Ground-Based Wind Turbine Blade Inspection System Successfully Demonstrated at Duke Energy Wind Farm

Ground-based wind turbine inspection technology can detect defects and anomalies in turbine blades while operating.

Wind Turbine Operators Looking for Optimized Inspection Approaches for Large Turbine Blades

Wind turbine systems have been advancing rapidly over the last several years, with many systems reaching or exceeding five megawatts (MW). These larger systems include wind turbine blades up to 200 feet (61 meters) long and weighing several tons. Maintenance costs for these wind turbines are high and the blades can be damaged by manufacturing and in-service defects, environmental degradation, fatigue, and lighting strikes. Many wind farm operators have been relying on inspection approaches that involve shutting down the wind system so that personnel can visually inspect the blades from scaffolding or hydraulic lifts or by rappelling down the blade surface. These inspections are challenging, expensive, highly labor intensive and may not provide reliable results since many structural defects in wind turbine blades are below the surface. If left undetected, these faults can degrade the blade to the point where it must be replaced at a cost of $300,000 to $700,000. In addition, shutting down one or more turbines for an uptower inspection or replacement reduces the net generating capacity of the wind farm.

EPRI has been conducting research on an advanced wind turbine blade inspection approach using non-destructive examination (NDE) techniques and was looking for a host site for field demonstrations. Since 2007, Duke Energy has been actively involved in growing its wind energy portfolio. Duke Energy Renewables owns and operates more than 1,600 MW of wind power and expects to bring another 250 MW online in 2015. The company hopes to grow its wind business to between 5 and 7% of its total generation. The company agreed to be the host site for field testing the SABRE™ Wind Turbine Inspection and Data Management System at its Los Vientos wind farm in southern Texas.

The SABRE™ system has several advantages over conventional inspection techniques for large wind turbine blades. The system inspects blades from the ground while the blades are operating. It includes a specialized, long wave infrared (IR) camera to detect slight IR emissions from structural anomalies in the rotating blades that show up as hot spots or cool spots. Acoustic spectral analysis technology uses broadband high sensitivity microphones to detect and locate lightning strike holes, cracks, and irregular surfaces. The system also includes phase imaging photography that can detect surface anomalies. The system is mounted on a sport-utility vehicle that can travel around a wind farm to inspect multiple blades and can usually inspect three blades on one turbine in less than 30 minutes.

> ***"This technology lets us conduct blade inspections quickly from the ground while the blades are running and the results are extremely reliable."***
>
> ***~ Scott Abramson, Duke Energy***

Challenge

Better techniques for inspecting large wind turbine blades were needed to improve reliability and reduce operating costs.

Solution

A field demonstration of a new ground-based wind turbine blade inspection system was demonstrated at Duke Energy's Los Vientos wind farm in Texas.

Results and Benefits

The inspection system was able to detect anomalies in turbine blades including lightning damage, delamination, and potential handling damage.

Inspections can be performed while the blades are operating in approximately 30 minutes.

The system eliminates the need for personnel to climb and rappel down wind turbine blades to conduct manual inspections.

SABRE™ System Detects Anomalies on Several Wind Turbines

Field testing was conducted at Los Vientos in February 2014. Duke Energy Renewables decided to use the SABRE™ system to inspect repairs that had already been conducted on Siemens turbines, which make up roughly half of the turbines at the site. The SABRE™ system field test showed that the majority of blade repairs previously performed were successful. It also detected anomalies in a few blades that could affect blade performance or result in blade failure, including a hot spot indicating a blade still had issues, lightning damage to two blades, potential crush or handling damage on two blades, and a delamination area on one blade. Duke validated the SABRE™ results wherever possible by visual inspection and contacted the blade manufacturer to make additional repairs as needed.

According to Scott Abramson, Director of Operational Excellence at Duke, "I firmly believe the SABRE™ system should be a commercially available inspection technology and it's to EPRI's credit that they've brought it to the industry's attention." Abramson was the recipient of an EPRI 2014 Technology Transfer award for his leadership in testing the SABRE ground-based inspection system for wind turbine blades.

Related EPRI Products

Title	Product ID
Wind Energy Technology Guide	3002003680
Wind Turbine Condition Monitoring Systems Review	3002002938
Wind Turbine Blade Maintenance Guidelines: A Comprehensive Guide to Optimizing Blade Performance	3002001502

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com)

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