DEPARTMENT OF ENERGY TECHNOLOGY
AALBORG UNIVERSITY

PhD Public Defence

Title:	Modelling Icing on Structures for Wind Power Applications
Location:	Pontoppidanstræde 105, room 3.115
Time:	Tuesday 4 September at 13.00
PhD defendant:	Marie Cecilie Pedersen
Supervisor:	Associate Professor Henrik Sørensen
Moderator:	Associate Professor Mads Pagh Nielsen
Opponents:	Professor Søren Knudsen Kær, Dept. of Energy Technology, Aalborg University (Chairman) Professor Lars Roer Sætran, NTNU, Norway Mark Žagar, Vestas Wind Systems A/S, Denmark

All are welcome. The defence will be in English.

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Abstract:

Wind turbines located in cold climate regions are exposed to icing during the wintertime, which can lead to several icing induced problems, such as production losses, blade fatigue and safety issues. Despite this, wind power located in cold climate regions is very attractive due to the combination of favourable weather conditions and that the sites are onshore, remote and sparsely populated. To circumvent the challenges related to icing, empirical models are used to understand and predict the severity of icing at a given site, but since wind turbine icing is a very complex phenomenon the industry needs strong reliable tools for ice prediction and production loss assessment.

Using Computational Fluid Dynamics (CFD) a 2D model to simulate icing over time has been developed. The CFD Icing Model is developed based on the demand to improve the currently used production loss assessment framework. The CFD Icing Model is developed by implementing know theory in a commercial CFD software by user defined functions and available macros. In-cloud icing conditions and rime ice accretion is the modelling target for the model and ice accretion is modelled using an impingement model and customised surface boundary conditions for the object exposed to icing. The shape of the object exposed to icing is changes according to the calculated mass of ice every timestep.

Ice accretion is a dynamic process, controlled by the atmospheric conditions given to the model as the inlet boundary conditions. Thus, for modelling icing over time and for validation purposes, on-site measurements are used to compile a dataset consisting of inlet boundary conditions and validation data, obtained using image analysis. The results of modelling icing over time using the CFD Icing Model, corresponds very well to the results of the maximum ice thickness obtained from image analysis. The study presents a unique methodology for modelling icing over time using the CFD Icing Model developed and on-site data, which are most often available to the wind turbine owner and/or operator.