Master project, 2021-2022

— *Integration of static DC / DC Converters for the Interconnection of HVDC grids* —

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Context

With the possible integration of marine renewable energy like offshore wind turbine or hydro-turbine, the concept of High Voltage Direct Current (HVDC) grids begin to emerge. The L2EP has worked on this subject for a decade in close cooperation with RTE and EDF for instance. 7 PhD thesis has been defended; 3 PhD students, 2 post-doctorates are in progress on this topic. A mock-up of Multi-terminal DC grid has been developed. This demonstrator has been presented as part of a European project name Twenties (http://www.twenties-project.eu/node/148). To connect the DC grid to the AC transmission grid, High voltage AC to DC converter are required. A structure has been proposed by SIEMENS in 2007 and has emerged as a reference. This AC/DC converter is called Modular Multilevel Converter (MMC) and it is shown in fig. 1. A small scale MMC has been developed in the L2ep in 2016.

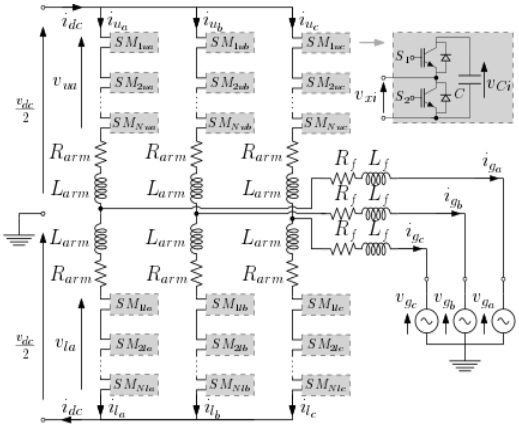

Figure 1: MMC Scheme

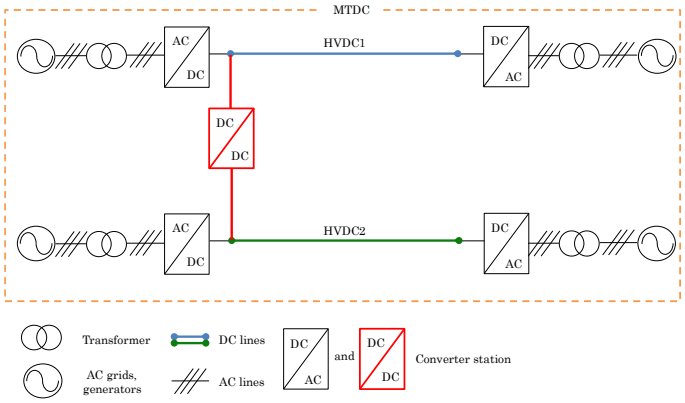

Figure 2: MTDC grid example

The interconnection of multiple HVDC grids cannot be directly considered. In fact, it is not certain that the voltage levels of these grids are the same due to DC grid progressive investment, design, non-industrial standardization between projects and permanent technological evolution for examples. Therefore, it will be necessary to introduce static converters for providing an interface of these different grids as illustrated in fig. 2. This project is part of the DICIT project (Development and Integration of static DC/DC Converters for the Interconnection of high voltage DC Transmissions grid) funded by the ANR (French national research agency).

The Master thesis project proposes to study the integration and the power flow control of a DC/DC converter within a MTDC grid. This work will be in collaboration with a PhD student and a Post-doc who work on the DICIT project.

Objectives

The objectives of the project are:

- to understand the converter model requirement to perform this study
- to integrate the chosen model into the HVDC system at various locations
- to study of energy management of the HVDC system

the works will be developed by using Matlab/Simulink.

Work steps

1. Bibliography on the subject
2. Derivation of an average model of the MMC and DC/DC converter
3. Control structure design
4. Implementation of the models and the controllers in Matlab/Simulink
5. Study some power flow control based on the literature review
6. Report writing

References

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