

Local control strategies of the interface converters between the MVAC and MVDC grid to ensure grids stability

Research Group

- L2EP (<https://l2ep.univ-lille.fr>)

Supervisors

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Introduction and general context

The electrical grid is undergoing a true upheaval with:

- the massive integration of renewable energies,
- the load which becomes more and more active
- and many other reasons.

The distribution grids are moving from a passive behaviour to an active one or even can become a power injector from the point of view of the transmission system and depending on the hour in the day. It is likely that the organisation of the actual network may have to evolve in the future. One of the solutions is the integration of DC grid at the distribution level which may facilitate the transfer of power between the different feeders of the AC medium voltage as it can add some flexibilities for DSOs (Distribution System Operators). This will induce some major modification in the grid management and also on the stability of such mix DC/AC systems. This is the core of the proposed subject.

Phd objectives and planning

Main aim of the Phd

The main objective the Phd is to analyse the integration of Medium Voltage Multiterminal DC in a Medium Voltage AC grid. Indeed, many works have already been done on High Voltage Multiterminal HVDC grid. Some of the concepts can be used to Medium Voltage application but others have to be adapted due to the different nature of the distribution grid compared to the transmission grid. The question of small signal and large disturbance stability of an hybrid AC/DC medium voltage grid is the main topic that will be addressed in this Phd.

Phd planning

1. Control of a Medium Voltage DC grid.

The general idea of the MVDC grid may be somewhat similar to its High Voltage equivalence. However, the control of this multi terminal DC grid has to be adjusted to take into account the specificities of the Medium Voltage AC/DC converters and also to integrate some new types of grid forming control for this converter.

2. Small signal stability of a Medium Voltage AC/DC grid.

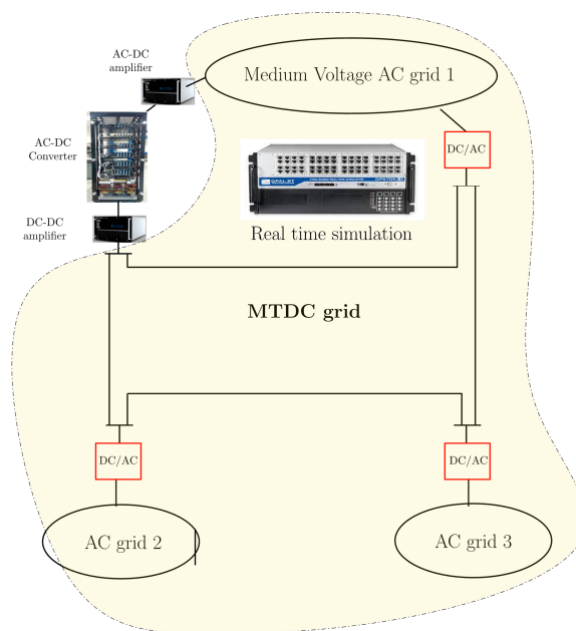
One of the key issues of the AC grid with high penetration of power electronic converters is the possible uncontrolled interactions between converters in case of weak grid. These studies which have been done on AC grid have to be extended to AC/DC grid in order to analyse if the DC grid may not propagate a possible instability one part of the AC grid connected to an AC/DC converter to another part of the AC grid connected to another converter.

3. Large disturbance stability analysis

The question of the large disturbance stability of the MTDC grid in case of an AC fault will be addressed. In a first step, the current in the converter has to be limited without inducing instability in the MTDC grid. Then, the resynchronisation of the converter when the fault is cleared has to be analysed to recover a stable operation point after this large transient.

4. Experimental validation on a small-scale test-bench

The different algorithm developed in simulation will be tested on a low voltage hybrid voltage as shown on the figure below. A real low voltage AC/DC grid is connected to a real-time simulated model of medium voltage AC and DC grid thanks to high bandwidth amplifiers. The overall real-time simulation model, the real converter will be developed by research engineers from L2EP and the Phd student will only have to test his own algorithm on the AC/DC converter on the existing test bench.



Position Requirements

As an ideal PhD candidate:

- You have a MSc with a relevant background in electric power systems or power electronic converters with application in power systems, preferably from a reputable institute from a country within the European Economic Area.
- You should have obtained excellent study results.
- You should have a keen interest to work in a team with experts studying different aspects of power electronics and power systems.



- You have experience with one or more of the following: power system dynamics, control design, power electronic converters, electrical networks
- You have excellent written and oral communication skills in English.

Localization and supervision

L2EP is a Laboratory of Electrical Engineering and Power electronic, located at Lille – France (<http://l2ep.univ-lille1.fr/>)

The research project is managed by professors Xavier Guillaud, Frederic Colas

How to apply?

Send the following elements by email to: phd.position@epmlab.eu

Selected candidates will be evaluated on technical skills and on their research capabilities (e.g. reviewing a paper)

- CV
- Cover letter
- Reference letters. At least one reference letter from your Master internship supervisor is necessary.
- Grades obtained during the master, and ranks.