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R&D PROJECT SHOWS NACELLE-MOUNTED LIDAR REDUCES YAW MISALIGNMENT AND IMPROVES TURBINE PERFORMANCE

A collaborative research project at the Energy Department's National Renewable Energy Laboratory has shown that the Wind Iris nacelle-mounted LIDAR from Avent Lidar Technology is an effective diagnostic tool for identifying wind turbine yaw misalignment, allowing users to improve wind turbine performance. This is the first independent scientific field study validating the benefits of using turbine mounted LIDAR to correct rotor-induced yaw misalignment. An AEP increase of 2.4 percent has been estimated for a 7.5 degree misalignment.

The research project, supported by DOE, focused on the optimization of turbine performance using forward-looking wind LIDAR measurements, with a focus on improvement of power output by correcting yaw mis-

alignment and a reduction in turbine O&M costs through improved load mitigation. The research was conducted in collaboration with Avent Lidar Technology and Renewable NRG Systems.

"Wind turbines traditionally rely on a wind vane mounted on the rear of the nacelle to measure the wind direction in order to control the yaw position of the turbine. Certain factors, like rotor-induced wakes, can lead the vane to measure the wind direction inaccurately. The principle focus of the project was to use a LIDAR to measure the wind direction ahead of the rotor and derive a correction function. The correction function was shown to reduce the yaw misalignment and improve power capture in below rated power wind speeds," said Andrew

Scholbrock, field test engineer at NREL.

The study also validated the energy increase after yaw misalignment correction using the Wind Iris as an external reference sensor. The power curve improvement was measured and found to be nearly identical with wind speeds measured from the LIDAR and NREL's reference meteorological tower. Based on the results, it is estimated that LIDAR-based yaw correction will increase the annual energy production by 2.4 percent for a 7.5 degree static misalignment and standard reference wind speed distribution.

"Yaw misalignment correction is a hot topic in turbine O&M optimization. These field-results will give us a strong edge in a market where no other type turbine mounted LIDARs have that kind of scientific track record," said Thomas Velociter, CEO of Avent.

NREL served as the overall project coordinator with the measurement campaign, taking place at its National Wind Technology Center in Golden, Colorado. The LIDAR was installed on the two-bladed Controls Advanced Research Turbine (CART2). NREL performed data collection and analysis related to the use of LIDAR measurements. Avent provided its Wind Iris LIDAR for the project together and performed part of the scientific analysis related to LIDAR technology. Renewable NRG Systems was responsible for the coordination of the LIDAR field activities.

Following the evaluation of static yaw misalignment correction, NREL, Avent and Renewable NRG Systems are set to begin a new collaboration phase to explore the use of LIDAR measurements to actively control the wind turbine, through improved rotor collective pitch and yaw control.

The Wind Iris is the only industry proven turbine LIDAR for power performance verification and optimization applications. It measures the horizontal wind speed and direction at hub height from 40m to 400m upwind of the turbine, and generates accurate data to optimize wind turbine performance. It combines unparalleled operational features, validated procedures and methodologies, and has a strong track record of over 100 deployments onshore and offshore. This unique combination allows operators and owners to yield a high return on investment turbine after turbine with clear and easy to implement processes.

DOE FUNDS FOUR WIND R&D PROJECTS TO THE TUNE OF $4.5 MILLION

The U.S. Department of Energy recently announced $4.5 million for four projects to help increase deployment of innovative wind power technologies by optimizing the operation, boosting efficiency, and improving the environmental performance of wind energy systems.

The research and development (R&D) projects, located in Maine, North Carolina, Nebraska, and Texas, contribute to the Energy Department's effort to advance innovative technologies that reduce carbon emissions and support the Obama administration's goal to double renewable energy again by 2020. These projects will pursue R&D not significantly represented in our current portfolio as a way to support and explore innovative new approaches for integration into our future program plans.

• Biodiversity Research Institute of Gorham, Maine, will receive $1.1 million to develop a stereo-optic camera system to detect and document bird and bat flight behavior in the vicinity of wind turbines.

This system will use near-infrared cameras and specialized software to detect animal movements throughout the day and night, and will work to automate the identification of different species of birds and bats. The project will help researchers better understand potential environmental impacts of wind turbines.

• Texas Tech University in Lubbock will receive $1.4 million to develop a first-of-its-kind, radar-based prototype to measure the flow of wind through wind farms, which will increase data availability and lead to improved modeling. While radar platforms have been used extensively in meteorological applications, this will be the first radar system specifically designed for wind energy research. This new design for a modular and portable system will require less power to operate and be able to measure larger areas than currently utilized conventional radar systems. The project complements the Energy Department's ongoing Atmosphere to Electrons (A2e) Initiative, which aims to

improve wind plant performance by increasing understanding of how wind moves throughout wind farms.

• The University of North Carolina at Charlotte will receive $500,000 to design and build a 30-kilowatt multistage magnetic gearbox, which will be validated for reliability, efficiency, and its potential to operate more quietly than currently available generators. The project will demonstrate that a magnetically geared generator has the potential to improve the reliability and efficiency of wind turbines.

• The University of Nebraska-Lincoln will receive $1.5 million to develop an online health monitoring system that uses the electric current signals produced by a turbine's generator in order to track the generator's performance and help determine when it needs to be repaired. This technology could reduce operating costs by decreasing unscheduled downtime due to unplanned maintenance.

EDF RENEWABLE SERVICES AND ROMAX ALIGN FOR TECHNICAL AND ENGINEERING SERVICES

EDF Renewable Services (EDF RS) and Romax Technology have signed a partnership agreement whereby EDF RS will provide labor specialists for Romax's technical and engineering services.

By combining Romax's deep technical knowledge in drivetrain design, turbine reliability and independent engineering with EDF Renewable Services expert field technicians and years of experience, the companies together will provide greater value to their customers by rapidly deploying technicians and reducing costs.

Romax regularly supports most of the top 20 wind owner/operators in the U.S. with a focus on building

technology in its Romax InSight division to improve turbine reliability and better manage the costs of failure, through monitoring, predictive maintenance, life extension, failure analysis, inspections, and related services. By working closely with EDF RS, the firm is able to faster scale its InSight technology to reduce the cost of energy for the industry.

Ashley Crowther, Group VP from Romax InSight discusses the relationship: "After running many projects with EDF RS, such as portable vibration, inspections and on-turbine engineering, it was clear they were the right partner. EDF RS brings depth of

experience along with very capable technician and technology teams. By jointly supporting clients on predictive and preventative maintenance activity, as well as end of warranty services, together we will bring a lot of value to our clients."

Kurt Christensen, EDF Renewable Services Business Development Manager commented, "Partnering with Romax allows each of us to use our core competencies to create hybrid offerings. This is an excellent opportunity as both organizations have a strong presence in the Americas as well as Europe, and both organizations continue to grow with the global expansion of wind."

EDF Renewable Services is an industry leader, providing O&M services to more than 8 gigawatts of wind, solar and biomass projects across North America. With over 25 years of experience and 450 full-time, trained and certified wind technicians employed, EDF Renewable Services has the resources and experience to optimize project availability and maximize revenues. ⊀