Dynamic Loadability of Cable Based Transmission Grids

This thesis is the product of three years research within the field of dynamic loadability of cable based transmission grids. The report contains a summary of the three year PhD project which has been conducted in a collaboration between the Danish Transmission System Operator (TSO), Energinet.dk who has fully funded the research, and the Department of Electrical Engineering at the Technical University of Denmark (DTU). All content of this report has been produced by the author during the three years, either individually or in collaboration with the different professional partners. The PhD project was carried out at three main locations, the headquarters of Energinet.dk in Errits, DTU in Kgs. Lyngby and during a six months external stay at Kinectrics in Toronto, Canada.

At Energinet.dk I gained considerable knowledge about the practical considerations regarding design, installation and dynamic loadability of cables. Energinet.dk has also been the main location where discussions, about how to implement the findings of the project into the real world, have taken place.

At DTU most of the academical discussions within the project have taken place. This includes discussions about pure mathematical issues, cable technology and software technical problems. DTU was also the place where most of the experimental work, for verification of the theoretical models, took place.

For the external stay, which is a mandatory activity to obtain a PhD degree from DTU, I visited Kinectrics in Toronto, Canada. Kinectrics is a large consultancy who employ, among others, one of the experts within loadability calculations, Dr. George Anders. During my stay, I obtained much insight into dynamic rating techniques, practical issues with loadability calculations and the mathematics behind. During the PhD project I supervised 2 master projects, as well as 5 special courses at DTU. Furthermore I created and taught a cable course, with approximately 25 students, throughout 13 weeks during the spring of 2011.

The PhD project has until now contributed with 3 journal papers and 4 conference papers. Selected papers can be found in the appendix. This thesis is divided into 9 chapters, plus list of references, appendices, etc. References to literature are denoted in square brackets, e.g. [1], and equations are denoted in parenthesis, e.g. (1.2) where the 1 refers to the chapter number and the 2 refers to the specific equation in the chapter. Similarly figures and tables are referenced as e.g. figure 1.2 and table 1.2, where the 1 refers to the chapter number and the 2 refers to the specific figure or table in the chapter.