations
Grid Connection network codes:

- Define technical requirements for grid connection to ensure secure system operation within the interconnected transmission network.
- Are a basis for ancillary services defined by Operational Codes.

RfG (Requirement for Generators) developed first, followed by DCC and HVDC.

RfG Overview:
- Provide a set of coherent requirements for generators (of all sizes) in order to meet the future power system challenges.
- Entry into force: May 17th 2016.
- Contents: technical requirements, operational notification procedure for connection, compliance, derogations.
RfG : Main technical requirements for PPM
RfG Technical Requirements (1/2)

Two kind of production unit: either a synchronous power-generating module or a power park module (PPM)

Connection point

- TSO, DSO ou CDSO

Synchronous unit

Connection Point

- TSO, DSO ou CDSO

Requirements depend on the voltage connection level and the active power capacity of the unit:

- Common failure mode for all plants (frequency)
- Automated response, operator control, information exchange
- Refined and controllable dynamic response Europe-wide balancing services

Threshold proposal for France:
- PB = 1 MW
- PC = 18 MW
- PD = 75 MW (to be validated)
Frequency and voltage stability

PPM contribution to

Active Power frequency response capability
- Coordinated response to frequency variations at synchronous area level (by all system users who provide frequency response).
- Limited Frequency Sensitive Mode - overfrequency (LFSM-O)
- Rate of change of frequency withstand capability
- Limited Frequency Sensitive Mode - underfrequency (LFSM-U)
- Synthetic inertia
- Frequency Sensitive Mode (FSM)

Reactive power capability and control
- To ensure system security and power quality for consumers, the TSO need to limit voltage unbalance during operation.

PPM connected to french TSO network:
- PV: operate at $P < 20\% \text{ Pmax}$ for 30% to 40% of the time.
- Wind: operate at $P < 10\% \text{ Pmax}$ for 20% of the time (on average).

Reactive power provision below max capacity is needed

50,2 Hz

Droop 5%

Emergency state

P- Q diagram

U-Q/Pmax diagram
Voltage stability and Robustness

PPM capabilities

Fast fault current injection:
- Improve transient stability of synchronous units
- Limit propagation of voltage dip during a fault

Fault Ride Through (FRT):
- Avoid the loss of a large amount of units due to a fault at transmission voltage level.
- FRT-profile defined by each TSO, depending on network protection schemes

Retained voltage during a symmetrical fault at 400 kV voltage level

Without fast fault current injection (K=0)

With fast fault current injection (K=2)

Type B and C FRT-profile

Type D FRT-profile
What’s next
What’s next?

Power-electronics-based components also constitute new means of flexibility for the power system of the future, which should be put to optimal use.

R&D EUROPEAN PROJECTS:
- MIGRATE https://www.h2020-migrate.eu/

=> Future changes in Grid Connection Codes to include those new capabilities (grid forming,...)