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Renewable electricity sources and System Stability

Network codes : New responsibilities for Power Park Modules

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Sommaire

01

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

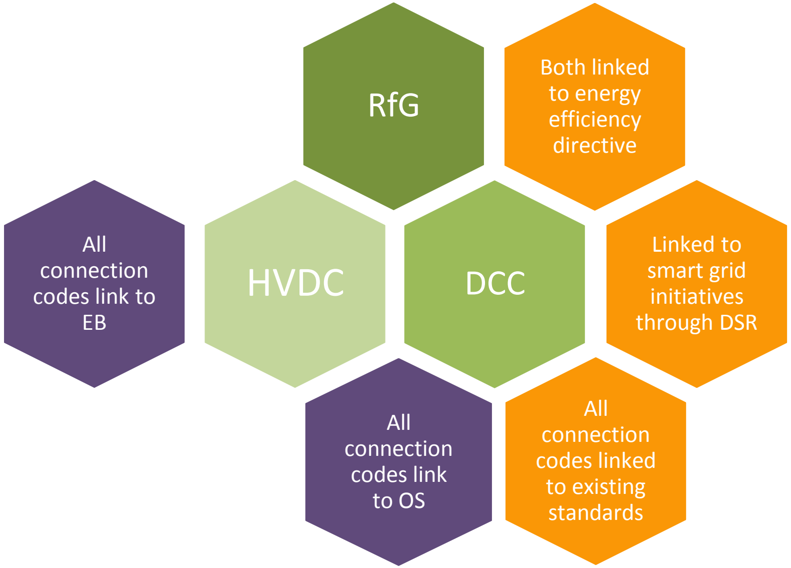
Grid connection Network Codes

Focus on RfG

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 :

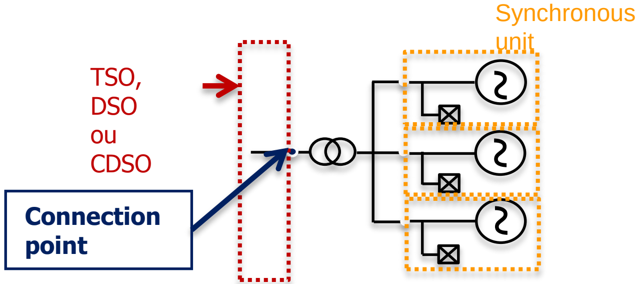
- ➢ Provide a set of coherent requirements for generators (of all sizes) in order to meet the future power system challenges.
- ➢ Entry into force : May 17th 2016
- ➢ Contents: technical requirements, operational notification procedure for connection, compliance, derogations

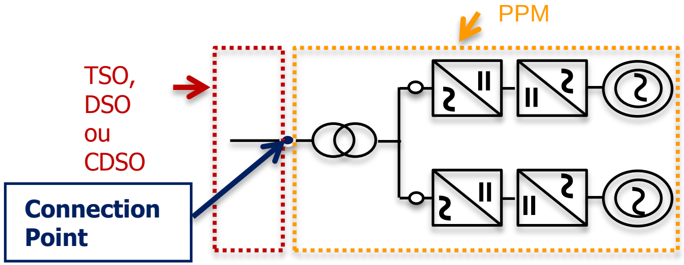
02

RfG : Main technical requirements for PPM

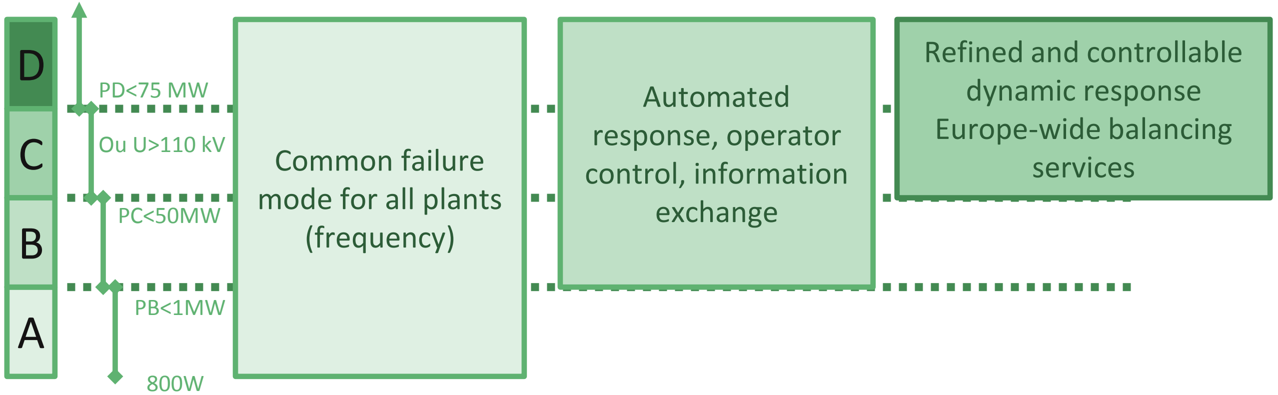
RfG Technical Requirements (1/2)

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



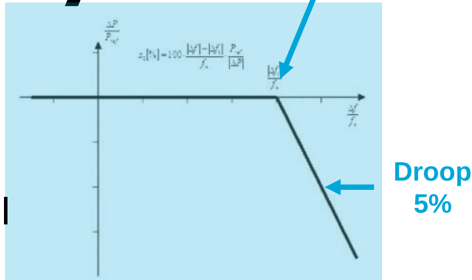


Requirements depend on the voltage connection level and the active power capacity of the unit :



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

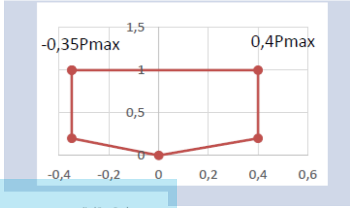
- Coordinated response to frequency variations at synchronous area level (by all system users who provide frequency response).

  - Limited Frequency Sensitive Mode - overfrequency (LFSM-O)
  - Rate of change of frequency withstand capability
  - Limited Frequency Sensitive Mode - underfrequency (LFSM-U)
  - Synthetic inertia

  } **Emergency state**

  - Frequency Sensitive Mode (FSM) → **FCR contribution**

P- Q diagram



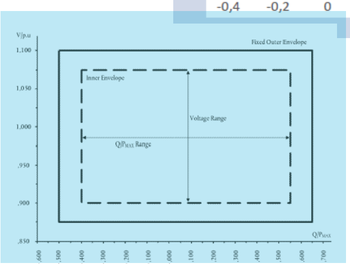
Reactive power capability and control

- 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% Pmax for 30% to 40% of the time.
- Wind : operate at P < 10% Pmax for 20% of the time (on average).

→ **Reactive power provision below max capacity is needed**



U-Q/Pmax diagram

Voltage stability and Robustness

PPM capabilities

Fast fault current injection :

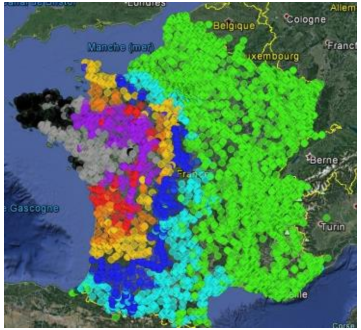
- Improve transient stability of synchronous units
- Limit propagation of voltage dip during a fault

Fault Ride Through (FRT) :

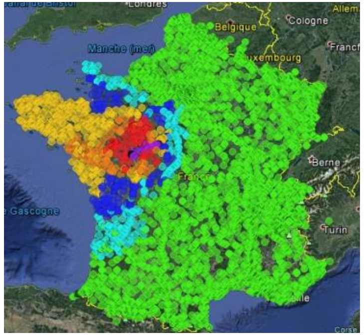
- avoid the loss of a large amount of units due to a fault at transmission voltage level.
- FRT-profile defined by each TSO, depending on network protection schemes

Retained voltage during a symetrical fault at 400 kV voltage level

Without fast fault current injection (K=0)



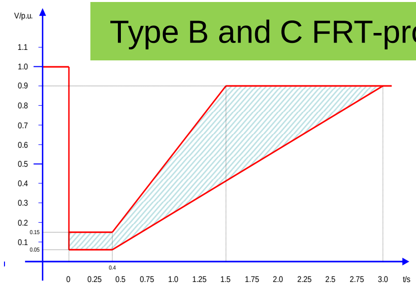
With fast fault current injection(K=2)



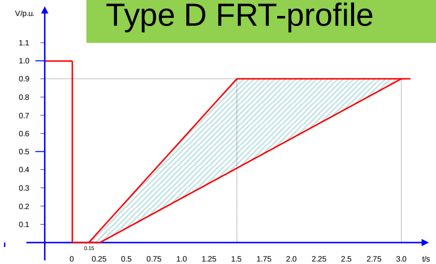
Retained voltage

- <5%
- <15%
- <25%
- <35%
- <45%
- <55%
- <65%
- <75%
- >75%

Type B and C FRT-profile



Type D FRT-profile



03

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,…)