ECN Wind Energy Industrial Support

Training Aeroelasticity of Wind Turbines

EWIS

Being one of the leading institutes on wind energy research, ECN established the EWIS (ECN Wind Industrial Support) group in 2009 to better bring the R&D results to the market. During the last three decades, ECN has developed expertise on aerodynamics, structural analyses, turbine control, offshore operation and maintenance, and grid connection. With the growing wind industry, ECN received more requests for assistance and EWIS has become the vehicle to support the wind energy industry in their product developments.

EWIS's focus is on the high end of the market which means that we will make use of tools and knowledge that have been developed in-house and include the latest R&D results!

The EWIS team is a mixture of young professionals and experienced researchers which ensures a fast response and high quality.

More information

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Description of training

Purpose

A successful wind turbine design must be aeroelastically stable. Several codes exist to analyse the turbine stability, but basic knowledge of aeroelasticity is necessary before one can use these codes safely and efficiently. This course will supply your staff members with the basics in aeroelasticity for wind turbines.

Organisation and content

The training is generally held in two days. The first day deals with dynamics, elasticity and aerodynamics. The dynamics of wind turbines are treated and a short introduction/recap is given into blade element momentum theory. Then the stability of a wind turbine blade is treated, flutter and stall flutter are explained.
On the second day resonance will be explained using Campbell diagrams and the stability of the complete turbine will be discussed, including an overview of possible instabilities and tools that can be used to analyse the aeroelastic stability of wind turbines. Also, design methods to enhance the stability characteristics of the wind turbine are presented.
The lecture material contains examples of various research projects in which ECN has been involved. The content of the lecture is regularly updated using the experiences from previous lectures and the most recent results from research projects.

A more detailed list of contents can be found on the next page.

CO-930 September 2010

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Target Group:	Wind turbine (blade) designers, research institutes, universities.
Required educational level of attendees:	Engineers or scientists. Basic knowledge of wind turbine aerodynamics, structural mechanics and dynamics and vibrations is required.
Track record:	The training will be given by specialists who do not only have many years of experience in wind turbine aeroelasticity, but who are experienced in educational activities as well.
Minimum/maximum number of participants:	The number of participants is not limited but if more than six persons are going to participate the training will become less efficient and special arrangements need to be made.

For more information about this training, please contact:

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Content

Part 1 (Day 1)
Basic wind turbine dynamic and aerodynamic models
- Introduction
- Vibrations
- Natural frequencies and mode shapes
- Centrifugal stiffening
- Blade element theory
- Blade Element Momentum (BEM) theory

Part 2 (Day 1)
Aeroelastic stability of rotor blades
- Static divergence
- Fluttter

Part 3 (Day 2)
Resonance
- Tower stiffness
- Blade frequencies

Part 4 (Day 2)
Stability of wind turbine
- Lead-lag and sideways tower instability
- Whirl flutter
- Advancing lead-lag mode coupled with tower modes instabilities
- Analysis
- Design methods to improve the stability characteristics

The content of the lecture can be combined with an introduction to some of ECN's aeroelastic tools (TURBU, BLADMODE, PHATAS). If necessary a demonstration of these tools can be added to the program. In that case an extended course duration may be necessary.