Power system resilience enhancement against high-impact, low-probability events by controlled islanding strategies

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Power system resilience relates to the ability of the grid to withstand the impact of High-Impact, Low-Probability (HILP) events (weather events, earthquakes…) by limiting the degradation of the energy supply and by ensuring a fast restoration of the grid performance.

Among possible resilience enhancement strategies, Intentional Controlled Islanding (ICI) is a special protection scheme that aims at separating a network in stable and self-sufficient islands, in order to enhance its resilience against severe disturbances. A previous master thesis (L. Hayez, "*Enhancing power system resilience with controlled islanding strategies*", ULB 2021) presented an ICI strategy design to minimize the risk of total blackout in case of severe windstorms. An optimal network split among predetermined islanding patterns, ensuring coherent generator grouping and nodes connectivity was first obtained. Then the grid resilience was assessed with a stochastic approach:

- wind speed values were randomly sampled;
- sets of contingencies were derived from these scenarios, based on fragility curves of the network elements;
- the dynamic response of the network to these contingencies was performed using Eurostag software, in order to assess the degradation level of the grid.

Simulation results performed on the IEEE 39-bus test-case network showed an important decrease of both blackout risk and average load shedding, considering the assumptions introduced in the model.

Several extensions of this work could be envisioned in one or two master theses, a.o.

- Inclusion of the restoration phase of the grid (duration, expected energy not served…) in the definition optimal ICI strategy;
- Impact of the geographical and time-dependent progression of the HILP event on the ICI strategy;
- …