Validation and application of the methodology to compute resilience indicators in the Italian EHV transmission system

Study Committee C1
Preferential Subject 1

Question 1.1.2: Have others identified ways to integrate grid forming or smart load shedding / non-firm connection capacity to improve resilience?

Emanuele Ciapessoni, ITALY

Resilience: not only grid hardening …

- **Resilience enhancement is a major target** for system operators, due to increasing frequency and severity of extreme events (caused by climate change)

- Also, specific requests from regulatory authorities (e.g. ARERA in Italy)

- How to achieve this? **Not only by hardening the infrastructure** (i.e. reducing the vulnerability of assets to the threat) but also …

- by **applying operational measures** which **limit the impact of contingencies** and **speed up the recovery** process.

- In general, the goal is achieved by a mix of both passive (hardening) and active (operational) measures

Resilience: what do we mean for «active measures"?

- **Anticipation of potential criticalities** in the grid by using sensors network on tower supports and monitoring/alert systems

- **Preparation of the system** by deploying **preventive actions** before the occurrence of a contingency in the grid, to preventively avoid potential security violations in case of contingency occurrence (e.g. the redispatch of dispatchable generation, the defensive islanding). A specific preventive action consists in redispatching generators to achieve a minimum anti-icing current for OHLs exposed to wet snow.

- **Mitigation of contingency effects** by applying **corrective measures** (e.g. PST tap control, topology reconfiguration, load shedding, generation shedding, islanding operation of microgrids, demand side management)

- **Fast recovery of unsupplied customers** by **speed up** the **recovery** process (e.g. optimal scheduling of maintenance crews, pre-allocation of emergency generators)

Group Discussion Meeting

Resilience: what's going on?

- **International research**: focus on different active measures such as defensive islanding

- **Fundamental question**: when to harden and when to use operational measures?

- A **high frequency and severity of extreme events** suggests **using a hardening solution** while a **lower frequency** does not justify such high capital costs and **favours the use of operational measures.**

- RSE has proposed an **optimization via simulation (OvS) framework** to identify the **optimal portfolio of active and passive measures**, including a probabilistic model for the **climate evolution** over a multi-year time horizon, and the simulation of **cascading outages** in case of multiple contingencies.

- Currently included (corrective) load and generation shedding, the (preventive) redispatching of dispatchable generators and the renewable curtailment.

- The **OvS approach allows** to easily inte**grate the models of** other measures such as the **grid forming** algorithm or **DSM**, in the optimization framework.

- Best portfolio selected **comparing benefits and (capital and operational) costs** of many alternatives and **accounting for climate changes, cascading outages** as well as the unitary costs of each measure.