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TESTING OF LARGE BLADES – CHALLENGES AND TRENDS

2018 Sandia Blade Workshop, August 28-29, Lubbock, Texas

By John Korsgaard, Sr. Director, Eng. Excellence
A little bit about LM Wind Power*

• Since 1978, LM Wind Power has produced more than 205,000 blades corresponding to a capacity of approximately 93W
• Contributing to saving more than 189 million tons of CO₂ per year
• ~10,000** employees, 15 manufacturing facilities in 8 countries on 4 continents
• Rotor solutions are supplied to 10 global and national wind turbine manufacturers, for Onshore and Offshore wind

* *Acquisition completed on April 20, 2017
** Employee number does not include contractors

LM Wind Power: a leading blade supplier to the wind industry.
Big, Bigger, Biggest

Calculations are based on European data
GE Renewable Energy is developing Haliade-X 12 MW, the biggest offshore wind turbine in the world, with 220-meter rotor, 107-meter blade, leading capacity factor (63%), and digital capabilities, that will help our customers find success in an increasingly competitive environment.

One Haliade-X 12 MW can generate 67 GWh annually, which is 45% more annual energy production (AEP) than most powerful machines on the market today, and twice as much as the Haliade 150-6MW.

The Haliade-X 12 MW turbine will generate enough clean power for up to 16,000 European households per turbine, and up to 1 million European households in a 750 MW configuration windfarm.
Blade design is not just aerodynamics, materials and structure

... it’s Cost of Energy and Reliability
Cost-effectiveness and reliability through understanding of interaction between materials, process and design.

Test pyramid picture from IEA task 35
Final validation through full scale static and fatigue testing

- Measurement of blade eigen-frequencies and mode shape
- Static test in min. four direction with extreme loads distribution applied to the blade
- Fatigue testing in flap- and edgewise direction simulating operational lifetime
- Post-fatigue static test to demonstrated blade strength after end of lifetime
- Extensive non destructive testing programme using infrared and ultrasound scanning
- Also full scale crash tests are performed in order to determine durability and scale effects
Is there a benefit of advanced full scale blade testing?

From 17m onwards the most fatigue critical element is the same element which is used to define the single axis (flapwise) fatigue test.

In terms of Palmgren-Miner damage sum, this blade will not benefit from bi-axial testing except near the root.

*Work performed by ORE Catapult, UK in the XL-Blade project (DemoWind)
Trends - future test paradigm

- Reduce cost and time for testing
- Replace full scale testing by more sub-component testing
- Learn about fatigue behavior on all levels – the devil is in the details
- Perform virtual full scale testing through a digital twin representation of physical blades including imperfections

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Thank you for your time

Contact details:
John Korsgaard
Sr. Director
Engineering Excellence
Tel +45 79 84 00 00
Mob +45 21 45 60 32
E jk@lmwindpower.com

Head quarters:
LM Wind Power
Jupitervej 6
6000 Kolding
Denmark
Tel +45 79 84 00 00
Fax +45 79 84 00 01
E info@lmwindpower.com
W lmwindpower.com

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