

TESTING SMALL WIND TURBINES AT THE NATIONAL RENEWABLE ENERGY LABORATORY

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INTRODUCTION

Reducing barriers to wind energy expansion, stabilizing the market, and expanding the number of small wind turbine (SWT) systems installed in the U.S. are important goals for the Department of Energy's (DOE) Wind and Hydropower Technologies Program. One of the barriers for the distributed wind market is the lack of SWT systems that are independently tested and certified.

To help industry provide consumers with more certified SWT systems, DOE/NREL launched a SWT system Independent Testing project in 2007. NREL's testing capabilities are accredited by the American Association of Laboratory Accreditation (A2LA). Through a competitive solicitation, NREL selected four commercially available SWT systems to test in 2008/2009 to the recently developed International Electrotechnical Commission (IEC) and American Wind Energy Association (AWEA) standards. These test data can be used by manufacturers to present to the Small Wind Certification Council (SWCC), a nonprofit organization with support from DOE, AWEA, state energy offices, and turbine manufacturers, for North American certification and to A2LA as partial input for international certification. SWTs that are tested and certified will give consumers greater confidence that the systems they install will perform within specified wind regimes as advertised by the manufacturer.

TURBINES SELECTED



The Mariah Power Windspire is a 1.2-kW vertical-axis Giromill wind turbine. The turbine's tower is 9.1 meters tall and its rotor area is 1.2 x 6.1 meters. It has a single-phase permanent-magnet generator that operates at 120 volts AC.



The Abundant Renewable Energy ARE 442 is a 10-kW 3-bladed horizontal-axis upwind turbine. The ARE 442 has a hub height of 30.9 meters and a rotor diameter of 7.2 meters. The turbine has a three-phase permanent-magnet generator that operates at variable voltages up to 410 volts AC.

The Entegrity Wind Systems EW15 is a 50-kW 3-bladed horizontal-axis downwind turbine. The turbine's rotor diameter is 15 meters and its hub height is 30.5 meters. It has a three-phase induction generator that operates at 480 volts AC.



The Gaia-Wind 11kW is a three-phase induction generator that operates at 480 volts. The turbine's downwind rotor has a 13 meter diameter and its tower is 18 meters tall. The twin-bladed, oversized rotor is designed for low to moderate wind speeds.



TESTS AND TESTING APPROACH

Tests conducted at NREL will include duration, power performance, acoustic noise emissions, safety and function, and power quality (for 3-phase only). Tests are performed to IEC standards and in compliance with A2LA requirements. Duration, power performance, safety and function, and power quality test data will be collected using National Instruments based data acquisition systems and compiled through custom LabVIEW software. Acoustic noise emissions testing summarizes the typical noise levels emitted from the turbine at different wind speeds. Sound data for acoustic noise emissions testing is recorded near the base of the turbine and processed using Noiselab software. Noise testing will be performed according to IEC standard 61400-11. All test results will be publicly available on NREL's web page.

ACCOMPLISHMENTS OF PROJECT TO DATE

The Mariah Windspire was the first turbine installed (March 2008). Its metrological (met) tower and test instruments are fully operable. The second turbine scheduled for installation is the ARE 442. Its met tower and testing instruments have been installed and the foundation construction has been scheduled. It is anticipated installation of the ARE 442 will be completed in April 2008. Instrument calibration and lab check out (a process of validating that all systems are working as designed) to A2LA requirements and IEC recommendations have been completed for both the Windspire and the ARE turbines. Met towers for the remaining two turbines have been installed and instrument calibration and lab check out are in progress.

PLANS TO EXPAND WITH SECOND SOLICITATION

Depending on the success of this first round of the Independent Testing project and funding availability, DOE will consider a second competitive solicitation to test additional SWTs in the FY10 timeframe. It is anticipated the second round RFP will be released in Fall 2009. In addition, DOE/NREL may consider expanding this project to support testing other SWT systems at the NREL site with funding from non-DOE sources.

FOR MORE INFORMATION

For more information on this project, see the authors' paper in the WINDPOWER 2008 proceedings. For progress on DOE/NREL's Independent Testing project, go to NREL's web page under a section titled Small Wind Turbine Independent Testing at: http://nrel.gov/wind/technical_support.html