Small Signal Stability Analysis of a Multi Terminal DC grid

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Context

Offshore wind power will help European countries to reach their objectives in terms of renewable energy. Since offshore wind farms may be located far from the shore, High Voltage DC transmission is the only viable solution to connect it to the shore. The connection of wind farm could be coupled with DC interconnections and reinforcements between AC systems to improve power transit flexibility and reliability between large AC systems. Before the achievement of such DC grids, control principles and protection scheme must be considered. Some control principle may be similar to AC grid but the stability issues have to be addressed to be sure that the DC grid is stable in any configuration even after major events as the trip of a substation or a cable. Modal analysis provides a good tool to estimate the dynamic behavior and assess the stability margin.

Main objective

This master thesis aims at investigating the dynamic behaviour and the stability issues of a Multi-terminal DC grid composed of several AC/DC substations, a set of cables and inductive components integrated in the grid to limit the derivative of the current in case of a DC short-circuit. Different behaviours may be found depending on the type of AC/DC converters and especially with Modular MultiLevel Converter which is the main topology used nowadays for this type of application.

Working steps

The project will start by a bibliographic research on small signal stability and modal analysis. The dynamic of the different elements composing the MTDC grid has to be analysed. The aggregation of the different elements will lead to the overall dynamic of the grid. A specific focus will be done on small signal modelling of a Modular MultiLevel Converter. A study will be done to find the main parameters which are influencing the stability of the grid.

References