

# Paris Session 2022



## Smart grid flexibility solutions for transmission networks with increased RES penetration

C2 – Power System Operation and Control  
PS2: Operational planning strategies, methodologies and supporting tools

Question 2.2: In what circumstances can grid-forming inverters be relied on to support system restoration plans

Christos Christodoulou



## Smart grid flexibility solutions for transmission networks with increased RES penetration

- The study presented in paper C2-10711 deals with the integration of storage to support RES penetration produced by a wind park in Northern Greece, that is demonstrated in the field.
- The demonstration consists of a battery energy storage system (BESS) and a customized controller based on the concept of Active Distribution Node (ADN), improving the share of clean energy unleashed in the grid while maintaining a high level of reliability and stability.
- Main parts of the BESS are the battery charge converter (it contains two bidirectional converters based on IGBTs technology), the MV transformer, the insulation monitoring device, the EMS-PMS system, the battery bank and the battery management system.

# Smart grid flexibility solutions for transmission networks with increased RES penetration

- One of its main objectives is to face a series of challenges and benefits related with the transmission and generation energy, i.e.:
  - ✓ to design and implement an innovative active substation, which integrates a BESS, for a WPP, in order to provide flexible regulation and power management services to the TSO and to improve its interaction with the transmission network, in an effort to enhance its regulation, stability and reliability.
  - ✓ to enable the usage of energy storage in a WPP active substation to demonstrate reduction of the resource variability impact on the performance of power systems with significant penetration of RES.
  - ✓ to design and implement a complete demonstration project of WPP controller and BESS in the SEE region.

# Smart grid flexibility solutions for transmission networks with increased RES penetration

- The expected benefits and the flexibility services envisioned are summarized as following:
  - ✓ **Grid Code:** It is highly important for the demonstrator to show how this type of systems provide a lot of benefits to the grid code and the different operational modes that the plants should provide. According to the European Grid ((UE) 2016/631) code for plants below 50MW the substation is considered of type C.
  - ✓ **Frequency regulation:** The system can be connected to the grid although the grid frequency changes. Moreover, the system helps to regulate the frequency by injecting or limiting the active power.
  - ✓ **Reactive control mode:** The BESS system is capable of controlling the reactive power in different modes:
    - Cos phi control: Maintain a constant cos phi.
    - Q control: Maintain a constant reactive power.
    - V control: Control the reactive power to maintain a defined voltage constant.
  - ✓ **Low Voltage Ride Through:** The system includes a fully dedicated super-capacitor bank connected in parallel with the control system power supply, in order to ensure the BESS is running without interruption according to the grid code voltage dips. All values (thresholds and timers) are parameterized and will be adjusted according to the Utility and Grid Code requirements.