Dipartimento Energia
Power Electronics Innovation Center (PEIC)
Politecnico di Torino

We are looking for a master student to work on:

Single-Phase Inverter for a Tokamak Non-Axisymmetric In-Vessel Coil Power Supply
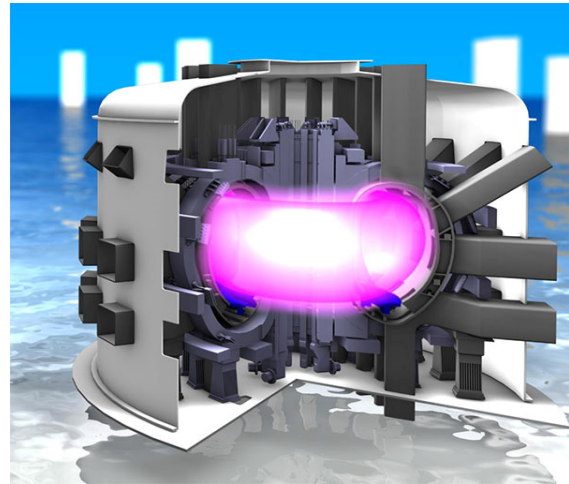
Background

Nowadays, nuclear fusion energy is one of the greatest challenges in worldwide research. Several international research projects are involved in the development of an actual nuclear fusion energy source structure. In the most promising ones, known as "tokamaks", a magnetically confined plasma is needed to achieve high rates of fusion reactions.

The Divertor Tokamak Test (DTT) project (https://www.dtt-project.it/index.php/science/dtt-project.html) aims to create an experimental facility that will have to solve some of the most complex

Divertor Tokamak Test (DTT) project plants

problems on the implementation path of nuclear fusion. The construction of DTT facility is starting within the ENEA Research Center in Frascati, Italy. The mission of the DTT project is to contribute to research on the implementation of nuclear fusion, achieving a plasma current of up to 5.5 MA with a magnetic field of 6 T and additional heating of up to 45 MW coupled to the plasma. The DTT was conceived as a "link" between the large international nuclear fusion projects ITER and DEMO (the reactor that after 2050 will have to produce electricity from nuclear fusion to provide scientific, technical and technological answers to major problems such as the management of the large power flows produced by the plasma exhaust and the materials to be used. In fact, the facility is named after the "divertor", that is the part of a tokamak devoted to such management.

The magnetic system includes several coils necessary to create and control the plasma current. Every coil is supplied by a dedicated power converter topology feeding the high current requested at different voltage levels.

The thesis will analyze and develop the inverter topologies already identified for the NAS (non-axisymmetric" coils), deepening the different operating conditions and the control system by simulation with the PLECS tool and using the development and verification techniques (testing) called hardware in the loop (HIL). This investigation strategy is implemented with software and hardware tools that reproduce in a more or less complete way the electrical and electronic system to be developed and verified.

Your tasks:

- Literature survey of the state-of-the-art of power supply for vertical stabilization Coils in tokamaks application.
- The inverter topology survey and critical review of the different approaches to arrange the DC/AC power converter.
- Simulation investigation in PLECS of the identified inverter topologies.

Converters power supply for NAS coils

- Control strategy analysis, and application in the considered in-vessel NAS coils.
- Study of Hardware in the Loop methodology for the topology and control strategy development and testing.
- HiL results processing and presentation.
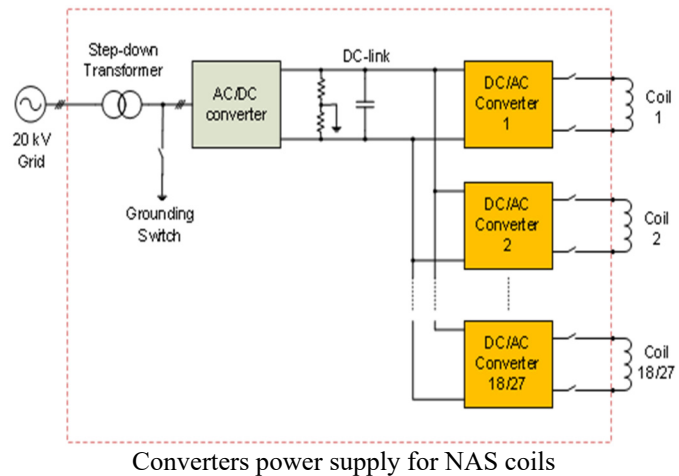
Necessary skills

- Power Electronic basics in converter topologies and power devices applications
- Basic knowledge of MATLAB/Simulink and/or PLECS tools
- C programming skills (e.g. Attendance to the course Laboratory of Power Converters and Electrical Drives is sufficient);
- Background of control theory and Basic knowledge of digital control.

What you will learn

- To analyze high level technical literature (mandatory and requested by the companies producing high level technology);
- Power electronics inverter operation and power device applications;
- Power electronics simulation skills using PLECS;
- Hardware in the Loop skills: how to implement a control of multilevel cascaded inverter connected a RL load, how to organize the testing, how to process and report the results of the activity in effectiveness way.

Duration of the thesis: 6 months

Application

We are looking forward to receiving your application. Please include your CV and a short explanation why you fit the position (Italian or English). Send your application to salvatore.musumeci@polito.it, giovanni.griva@polito.it and radu.bojoi@polito.it.