DEPARTMENT OF ENERGY TECHNOLOGY
AALBORG UNIVERSITY

PhD Public Defence

Title: Predicting Performance Degradation of Fuel Cells in Backup Power Systems

Location: Pontoppidanstræde 105, room 4.127

Time: Friday 4 October at 13.00

PhD defendant: Simon Heindorf Sønderskov

Supervisor: Professor Stig Munk-Nielsen

Moderator: Associate Professor Tamas Kerekes

Opponents: Associate Professor Erik Schaltz, Dept. of Energy Technology, Aalborg University (Chairman)
Dr. Cesare Pianese, University of Salerno - Dept. of Industrial Engineering, Italy
Dr. Suresh Perinpanayagam, Cranfield University, UK

All are welcome. The defence will be in English.

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Abstract:

Fuel cell based backup power systems supply sensitive telecommunication equipment with a stable and continuous electricity to maintain internet infrastructure during disturbances and outages in the electrical utility grid.

Predictive maintenance can help minimizing the risk of system downtime and thereby the availability of the internet connection and other communication infrastructure. Furthermore, it can help improve backup system lifetime and bring down the maintenance costs. Key parts of predictive maintenance are the assessment of system condition and forecasting of how the system condition develops in the future. This is commonly referred as prognostics. The unique operating patterns of backup power systems makes state of the art prognostics approaches for fuel cells inapplicable. Hence, new approaches are required.

This thesis describes methods of extracting fuel cell performance indicators from backup power system data from systems in actual field operation. The performance indicators are used for estimating the fuel cell stack degradation level. Detection of fuel cell stacks with abnormal usage or performance characteristics as well as prediction of future performance levels of the fuel cell stacks is developed. The methods are based on machine learning algorithms, including density-based outlier and cluster detection and recurrent neural networks.