The Danish Test Facilities – Megavind Offspring

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DTU Wind Energy

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Megavind 2007 - 2013

- Components and turbine parts
- Wind turbines (prototypes and pre-series) and wind power plants
- Offshore installations (e.g. foundations and grid)
- Wind power plants in the energy system
Validation – Products and research

The turbine

Deterioration:
Demands and specifications for components and subsystems

Integration:
Testing of components and subsystems as well as integration into the electricity supply system

Component

Validated

Review

Full-scale test
Large sub component
Large size specimens
Small test specimens

DTU Wind Energy, Technical University of Denmark
Survey of test and research infrastructures

- **Existing and pipeline**
  - Testcenter Østerild and Test Center for Large Wind Turbines at Høvsøre, DTU Wind Energy
  - Blaest blade test facility and DTU Wind Energy static blade test facility
  - LORC test facilities and DTU Wind Energy Drivetrain Test Facility
  - Wind tunnel, DTU Wind Energy
  - Grid test facility on Testcenter Østerild, DTU Wind Energy
  - Computer Clusters, DTU Wind Energy
  - Material and component tests (Hydraulic test bench – microscopes), DTU

- **Need for new research infrastructures, DTU**
  - Research wind turbine Fatigue research blade test facility
  - Research (acoustic) wind tunnel instrumentation
  - Offshore wind conditions test equipment
  - FiberLab (scale models, prototype components)

- **Need for new industry infrastructures**
  - More test sites (Low wind, cold/warm climate, complex flows, duration)
DTU Test Stations – Prototype Testing

5 test beds
< 165 m
< 8 MW
Spacing 300 m

7 test beds
< 250 m
< 16 MW
Spacing 600 m
# Wind Turbines at Østerild

<table>
<thead>
<tr>
<th>Stand (no.)</th>
<th>Turbine Company (model)</th>
<th>Effect (MW)</th>
<th>Diameter (m)</th>
<th>Nac / Tip height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><a href="http://www.WindTurbineTest.com">www.WindTurbineTest.com</a></td>
<td>Tender:</td>
<td>28/6-2013</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Vestas (in 2014)</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>Vestas (in 2013)</td>
<td></td>
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<tr>
<td>5</td>
<td>Envision (in 2014)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Siemens (SWT-6,0)</td>
<td>6,0</td>
<td>154</td>
<td>120 / 197</td>
</tr>
<tr>
<td>7</td>
<td>Siemens (SWT-4,0)</td>
<td>4,0</td>
<td>120</td>
<td>110 / 170</td>
</tr>
</tbody>
</table>
Østerild Test Center

**Wind turbine testing:**
- Tests acc. to international standards (IEC)
- Development tests

**Research:**
- Meteorology (Wind)
- Turbine technology
- Grid integration

Test facility supports test of wind turbines with rated power $P_n < 10$MW. Two types of equipment included in the Test Facility:

1) Short circuit equipment
   - only applicable to LVRT tests,
   - required by most TSOs today

2) Power converter equipment
   - net emulation which enables tests of wind turbine response to a variety of grid conditions, including system services like primary frequency control and virtual inertia
Blaest Blade test facility and DTU Wind Energy Blade Test Facility

Blaest
The Danish National Wind Tunnel
Dedicated for wind turbine testing

Efficient workflow

Wing section testing: Aerodynamics and aeroacoustics
Drivetrain test facilities at LORC and DTU Wind Energy

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Need for research infrastructures at DTU Wind Energy

- Research wind turbine at DTU wind energy
- Fatigue research blade test facility
- Research instrumentation of new Wind tunnel
- Offshore wind conditions test equipment
- FiberLab
Research Wind Turbine, DTU Wind Energy

- Tip Design
- Flap Control
- Truncated Airfoil
- Root Design
- The Modular Rotor

- Generator type
- Spinner anemometer
- Rebuilt modern instrumented turbine
- System integration

Control center

DTU Wind Energy, Technical University of Denmark
Thank you for your attention