

## Field Testing Research at the NWTC

The National Wind Technology Center (NWTC) at the National Renewable Laboratory (NREL) has extensive full-scale field testing and research capabilities that have been used in collaboration with the wind industry to accelerate wind technology development and deployment for more than 30 years.

Field testing is vital to assessing the performance and reliability of wind turbines and turbine components before they enter the commercial market. Testing of prototypes may save manufacturers from having to make expensive retrofits by ensuring the performance of prototypes before they are deployed in the field. Field testing also validates modeling codes used by

### Accreditation

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
- 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 and IEC 61400-22



Aerial photo of the National Wind Technology Center (NWTC). Photo by Dennis Schroeder, NREL 25882

industry designers to develop the next generation of wind turbines and helps manufacturers identify problems and improve the performance of commercial machines and components.

The NWTC's field test sites are also integrated with a controllable grid interface, a grid simulator that enables the multimewatt wind turbines to be exposed to specified power anomalies such as grid faults and frequency fluctuations under controlled, safe testing conditions. Testing on the controllable grid interface helps ensure that turbines can be safely and reliably operated on a utility grid.

The NWTC features field test pads scaling from 400 watts to 5 megawatts (MW), expert engineers, and specialized facilities, all in one of the best meteorologically characterized test sites in the world. Furthermore, the site experiences high turbulence winds exceeding the International Electrotechnical Commission's (IEC's) Class I, making it ideal for extreme-event testing.

### Capabilities

The NWTC performs field testing and research in the areas of:

- **Type Testing:** NREL's testing capabilities are accredited by the American Association for Laboratory Accreditation (A2LA). Tests include acoustic noise emissions, duration, mechanical loads, power performance, power quality, and safety and function. Such high quality testing enables turbine manufacturers and wind plant developers to meet requirements levied by wind turbine certification agencies, financial institutions, and other oversight organizations worldwide.
- **Modal:** The NWTC is capable of performing both full-scale and component-level modal testing on wind turbines, blades, drivetrains, and towers. By determining a turbine or component's natural frequencies, damping values, and mode shapes, engineers are able to eliminate resonant frequencies from turbine operation conditions, leading to lower dynamic loads, improved performance, and longer lifetime.



Aerial photo of the National Wind Technology Center (NWTC). Photo by Dennis Schroeder, NREL 25915

- **Aerodynamics:** The NWTC works with manufacturers and wind developers to study the aerodynamic properties affecting wind power, from individual blades or turbines, to entire wind plants, for optimal performance and power output. Furthermore, in conjunction with the National Air and Space Administration (NASA), the NWTC has analyzed more than 1,700 different wind turbine conditions using the NASA Ames wind tunnel, providing a valuable resource for research into wind turbine aerodynamic codes, aerodynamic force predictions, and turbine designs.

## Standards

Committees that NWTC field-testing staff belong to include:

- IEC:
  - Standards committees for Power Performance (MT12-1, MT12-2)
  - Small wind turbines (MT2)
  - Noise (MT11)
  - Mechanical loads (MT13)
  - Power quality testing (MT21).
- The International Measuring Network of Wind Energy Institutes

field testing proficiency and procedures development committee

- The American Wind Energy Association small turbine safety and performance committee.

## Partner With Us

The NWTC encourages those interested in testing and researching wind turbines or turbine components to take advantage of the center's unique and extensive facilities. Past collaborations and partnerships in NWTC field testing have included a number of turbine manufacturers.

Turbines tested at the NWTC have included:

- Abundant Renewable Energy (ARE 442)
- Bergey (Excel)
- Entegrity Wind Systems (EW50)
- Gaia-Wind
- Mariah Wind (Windspire)
- Southwest Windpower (Skystream, Whisper H40)
- Pika Energy
- Northern Power Systems (Northwind 100B)

- Urban Green Energy
- Ventera (VT10)
- Windward Engineering (Endurance)
- Xzeres.

Multimegawatt turbines tested at the NWTC have included:

- Alstom (ECO110, 3 MW)
- Gamesa (G97, 2 MW)
- GE (1.5 MW)
- Siemens (2.3 MW).

## Contact

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NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

NREL/FS-5000-63355 • February 2015

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