Clemson University Wind Turbine Drive Train Test Facility

Taking Wind Energy into the Future
Historically independent drivers

.. have merged to drive new thinking

Integrated Energy Policy
Opportunities for Economic Development
Innovation

National Security
Wind Market Growth Leads Renewable Energy Industry

9,922 MW ($20Bn) of new capacity added in 2009
US reaches 35,159 MW ($70 Bn) of total installed capacity

Global installed wind power exceeds 120 MW (>250Bn) in 2009, with > 28% Annual Growth
U.S. Wind Market Targeted for Growth: 20% by 2030

- Requires 290 GW of new wind to reach goal
- 50 GW of offshore along NE and SE
- Technology and infrastructure improvements
- GHC reductions and water savings
- Economic development
Turbine technology continues to evolve

Market Driving Need for Larger Turbine Designs

- GE 1.5 MW
- Siemens 2.3 MW
- Vestas 3.0 MW
- RePower 5 MW
- Enercon 7 MW
Industry Goal: Reduce the Cost of Energy Delivered

Key Issues:
- Increase Reliability
- Improve Efficiency
- Reduce Capital Cost
- Reduce O&M Cost
- Improve Grid Compatibility
- Match Generation with Demand

Challenges & Opportunities:
- Drivetrain Systems
- Gear Box Design
- Advanced Materials
- Predictive Failure Modeling
- Accelerate Testing
- Sensors

Courtesy of Bosch-Rexroth
CU Wind Turbine Drive Train Testing Facility

**US DOE EERE**: DE-FOA-000012 : $98M Project
- $45M US DOE EERE, $53M Matching Funds

**Primary Mission**: Provide high quality testing services to wind turbine industry for up to 15 MW turbines, drivetrains or gear boxes.

**Secondary Mission**: Establish long term partnerships with industry for work force development, research and education.
Business model based on proven CUICAR model

Public/Private Partnerships Focused on Meeting Industry’s Needs

- Research / Full Scale Testing
- Education: developing people for industry
- Collaboration with Industrial Partners
Project Partners

- Naval Complex Redevelopment Authority
- State of South Carolina
- City of North Charleston
- City of Charleston
- South Carolina Ports Authority
- South Carolina Public Railways
- Savannah River National Laboratory

- Renk Labeco
- Fluor
- SCE&G
- CMMC
- EcoEnergy
- Private Donors
Strategically located at industrial port facility

To simplify movement of large test specimens up to 300 tons
Facility Will Utilize Existing Port Infrastructure

- Former DOD Non-Haz Warehouse
- Built 1985, decommissioned 1992
- 6 acre site
- 82,264 ft² (7642 m²)
- 48 ft (14.6 m) clearance

- Deepwater port access
- Pier J, 1100 ft, 42 ft draft
- South Carolina Ports Authority Site
- Detyens Shipyard
- CMMC Port Infrastructure
- 500 ton lift capacity at docks
Dedicated rail spur to facility
15 MW Test Stand with Dynamic Load Applicator
7.5 MW Test Stand with Static Load Applicator
Advance Data Acquisition System Designed by the Savannah River National Laboratory

- Integrated System:
  - Electrical Grid Monitoring System
  - Vibration Monitoring System
  - Facility Instruments and Sensors
  - Wind Turbine Vendor Sensors
  - Sensors from Renk Control System

- Secure Remote Real-time Access to Critical Information and Data

- 750 Channel Capacity Each

- 3rd Portable System for Preparation Area Prior to Testing
Facility will focus on key components that drive cost and reliability

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<th>Subcomponent</th>
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<td>Iron Foundries</td>
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Source: U.S. Census Bureau
Challenges and Opportunities

- Managing huge torques (15 M - 27 M Nm) and forces
- Integration of dynamic and static load applicators
- Calibrating applied loads to field conditions
- Advanced sensor integration
- Integration of complex system
- Ensuring protection of intellectual property
- Logistical handling of large test specimens
- Ensuring long term viability of facility in a changing market
Offshore Wind Turbine Manufacturing and Services Cluster

Facility Serves as Catalyst

Tower Fabrication → Cable Laying → Turbine Assembly

Component Manufacturing → Logistics → Foundation Fabrication

Blade Manufacturing → Construction
