DEPARTMENT OF ENERGY TECHNOLOGY
AALBORG UNIVERSITY

PhD Public Defence

Title: A Power System Emergency Control Scheme in the Presence of High Wind Power Penetration

Location: Pontoppidanstræde 101, Room 23

Time: Friday 29 May 2015 at 13.00

PhD defendant: Bakhtyar Hoseinzadeh

Supervisor: Professor Claus Leth Bak

Moderator: Associate Professor Birgitte Bak-Jensen

Opponents: Associate Professor Jayakrishnan Pillai, Dept. of Energy Technology, Aalborg University (Chairman)
Professor Göran Andersson, EEH-Power Systems Laboratory, Zürich, Switzerland
Consultant Engineer Ivan M. Dudurych, Eirgrid, Ireland

All are welcome. The defence will be in English.

After the public defence there will be an informal reception in Pontoppidanstræde 101 room 25/27.

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Abstract:

The main goal of the project is to improve existing protection technology by localizing the load shedding scheme in grids with high share of dispersed generation dominantly provided by renewable energy sources, i.e. wind, wave, solar, biomass, etc.

The higher complexity and lower predictability of grids with a high penetration of renewable energies makes it difficult to overseen and overcome widespread range of combinational and cascading events, just by relying on conventional protection systems, which generally do no coordinate the different grid variables in the respective protection schemes. Utilization of all of locally measurable variables, e.g. frequency, its rate of change, voltage drop, power flow direction under an integrated decentralized plan is done in this project, in order to improve the grid reliability.

The proposed scheme benefits from a decentralized strategy, which reduces the burden of central control by decreasing the amount of data processing and more important, by avoiding any control problems in the system due to loss of communication link resulting from accidents of Cyber Security attacks, which have been recently located in the center of attention. The algorithms developed in this project may also constitute the lower level of a hierarchical control strategy, which can be activated in case of losing the communication with the control center.

Modern power protection relays often provide several protection schemes inside of one common package. However, they normally operate without coordination even when they are implemented inside a common module. This project intends to benefit from the fact that the existing technology already uses, as input, all the required data, to coordinate distinct plans under an integrated and versatile scheme. The proposed scheme automatically updates the frequency set points, stage time delays used for load shedding as a function of fault location and severity of the disturbance/s. It is a comprehensive solution for all possible combination of contingencies; i.e., not only is efficient for conventional power systems, but also for the time-variant structure and dispatch of grids resulting from high share of renewable energy sources.