MA- DOE/NREL Large Blade Testing Facility Overview

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Wind Blade Testing- Expanding Requirements

- 2007 worldwide estimated blade production was 43,777 and is predicted to grow by a factor of 3.2 to 140,864 in 10 years.
- Higher costs and lower than predicted service life for components, including blades, is raising the requirements for manufacturers to **further test and improve reliability**
- International certification standards **require more testing**, including endurance/fatigue testing , manufacturing audit testing.
- Testing to validate and further use of numerical simulation and design optimization work.

Picture from internet

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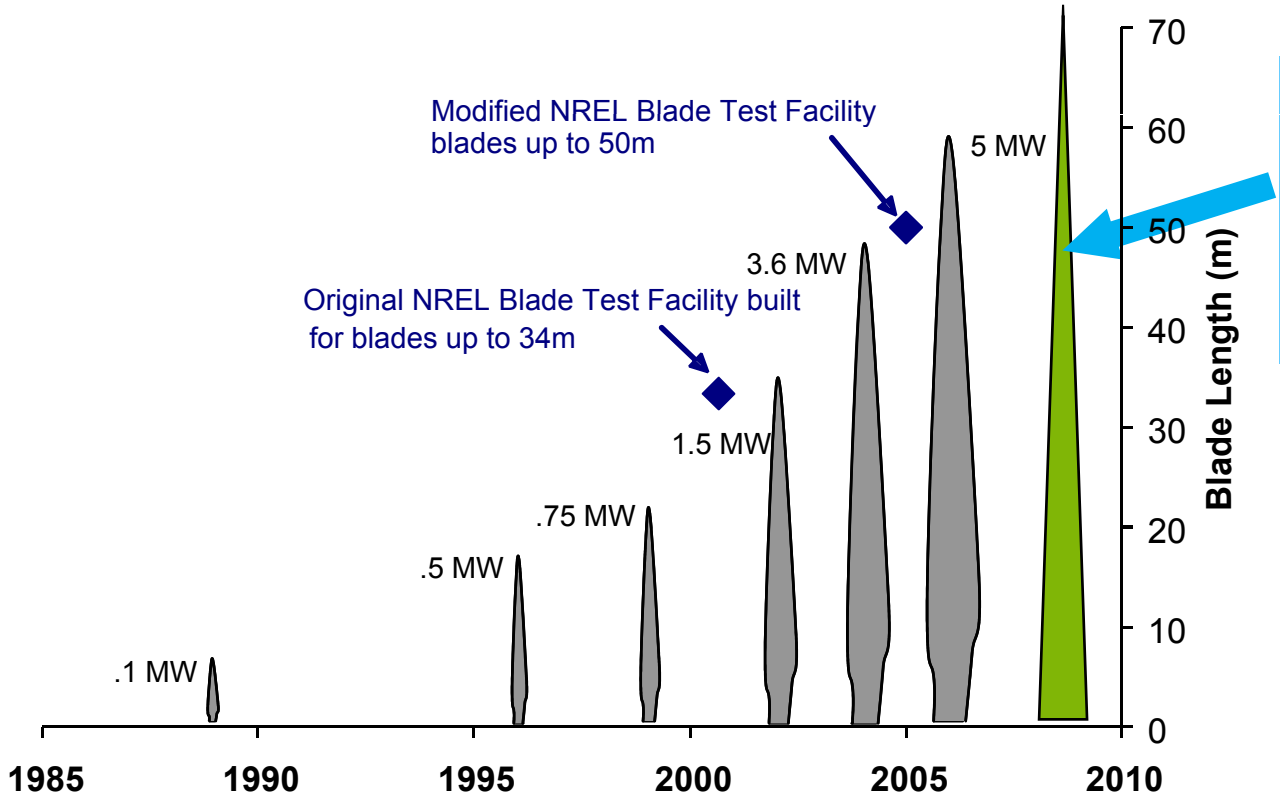
Larger Blade Testing Facility in USA is needed

- Blades **now longer** than only US facility (NREL in Colorado) can test
- Blade reliability is a key issue to support Wind industry growth
- Next Generation Wind especially offshore requires larger wind turbines with larger blades that **require more rigorous testing**



MA-DOE/NREL Wind Technology Test Center (WTTC) can test up to 90m blades

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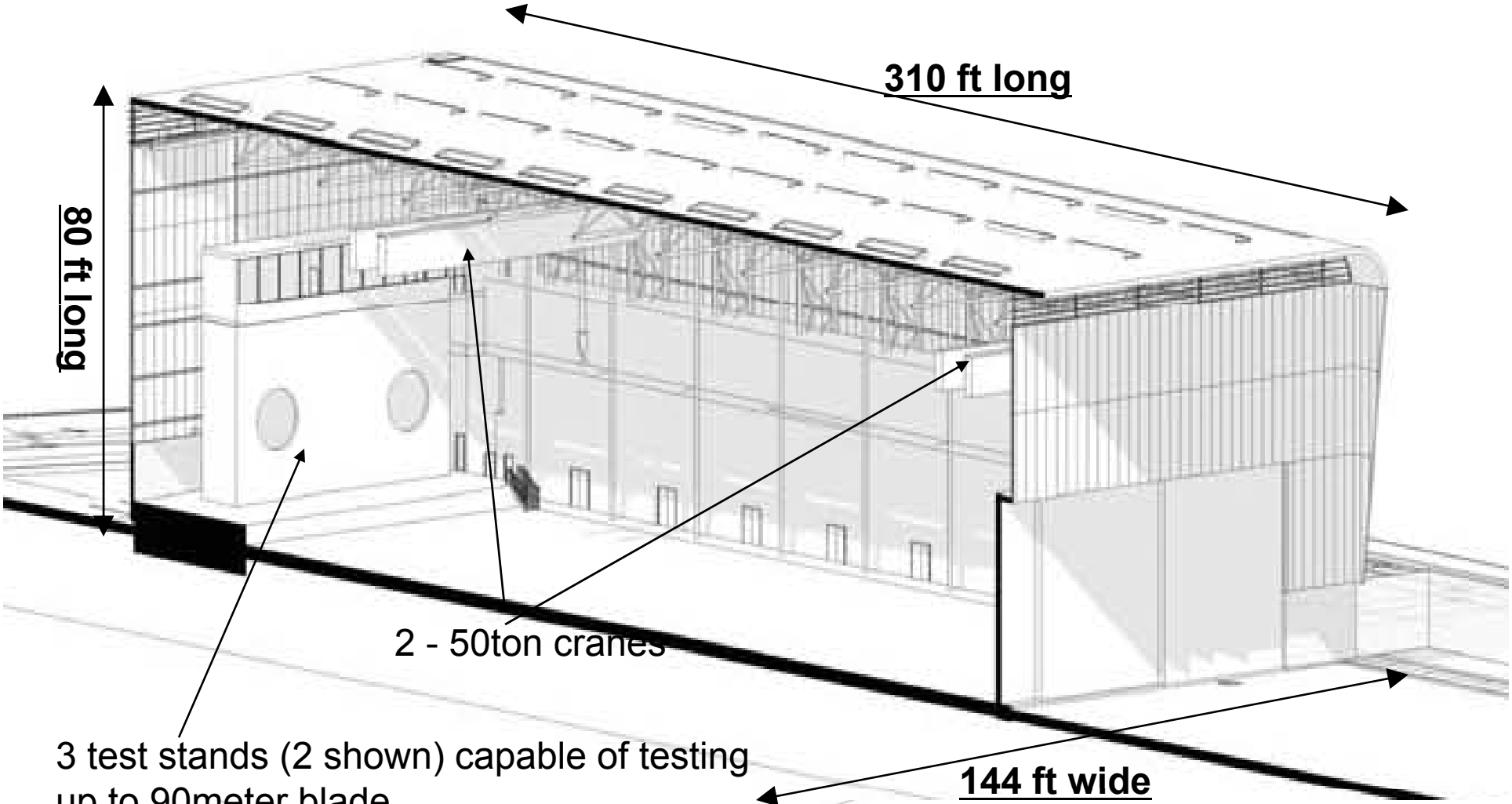
WTTC facility layout (preliminary)



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Core testing capabilities

- Three test stands capable of testing up to 90m wind turbine blades.
- Full suite of static and fatigue blade tests
- R&D testing (new designs & materials)
- Manufacturing/QA testing (audit) prior to deployment or after repairs
- Lightning protection testing?
- Workforce training

Picture courtesy of NREL

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Static Testing

- Vertical and Horizontal static testing
  - 85meter blade can be tested inside the building.
- Maximum static bending moments - 84 MNm
- Maximum horizontal deflection - 35meters
- Maximum vertical deflection - 22meters
- Up to 9 hydraulic or electric winches for load application.

Picture from internet

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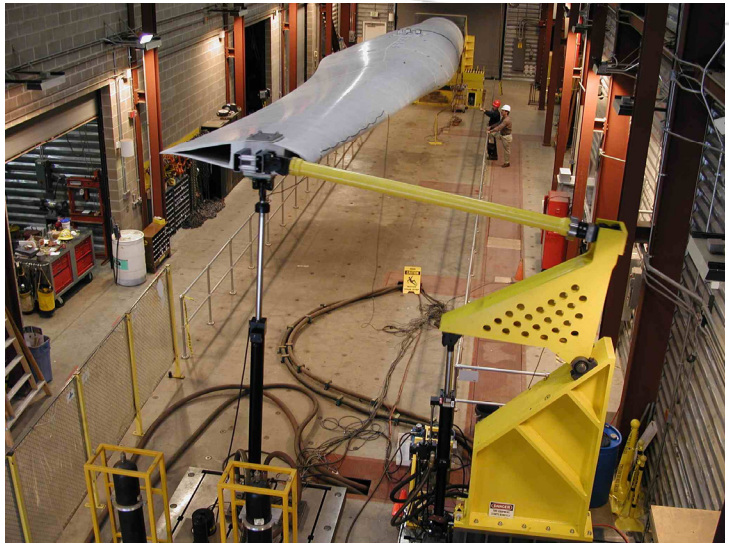
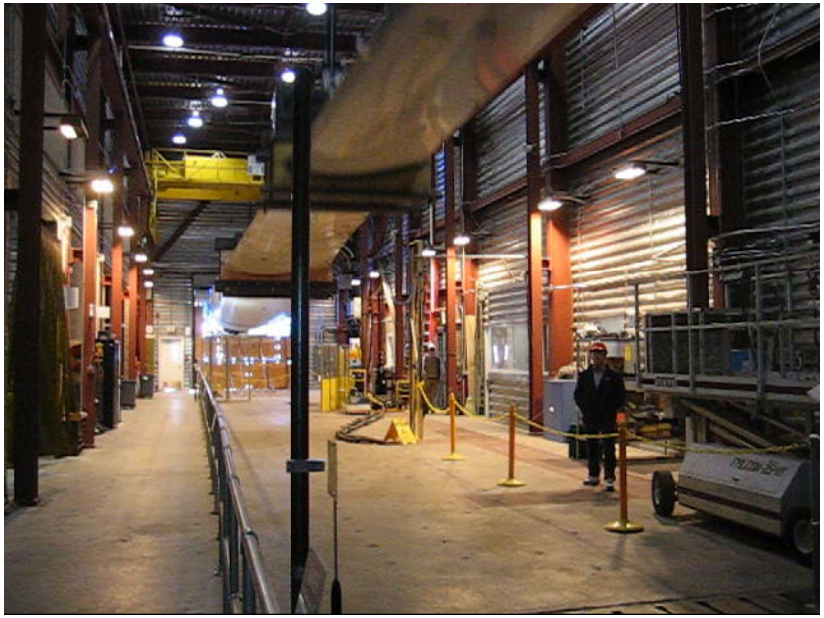
Fatigue Testing



This slide courtesy of NREL's NWTC

- Tests the ability of the blade to withstand operating-life loads
  - 20-year blade life on the order of 1×10^9 cycles
  - Laboratory testing accelerates loading through increasing load magnitude to manageable number of cycles, typically 1-million to as high as 10-million
- Methods
  - Single-axis
  - Two-axis
  - Forced Displacement
  - Resonant



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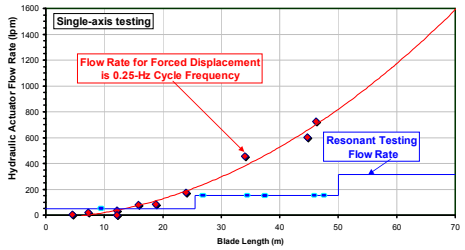
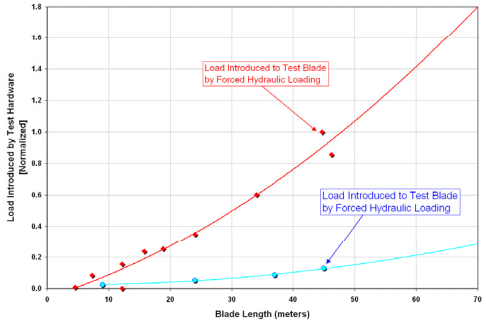
Testing methodology development

- Forced Displacement Testing
  - Dual-axis capability
  - Accurate load replication
  - High equipment and operating cost
  - Longer test duration
  - Prohibitive to test entire blade length
  - Large test loads introduced to blade
- Linear Resonant Testing
  - Low(er) Equipment costs
  - Relatively short test duration
  - Can test entire blade span
  - Method scales favorably for larger turbines
  - Ability to ramp load at resonant frequency





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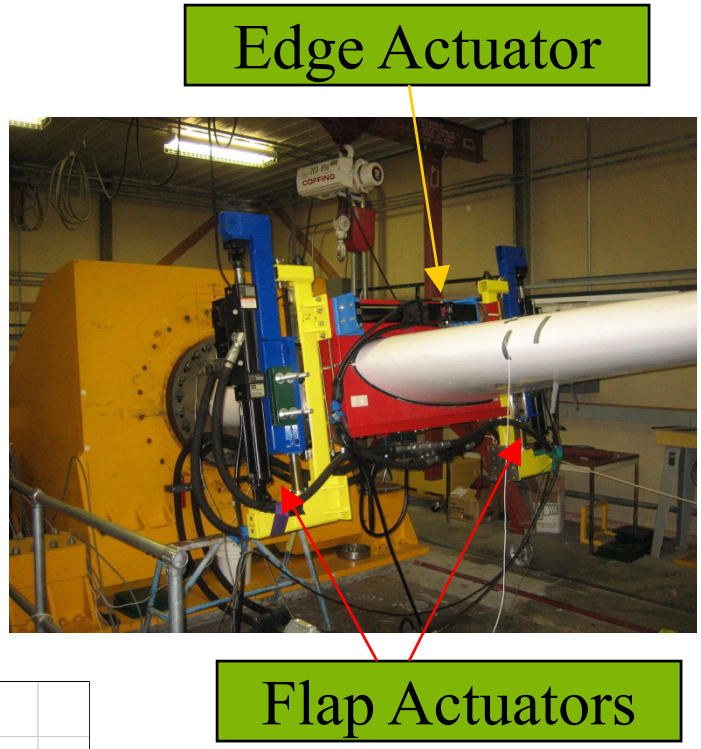
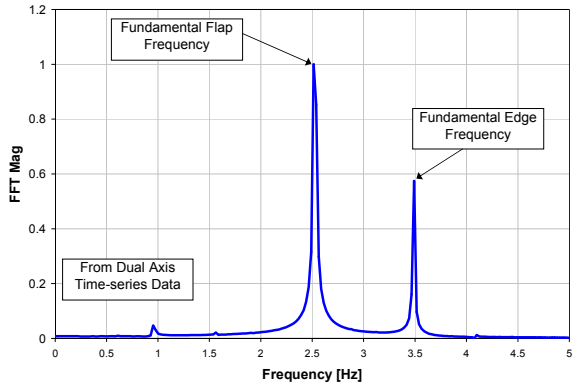
Dual Axis Resonant Testing

- Employ linear actuators in both flap and edge directions
- System operated at two distinct frequencies
- Potential for single-frequency operation with tuning elements
- CRADA Between NREL and MTS to accelerate commercialization of UREX, Dual Axis, and other technologies





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Thank You

- This facility is planned to be operational and ready to test blades in early 2011.

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