Analysis and validation of dynamic wind farms models and fault-ride through (FRT) study

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Context

Wind power generation has experienced great changes in the past years concerning the deployment of different technologies and the enlarged grid integration requirements. The operation of connected wind turbines has to match the network operators' requirements to ensure the security and stability operation under normal conditions and grid disturbances. The dynamic behaviour of WTs during grid faults had become a critical issue in the grid codes evolution and the extent of wind energy in the power system mix increase the interests in assessing its capability in providing "ancillary services".

One important aspect involving the performance during and after disturbances is their fault-ride through (FRT) capability, including low-voltage ride through (LVRT), zero-voltage ride through (ZVRT), and high-voltage ride through (HVRT) and Frequency Ride-through Requirements (IEEE 1547).

Large penetration of wind energy has led to the imposition of FRT to wind turbines because of their impact in the grid security and transient stability of the system.

Objectives

This work proposes two main contributions: an accurate wind farm model for transient analysis and FRT solutions of existing Engie Green installations.

The objectives of the master project are i) to propose an accurate dynamic model of Engie Green wind farms through simulation studies and validation tests for meeting the technical requirements of grid codes related to under-voltage response (LVRT) and Frequency Ride-through. The test results aim at model validation; ii) proposing external solutions for existing DFIG and PMSG-based wind farms: protection (new devices or update protection settings of the wind turbines), storage, FACTS-based or new control solutions. It will be important to consider the technical and economic aspects of retrofitting.

Progress

The work should follow the next steps:

1- State of the art and assessment of dynamic models of wind turbines Type 3 and 4.
2- Study of grid codes and new technical conditions for wind farms.
3- Simulations and validation test of dynamic models of wind farms and evaluation of FRT requirements.
4- Proposition of external solutions for fulfilment grid code obligations of existing DFIG and PMSG-based wind farms.

The results are expected to validate that the low ride through capability of the Engie Green WFs meets the current French associated grid code requirement and the potential future required ancillary services

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