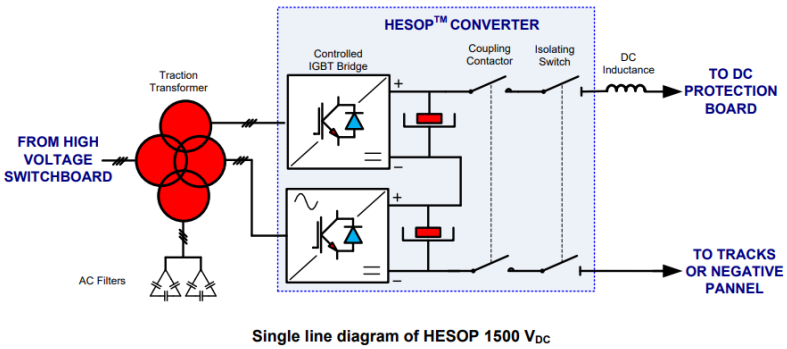
Design for Energy Savings in Reversible Substations

Bachelor thesis project



Single line diagram of HESOP 1500 V_{DC}

https://www.alstom.com/solutions/infrastructure

Summary:

The aim of this thesis is to model, design and simulate a reversible substation with several regenerative options/scenarios. The traction system of subway stations when operated bidirectionally, can save energy during braking operation of the motor. Also, with the presence of an energy storage system, the energy can be stored and used later for peak shaving etc. Furthermore, exchange of energy between the various trains can yield lower distribution losses in the system.

Problem definition:

Controlled rectifier with paralleled IGBT converter forms the basic building block of Alstom's HESOP system. Depending on power levels, the modules paralled and in earlier versions, controlled rectifiers (thyristors – 6/12 pulse implementations etc depending on power level) in combination with IGBT modules are implemented. In this study, a number of these options and other regenerative braking options are compared to look at losses, efficiency, energy savings etc.

Research objectives:

- Perform a literature survey for several examples of reversible power converter implementations in substations (Alstom HESOP)
- Perform a comparative analysis of different strategies for recuperation in substations (including with and without energy storage systems (ESS))
- Compare, select and simulate a couple of key topologies (including HESOP) and perform simulations to see the improvement in efficiency/losses in the system with and without recuperation
- Perform benchmarking of the various topologies (against HESOP) and compare their relative strengths and weaknesses

Courses and supervision:
This is a a challenging, power electronics project that needs good analysis, design skills. Background of EE and power electronics and battery-related courses are considered mandatory.

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