



Field Testing

Independent, Accredited Testing and Validation for the Wind Industry

NREL's specialized facilities and personnel at the National Wind Technology Center (NWTC) provide the U.S. wind industry with scientific and engineering support that has proven critical to the development of wind energy for U.S. energy needs. The NWTC's specialized field-testing capabilities have evolved over 30 years of continuous support by the U.S. Department of Energy Wind and Hydropower Technologies Program and long standing industry partnerships.

The NWTC provides wind industry manufacturers, developers, and operators with turbine and component testing all in one convenient location. Although industry utilizes sophisticated modeling tools to design and optimize turbine configurations, there are always limitations in modeling capabilities, and testing is a necessity to ensure performance and reliability. And although designs may be robust, they require validation, and testing is the only way to shake out problems. Prototype testing is especially important in capturing manufacturing flaws that might require fleet-wide retrofits.

The NWTC works with its industry partners to verify the performance and reliability of wind turbines that range in size from 400 Watts to 2.5 megawatts. Engineers conduct tests on components and full-scale turbines in laboratory environments and in the field that produce test data that can be used to validate turbine design codes and simulations to further advance turbine designs.

Accreditation

As a facility accredited through the American Association of Laboratory Accreditation (A2LA) to perform several critical tests, the NWTC provides high quality testing to turbine manufacturers and wind plant developers, to enable them to meet requirements levied by wind turbine certification agencies, financial institutions, and other oversight organizations throughout the world. A2LA is an independent organization that audits and monitors all NWTC testing activities to ensure that sufficient quality control processes are followed to produce reliable test results. The NWTC is accredited to perform the following tests in accordance with international standards:

- Acoustic Noise to IEC 61400-11 and MEASNET
- Power Performance to IEC 61400-12-1 and MEASNET



Aerial photo of the NWTC, located at the base of the Rocky Mountains in Colorado.

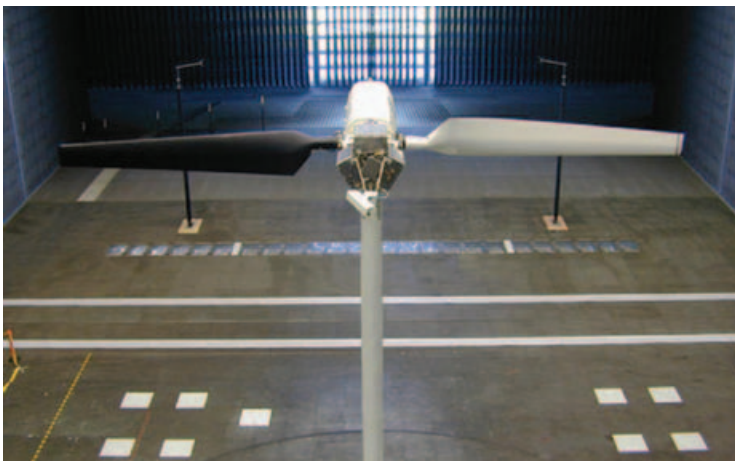
- Mechanical Loads to IEC 61400-13
- Power Quality to IEC 61400-21 and MEASNET
- Duration Testing to IEC 61400-2
- Safety and Function to IEC 61400-2

NWTC field-testing staff are members of IEC (International Electrotechnical Commission) standards committees for Power Performance (MT12-1, MT12-2), Noise (MT-11), Loads (MT13), and Power Quality (MT21) testing; are also members of the international Measuring Network of Wind Energy Institutes (MEASNET) field-test proficiency and procedures development committee; and additionally are on the AWEA (American Wind Energy Association) small turbine safety and performance committee. NWTC field-test partnerships include Clipper Windpower, General Electric, Siemens, and Renewable Energy Systems Americas.

Other tests include structural dynamic characterization testing and modal testing. In addition, NWTC has ducted many tests that support turbine R&D, most notably the



Installation of DOE's 1.5 MW GE wind turbine at the NWTC.



The heart of the Unsteady Aerodynamic Experiment conducted at NASA is the pressure measurement system installed in the black blade of the turbine.

NREL Unsteady Aerodynamics Experiment in the NASA-Ames Wind Tunnel: A Comparison of Predictions to Measurements that acquired data sets for more than 1,700 different turbine conditions. These data are a valuable resource for developing and validating wind turbine aerodynamic codes.

Industrial User Facility

The National Wind Technology Center Industrial Users Facility (IUF) provides wind industry partners with the ability to conduct full-scale static and fatigue testing of wind turbine blades up to 50 m in length. The IUF is currently the only such structural testing facility for wind turbine blades in the United States. A cooperative research and development agreement formed between NREL and the Massachusetts Clean Energy Center (MASSCEC) provides for building the nation's largest wind turbine blade testing facility in Boston. With the technical assistance of NWTC, this facility will be complete in 2010 and will be able to test blades up to 90 m. Meanwhile, NWTC's blade test capabilities provide the Wind Program with a stop-gap means of meeting critical industry needs. Scaled-up, re-engineered prototype large-scale test apparatus are housed in the IUF include two blade structural-testing stands equipped with overhead cranes and servo-hydraulic systems, controls rooms, a high bay, and several small test bays. Staff undergo many months of highly specialized blade test training utilizing hands-on application to conduct operational blade testing.

Test Pads

The NWTC also has test pads that manufacturers can use to test their prototype machines, which range in size from 400 Watts to 2.3 megawatts. Turbines tested at the NWTC include those manufactured by Atlantic Orient Corporation, Bergy Windpower, Southwest Wind Power, Northern Power Systems, Endurance Wind Power Inc., Gaia-Wind Ltd., Entegri Wind Systems Inc., and Global Energy Concepts (formerly Advanced Wind Turbines), General Electric, and Siemens.

Two multi-megawatt test turbines at the NWTC include Siemens 2.3 MW and GE 1.5 MW commercial turbines. The Siemens 2.3 MW



The Southwest Windpower Skystream 3.7 wind turbine rated at 2.4 kW, with a blade diameter of 3.7 meters, and mounted on a 10-meter monopole.

turbine is a late-stage prototype. It is heavily instrumented to produce a constant stream of data on aerodynamics, power characteristics, vibrations, system fatigue, acoustics, and other key measurements. The GE 1.5 MW turbine provides a long-term testing and R&D tool. It is instrumented to collect detailed data on wind farm underperformance and premature turbine component failure. In addition, it is used for educational and outreach purposes.

For more information about the NWTC's field testing capabilities contact the National Wind Technology Center at 303-384-6900.

Helpful Web Sites

The National Wind Technology Center
www.nrel.gov/wind

Department of Energy Wind and Hydropower
 Technologies Program
www.windandwater.energy.gov

National Renewable Energy Laboratory

1617 Cole Boulevard, Golden, Colorado 80401-3305 • 303-275-3000 • www.nrel.gov

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