



- PhD position –

Optimal methods for the sizing and design of integrated MVDC networks in AC grids

Centrale Lille and University of Nantes

Dates: September/December 2023 - September/December 2026 (36 months)

Keywords:

DC electric grid, DC renewable energy sources, technico-economic analysis, Medium Voltage DC networks, multi objective optimization, electrical network architectures, DC loads, reliability, power electronics

Socio economic context:

Currently, more and more electrical devices are supplied from a DC voltage source, ie, electrical vehicle chargers, PV generation, drive for variable speed applications... The general research objective is to imagine future MVDC extensions of current distribution grids based on the characteristics of power electronic converters. These MVDC infrastructures should be designed for bidirectional flows of energy with some meshed parts for a high reliability are requested. Moreover, the type of architecture (length of cables; voltage levels, etc.) will also influence the controllability of DC parts under different voltage levels. Studied MVDC architectures are expected to improve efficiency and should be optimally designed for other functionalities, like collecting electricity from intermittent renewable sources, distributing it to local DC loads, satisfying their various operation voltages, balancing the energy equilibrium on this DC area through energy exchanges with the existing MVAC grid, etc. There is still a need for processes and tools for designing, sizing and planning the evolving electrical grid.

Scientific challenges

The problem addressed by this thesis can be summarized by this disruptive question: What would be the architectures of future hybrid AC-DC MV distribution grids, i.e., taking place in existing AC grids, but also able to interact with (existing or future) LV and HV DC grids? Research works will focus on the principles of new DC architectures, made available with parts in DC and new active Power Electronic Converters. With those results, it should be possible to estimate the benefits of such architecture in terms of integration of renewable energies, flexibility, resilience, and maintainability, but also environmental impact and costs. For this, scenarios will be proposed to represent the operation of these new DC systems. They will be declined in technical problems (choice of voltage levels, neutral regime, etc.). The targets is to propose optimal methods for the sizing and design of integrated MVDC grids in AC grids and Eco-design of a meshed AC/DC grid for reliability and robustness enhancement.

Location and financial support

This research work is a cooperation between two French laboratories L2EP and IREENA and is funded by an ANR project « DC-Architect » in the French R&D program « PEPR TASE ». The PhD will be hired by Ecole Centrale de Lille, co-supervised by professors from both laboratories. He will be also a visiting researcher at University of Nantes and will have regular R&D periods at IREENA (Saint Nazaire).

Gross salary of about €2,055 €/month alongside a monthly lump sum to cover mobility, travel and accommodation costs at Nantes.

Supervisors:

B. Francois (Bruno.francois@centralelille.fr) and C. Saudemont (L2EP, Centrale Lille, Junia HEI)
S. Bourguet (IREENA, Université de Nantes)

Candidate profile

Candidates should have a Master degree in Electrical Engineering. The candidate with the following knowledge will be preferred:

- Fundamental knowledge about the power system operation, control and analysis,
- Good knowledge in optimization theory and familiar with an optimization software,
- Knowledge/experience about distributed electrical networks, modelling and operation of power systems.

Past experiences related to research activities, stochastic problems, DC power networks will be added values.

The candidate must have the ability to work independently, to well organize himself and to communicate regularly with all implied researchers. An analytical thinking and creativity will be appreciated.

Good communication and writing skills in English are mandatory.

How to apply :

Send in a pdf format, to the following email address: Bruno.francois@centralelille.fr :

- CV + motivation letter + Copy of identity card or passport,
- Grades obtained during your last 3 years of graduate studies and program of courses attended by students graduated from a university abroad. Official academic transcripts must be provided for each semester of each year. If you do not have a transcript (examples: internships, breaks,...), you must enclose a justification
- Photocopy of diplomas. For students with foreign degrees, the translation must be certified by a consular officer
- Letters of recommendation from your previous teachers, university tutors or people who supervised you during an internship (at least two).
- Copy of your personal works (internship reports, professional experience, employment contracts, etc...)