LABORATOIRE D'ELECTROTECHNIQUE ET D'ELECTRONIQUE DE PUISSANCE DE LILLE

Master project, 2025-2026

— *Modular Multilevel Converters: DC fault behavior and analysis*

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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 15 years in close cooperation with RTE and EDF for instance. Many PhDs thesis have been defended on this topic and now 2 PhD students, 2 post-doctorates are in progress. A demonstrator 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 and 2. two small scales HVDC/HVAC converter has been developed in the L2ep.

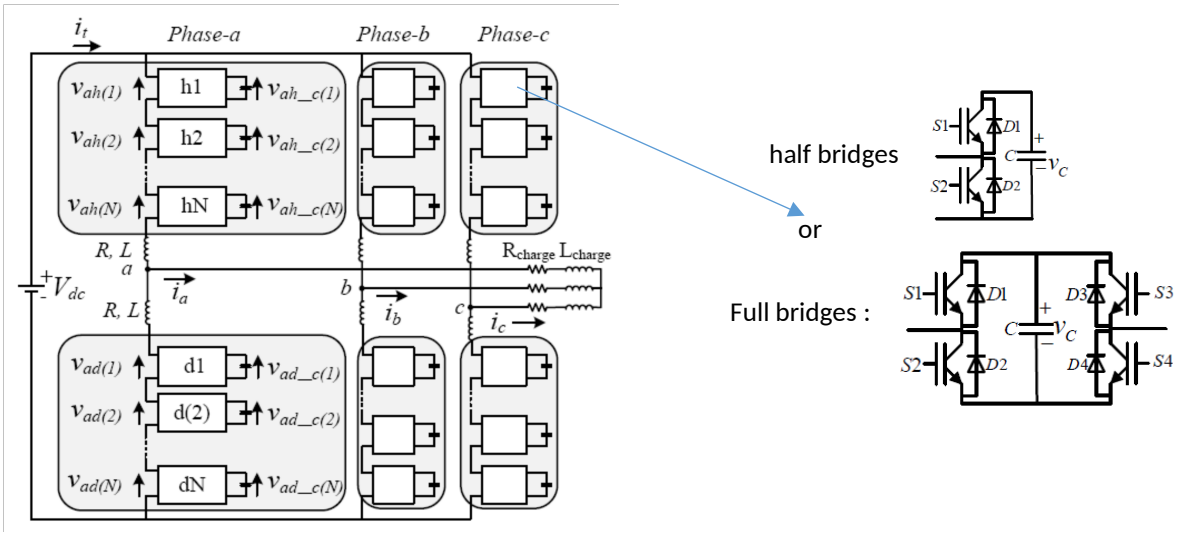

Figure 1 : MMC Scheme

Previous L2EP studies were focused on the design, the low level and high-level controls, HIL, PHIL, Experimental setup mainly with half bridges MMC due to its relative low losses compare to the full bridge one. However, the full bridge MMC have inherently the DC fault capability.

In the case of Meshed DC grid (MTDC grid), DC breakers will be needed to disconnect a station or a cable in case of DC fault. Questions are now how currents (DC and Arms) and Arm Voltages behavior are and how the DC breaker influence the dynamic? This topic is included on a part of the European project named PROSECCO

Objective

The objectives of this internship are to develop and to understand the model of DC breaker, analyse the impact on the DC faults. A question on the Larm requirement will be answer depending on the hybridation of SM (mix between half bridges and bull bridges Sub modules)

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Work steps

The proposed work consists of:

- Bibliography study on the subject
- Modeling the Full Bridge MMC with breaker.
- Implement it in Matlab-Simulink simulation
- test its control in DC fault operation
- if we have time, Implement it in HIL
- Report writing

Key word

Modular Multilevel converter; MMC; High Voltage Direct current; HVDC link; HVDC converter.

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