EUROPEAN SPALLATION SOURCE

IEA Industrial Electrical Engineering and Automation

LUND INSTITUTE OF TECHNOLOGY
Lund University

Master Thesis in Electrical Engineering

on

High Voltage Pulsed Power Converters for the ESS Linear Accelerator

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Duration: 6 months, 2 students per project

Remuneration: Upon successful evaluation of the results achieved, each student will receive a grant for his/her contributions to the projects

For further questions or applications please contact Carlos A. Martins

1 - Introduction:

The European Spallation Source will be the most powerful neutron source worldwide. It's linear accelerator (Linac) will accelerate a beam of protons with a peak power of 100 MW, a pulse length of 2.86ms and a pulse repetition rate of 14 Hz. The RF power sources will require several High Voltage Pulsed Power Converters rated for peak voltages and currents of 100kV and 50A, respectively, and for pulse lengths/pulse repetition rates of 3.5ms/14Hz. Due to their pulsed nature, these power converters may impact strongly on the grid power quality and in particular on the flicker levels. Besides the design, dimensioning and control of the HV pulsed power converter itself (project 2), which constitutes on its own a huge challenge, the compliance of the grid power quality to international standards is another topic of the upmost importance (project 1). These topics have rarely been addressed on the framework of a scientific installation of this size encompassing such special requirements.

2 – The projects:

Project #1: Flicker-free active front end for grid power quality improvement in pulsed power applications

Work description:

- Study of an Active Front End three-phase rectifier + DC/DC converter;
- In depth study and analytical modeling of the topology;
- Development of the control/regulation loops, allowing simultaneously for a sinusoidal current and constant power absorptions from the mains;
- Optimal dimensioning of the power components and selection of operating parameters;
- Simulation of the complete system;
- Construction and validation of a reduced scale prototype, using the Compact RIO control platform;

Project #2: Resonant Multi-Level power converters for high voltage pulsed power sources

Work description:

- Study of resonant power converter principles and their typical applications;
- In depth study and analytical modeling of resonant multi-level topologies;
- Development of the control/regulation loops;
- Optimal dimensioning of the power components and selection of operating parameters;
- Simulation of the complete system;
- Construction and validation on a reduced scale prototype, using the Compact RIO control platform;

Methodology:

- Use of different software packages for calculations and simulations (MathCad, Matlab, SABER);
- Use of control RIO environment;
- Basics of HV design and implementation techniques;
- EMC compliant implementation techniques for reliable constructions in power electronics;