DEPARTMENT OF ENERGY TECHNOLOGY
AALBORG UNIVERSITY

PhD Public Defence

Title: Economic Operation of Power Systems with Significant Wind Power Penetration

Location: Pontoppidanstræde 101, Room 23

Time: Tuesday 19 May 2015 at 13.00

PhD defendant: Mostafa F. Astaneh

Supervisor: Professor Zhe Chen

Moderator: Associate Professor Thomas Condra

Opponents: Prof. Poh Chiang Loh, Dept. of Energy Technology, Aalborg University (Chairman)
Prof. Asgeir Tomasgard, Dept. of Industrial Economics and Technology Management, Trondheim, Norway
Prof. Carlo Alberto Nucci, Dept. of Electrical, Electronic and Information Engineering, University of Bologna, Bologna, Italy

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 PhD project is to addresses economic operation of power systems with high penetration of wind power. Primary concern in such power systems is high variability and unpredictability. Unlike conventional power plants, the output power of a wind farm is not precisely controllable and depends on weather conditions. This brings additional complexity to operation and planning of wind dominant power systems. The key solution in face of wind power uncertainty is to enhance power system flexibility. The enhanced flexibility level should be economic and can be a provided by different tools which will be studied in this project.

First an optimal pricing scheme is investigated to enhance long term flexibility is in wind dominant power systems.

Next, cooperative wind-storage operation is studied. Lithium-Ion battery units are chosen as storage units. A novel formulation is proposed to investigate optimal operation of a storage unit considering power system balancing needs.

An optimization framework is then presented to increase demand responsiveness. The key idea is to magnify the price difference between peak and off-peak hours. The result is a new set of prices under which the peak demand is reduced (and thus power system security is enhanced). The optimal charging scheme of Eclectic Vehicles (EVs) in a distribution feeder is then studied considering the proposed pricing scheme. Technical constraints of the distribution grid are formulated to give an optimal EV charging.

A formulation is then proposed for optimal reserve scheduling considering the role of reserve provision scenarios from cross-border interconnections. The framework decouples the share of upward and downward primary, secondary, and tertiary reserve services within DK1 (western Danish power system) and neighboring cross border resources (Norway and Germany). Environmental impact of reserve providers are taken into account.