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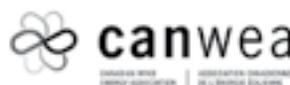
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# EDITOR'S DESK

FEBRUARY 2016

The cold weather months are officially upon us. During this season, it's important to remember the role wind power plays in keeping the heat on.

According to a recent report by the American Wind Energy Association (AWEA), wind-generated energy saved consumers more than \$1 billion in just two days during the polar vortex of January 2014. Demand for electricity and natural gas skyrocketed as much of the eastern United States needed energy to heat their homes and while the unusually freezing temperatures caused several conventional power plants to fail. The resulting higher prices for energy meant higher electricity bills and higher heating bills for those who used natural gas to stay warm. The Mid-Atlantic and Great Lakes states were hit especially hard during this cold snap and the resulting spikes in energy costs. Luckily, wind farms across the nation continued to produce a reliable source of energy when the demand for it was high and when other sources for that energy failed, thereby preventing power outages and softening the dramatic rise in the cost of electricity.

According to the report, wind energy's consumer benefits stem from its fuel price stability. Wind is one of the few energy sources that offer perfect fuel price stability that can be locked in up-front because wind's fuel cost will always be zero. For all other major conventional sources of electricity, fuel prices cannot be locked in for the long term and are often set by the spot market. The report also explains that wind energy creates large consumer benefits by displacing the most expensive, least efficient, and most volatily priced power plants with a fixed-priced, zero-fuel cost, zero-emission energy source.

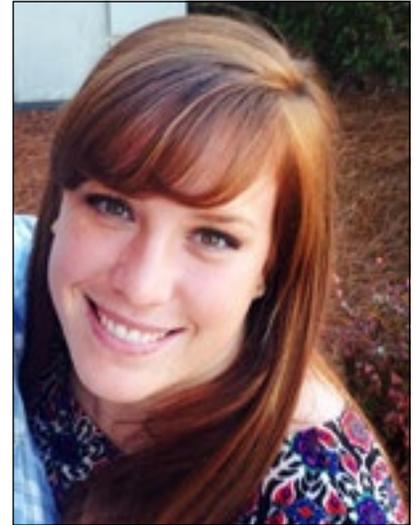
So, as the winter months grow more and more frigid, it can warm your heart to know that the turbines will keep turning, providing much of the country with the electricity it will need to make it to spring.

This month, we explored the operations side of O&M as well as the role obstruction lighting plays in the wind industry. Our inFocus section features a company profile on Vaisala, a leading provider of reliable environmental and industrial measurement equipment and services for a wide range of industries that has recently made a name for itself in wind. You'll also find our conversation with Jim Mikel, the president of Renew Energy Maintenance, where we delve into the company's role as a leading ISP in the wind market. Additionally, we feature an article by Dr. Zhiwei Zhang and Jesse Graeter of Romax Technology on the use of temporary measurement systems and the value they provide wind turbine owners and operators as well as an article by Jason Fohr of International Tower Lighting, LLC, on revised FAA guidelines for wind turbines and wind farms.

Columnists Jack Wallace and Jeff Walkup return this month to share their insights in their respective areas of expertise. The direction section also features a column by Gordon Moran from the European Energy Centre on what the U.S. wind industry can learn from Europe's example. ↪

As always, thanks for reading!

*Anna Claire Howard*



**Anna Claire Howard, associate editor**  
*Wind Systems* magazine  
annaclaire@windssystemsmag.com  
(800) 366-2185, ext. 204

## CONTRIBUTORS



**Jeff Walkup** is the vice president of sales and operations for Gram & Juhl North America, based in Denver, Colorado. He has over 25 years of experience with oil analysis and in the fields of lubrication, tribology, and condition monitoring

in the mining and wind energy sectors. He can be reached at [jwa@gramjuhl.com](mailto:jwa@gramjuhl.com) or (970) 640-3439.

**Jack Wallace** is a veteran of wind farm operations and maintenance with more than 30 years of industry experience, and he is the director of composites and innovation at Frontier Pro Services. He can be reached at [jwallace@frontierpro.com](mailto:jwallace@frontierpro.com) for questions or comments.



**Gordon Moran** is a European Energy Centre (EEC) researcher and columnist who writes regular column articles for renewable energy magazines internationally. His columns cover a wide variety of topics including government policy,

industry trends, opportunities in the sector, and analysis of the latest technologies. For more information on the EEC, go to [www.euenergycentre.org](http://www.euenergycentre.org).

**Jesse Graeter** works in Romax Technology's wind energy division in a lead technical engineering role. For more information, go to [www.romax-tech.com](http://www.romax-tech.com).



**Dr. Zhiwei Zhang** is the vice president of engineering for North America at Romax Technology, and he is responsible for Romax's InSight business in North America. His technical focus

is on drivetrain re-engineering and refurbishment and root cause analysis (RCA). For more information, go to [www.romaxtech.com](http://www.romaxtech.com).

**Jason Fohr** began his career in FAA obstruction lighting in 2011 at International Tower Lighting, LLC (ITL) in the position of business development for wind energy. In his current role at ITL, he works with EPC companies, developers, owners,



and general contractors in all aspects of each wind project providing FAA obstruction lighting. For more information on ITL, go to [www.itl-llc.com](http://www.itl-llc.com)



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# DIRECTION

Policy • Advocacy • Business • Finance • Legal • Environment • International

## GULF POWER CUSTOMERS SEE LOWER PRICES AND USE OF WIND-GENERATED ENERGY

As of January 1, Gulf Power customers saw a 2.7 percent decrease in their electricity bills. The average residential bill for 1,000 kWh of electricity dropped by \$3.71. Every year in January, the Florida Public Service Commission adjusts Gulf Power's prices to reflect cost changes in fuel, environmental compliance, and energy conservation programs.

According to Rick DelaHaya, a Gulf Power spokesperson, the price decrease is a result of Gulf Power employees' commitment to use the most cost-effective fuel resources available to generate electricity.

"We work hard to manage our fuel mix to provide affordable and reliable electric service for our customers," DelaHaya said. "This is great news for all of our customers. We work diligently to keep prices down, and the result is lower electric bills."

Gulf Power customers also saw the addition of another source of renewable energy added to the utility's energy portfolio. As of January 1, Gulf Power's first wind project became operational in central Oklahoma.

"The power we get from this project is expected to represent approximately 5 percent of our projected energy mix," DelaHaya said. "Wind power helps diversify our power supply and, in this case, is projected to provide lower overall energy costs."

Under the first agreement of its kind in the state, Gulf Power will be a leading purchaser of



Lars Schmidt / Gulf Power

The Macho Springs Wind Farm in New Mexico

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wind generation among all Florida utilities. Built in central Oklahoma where conditions are favorable for wind energy, the project will supply 178 MW of renewable energy to Gulf Power, enough energy to power approximately 50,700 homes per year.

“Wind power is an integral part of our diverse renewable energy portfolio,” DelaHaya said. “The best part of these new renewable energy projects is that they are cost effective for customers. It’s cost-effective renewable energy that di-

versifies our power supply. That makes environmental and economic sense.”

This will be Gulf Power’s fifth renewable energy project following the Perdido Landfill Gas-to-Energy Facility, which has produced more than 100 million kWh of electricity since 2010. ↵

— Source: Gulf Power

For more information, go to [www.gulfpower.com](http://www.gulfpower.com).

## WIND ENERGY CONTINUED RAPID GROWTH IN CANADA IN 2015

2015 was another remarkable year for wind energy in Canada. The Canadian Wind Energy Association (CanWEA) reported that Canada closed 2015 as seventh in the world for total installed wind energy capacity with 11,205 MW and sixth in the world for the amount of capacity added in 2015. Over the year, Canada added 1,506 MW of new wind capacity by commissioning 36 projects, 23 of which involved Aboriginal peoples, municipal, or local ownership. Wind energy supplied approximately 5 percent of Canada’s electricity demand in 2015, enough to power over 3 million Canadian homes.

“Not only has the wind energy industry continued its five-year trend as the largest source of new electricity generation in Canada, but the industry in Canada has demonstrated a five-year annual average growth rate of 23 percent per year and an average of 1,438 MW per year,” said CanWEA President Robert Hornung.

Ontario continued to lead the way in market size and growth by adding 871 MW of installed capacity in 2015 for a new total of 4,361 MW. Between contracts signed and planned new purchases through the province’s new Large Renewable Procurement process, there remains more than 2,000 MW of wind slated to be built in Ontario over the next few years.

Quebec, which is Canada’s second largest wind energy market, was also

11,205 MW total installed wind energy capacity in Canada...  
enough to power over  
**3 million homes**  
That’s 5% of Canada’s electricity demand!



the second largest contributor of new installed capacity in 2015, adding 397 MW for a total of 3,262 MW. This included the largest multi-phase project commissioned in Canada to date — the 350-MW wind farm in Riviere du Moulin. The first phase with 150 MW was commissioned in 2014, and the remaining 200 MW was commissioned in 2015. The province has another 700 MW due to come online in the next two years.

Nova Scotia, which currently has 552 MW, commissioned 186 MW in 2015, including one of the largest municipal-owned wind projects in Canada (14-MW Sable Wind Farm), bringing the total installed capacity in Atlantic Canada to 1,104 MW (294 MW in New Brunswick, 204 MW in Prince Edward Island, and 55 MW in Newfoundland). Notably, Prince Edward

Island currently receives approximately 40 percent of its electricity supply from wind energy and Nova Scotia receives almost 10 percent from wind energy.

Alberta, which is Canada’s third largest wind energy market at 1,500 MW, added 29 MW in 2015. More remarkable was the commitment in November by the province to replace two-thirds of coal generation with renewable generation, which is expected to increase installed wind energy capacity in Alberta by thousands of megawatts over the next 15 years.

Similarly in November, Saskatchewan, which added 23 MW of installed wind energy capacity in 2015, committed to significantly grow this capacity from 221 MW presently to more than 2,000 MW by 2030 starting with an initial procurement of new wind energy capacity in 2016.

British Columbia held steady in 2015 at 489 MW of installed wind energy capacity, as did Manitoba with 258 MW, the Northwest Territories at 9 MW, and Yukon with just under 1 MW.

Six wind turbine OEMs, all CanWEA members, supplied the technology for the new wind capacity commissioned in 2015 in Canada. Siemens Canada Limited led installations with close to 50 percent, followed by Senvion Canada Inc., GE Renewable Energy, Enercon, Acciona Wind Energy Canada, and Vestas Canada.

“Canada’s new wind energy projects in 2015 represent over \$3 billion in investment,” Hornung said. “Wind energy is now providing economic growth and diversification to well over 100 rural communities across Canada through land lease income, tax payments, and community benefits agreements.”

With the cost of utility-scale wind plummeting 60 percent over the past six years, as reported in November by U.S. investment bank Lazard, wind energy is now cost-competitive with virtually every other potential source of new electricity generation. That down-

ward trajectory is expected to continue while the costs of natural gas are exposed to both future carbon and commodity price risk.

“As we look ahead in Canada, we expect at least another 1,000 MW to be installed by the end of 2016,” Hornung said. “The recent policy decisions in Alberta and Saskatchewan provide clear evidence that wind energy’s growth prospects will remain strong beyond then.” ↵

— Source: CanWEA

For more information, go to [www.canwea.ca](http://www.canwea.ca).

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## **NORTHERN POWER SYSTEMS ANNOUNCES LEASE FACILITY FOR DISTRIBUTED GENERATION WIND FINANCING**

Northern Power Systems Corp., a next-generation renewable energy technology company, recently announced that its flagship distributed generation wind platform is available to businesses, farms, and other property owners with a compelling financing solution.

Northern Power Systems is now offering a lease program to allow users to take advantage of wind energy with 100-percent financing and no increase of payments during the lease period. According to the U.S. Energy Information Agency, U.S. electricity prices are forecasted to increase every year by at least 2.7 percent in the next 20 to 30 years, surpassing the expected rate of inflation.

The NPS 100 wind platform is a state-of-the-art product in its third generation of technology that is optimized for efficiency and proven to be reliable with a fleet of nearly 500 turbines deployed around the globe. It is targeted to medium-level power users such as a wind garden feeding 15-20 homes, a farm with substantial agricultural machinery, or a small factory or business that is keen to lock in flat electricity rates, save substantial money, and eventually own the asset.

“Over a period of 20 years, the Northern Power solution will save our customers significant amounts on their electricity bill with no upfront equipment costs and a path to full ownership within seven years,” said Diego Tebaldi, vice president of global business development at Northern Power

Systems. “The Northern Power offering comes as a turnkey solution including installation, maintenance, and servicing to assure maximum value and peace-of-mind. This agreement with LFC gives yet another option for people to go green.”

LFC Capital, Inc., with more than \$1.5 billion of equipment leasing experience, has created the LFC Clean Energy Ownership Program for commercial and industrial companies seeking greater overall value from clean energy systems than the limited cost savings offered by power purchase agreements. The program is especially appealing to companies such as LLCs that cannot directly benefit from a federal tax credit.

“We’re very pleased that Northern Power Systems has selected the LFC program as an effective way to make wind systems affordable for their business customers,” said Stanley S. Fishbein, managing director of LFC Capital, Inc.

The LFC program uses a traditional operating lease and innovative purchase options after six to seven years to provide companies with a predictable low cost of ownership while satisfying tax rules. Companies obtain an attractive return on investment by keeping all energy savings over the long life of these wind systems. The program is available in all 50 states. ↵

— Source: Northern Power Systems

For more information, go to [www.northernpower.com](http://www.northernpower.com).

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## **SGURRENERGY MOVES INTO MEXICO**

SgurrEnergy has boosted its presence in the Americas by opening an office in Mexico City. This latest venture provides a base for SgurrEnergy, a

Wood Group company, to strategically support the development of renewable energy in Mexico and surrounding countries. The office is headed up

by David Barrie, the company’s business development coordinator.

Already active in Mexico, SgurrEnergy has worked on wind projects

across the country, including energy yield prediction and wind feasibility and operational management of wind projects.

Mexico has ambitious renewables targets, aiming to add 20 GW of renewable energy by 2030 and generate 35 percent of the country's energy from clean resources by 2024.

These targets have been backed up by legislation to open up the electricity market with further development of renewables, and there are plans for extensive grid infrastructure improvements in the country to cope with this energy growth.

"The opening of the Mexican office comes just a few months after we announced our expansion into Chile, representing healthy growth for SgurrEnergy and a strong presence in South and Central America," said Molly Iliffe, SgurrEnergy's international office manager. "With on-



the-ground specialists in the region, we are looking forward to effectively supporting our clients toward their renewable energy goals."

According to Barrie, there is a huge amount of potential for renewable energy solutions in Mexico.

"With ambitious energy targets in place, this paves the way for significant growth and market development," Barrie said. "I'm looking

forward to driving SgurrEnergy's presence in the region."

With nine locations across North and South America, SgurrEnergy is working extensively across both continents, utilizing the expertise and capabilities of its 250 employees in 17 locations. ↴

— Source: SgurrEnergy

For more information, go to [www.sgurrenergy.com](http://www.sgurrenergy.com).



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# PROSPECTS FOR THE NORTH AMERICAN WIND INDUSTRY AND LESSONS FROM THE WIND INDUSTRY IN EUROPE

*By Gordon Moran*

Globally, there has been an increase in the amount of installed wind capacity for electricity generation in recent years. However, only a few countries and regions account for the vast majority of it, including China, which has the largest proportion of installed wind capacity, followed by the United States and the European Union.

The majority of this is made up by onshore wind turbines with a smaller, but rapidly growing, offshore sector. Both technologies are increasingly being installed around the world to meet climate change goals and address energy security concerns. While the rate of installation in countries such as China has been very high, Europe and North America provide a helpful comparison to assess the future prospects for the industry in these locations, as they are two regions with comparable markets and support structures for the development of wind energy.

Governments in both regions have provided feed-in tariff contracts, tax incentives, and capital grants to support the industry, resulting in installations — largely for onshore wind farms — that have been developed at a rapid rate in many European countries as well as many parts of the U.S. Offshore wind farms have also been built, but they have been restricted to a few nations including the U.K., Denmark, and Germany due to higher capital costs and complexities in their construction.

## WIND ENERGY IN EUROPE

A number of countries in Europe have successfully developed large-scale wind industries. Denmark was one of the first countries to develop an onshore wind industry and has since developed a large manufacturing base. Other countries such as Spain, Ireland, Germany, and the U.K. have installed sufficient numbers of turbines to provide a substantial proportion of overall electricity generation.

The rate of installation depends in part on social acceptance of wind technology. In some countries, it has been much more readily accepted than others. For example, there has been a high level of public support for the installation of onshore wind farms in Germany and Denmark for many years with widespread community ownership of projects, which is encouraging development. In other countries, including the U.K., there has been social and political opposition to onshore wind with stronger support for offshore wind farms, as they do not have the same impact on landscapes that onshore projects can face.

## WIND ENERGY IN NORTH AMERICA

In the U.S., there has been a great deal of success with the installation of onshore wind. Since 2008, installed capacity has increased more than 300 percent from 16.7 GW to 69.5 GW at the end of 2015. This has led to individual states generating a substantial proportion of their electricity from wind. The current support available for constructing wind farms in many parts of the U.S. is robust, with strong tax incentives for installations in states such as California, Texas, and Iowa.

There is also strong support on a federal level. President Obama recently passed a five-year extension to the production tax credit (PTC). Under the legislation, the 2.3-cent-per-kilowatt-hour PTC for wind will be extended through next year, and then the credit will be reduced by 20 percent each year through 2020. The PTC extension means that predictable financial support is guaranteed for the next five years for the industry, which will mean a greater number of projects that will likely be installed to bolster the development of the industry nationally.

There is also a reasonable market in Canada. Provinces such as Ontario, Quebec, and Alberta have substantial installed capacity with tax incentives for further development. However, there is currently very little offshore wind development in the U.S. or Canada. Some farms have been proposed in the Great Lakes region and on the East Coast, although these have been beset by funding issues and local opposition to their construction. One project that is currently under construction is the Block Island Offshore Wind Farm in Rhode Island. While there have been controversies about the approval of the project, once it has been constructed it should make it easier for other projects to be built.

## LESSONS FROM EUROPE'S WIND INDUSTRY

Governments have provided support for the wind industry through feed-in tariff contracts, tax incentives, and capital grants, providing long-term financial incentives to encourage investment. However, changes in the regulatory environment can occur quickly if a country is facing financial difficulties or a new government has different priorities for future energy provision.

This has been the case in a number of European countries — including the U.K. where the government has substantially reduced financial support to the onshore wind sector, leading to a decline in predicted rates of future installation and affecting levels of private sector investment.

This is due to a perceived reduction in financial stability and long-term support for the sector.

Due to the variable nature of the output of electricity from wind farms, there is a limit on the proportion of power that can be generated using the technology on a conventional power grid system.

Germany is now facing issues with balancing its national grid due to the success of increasing the proportion of electricity generated from renewable sources. This is a design issue that can be mitigated with sufficient energy storage capacity and interconnectors with other nations. However, the timescales and financial considerations on which such solutions can be implemented do place limitations on the amount of wind power that can be installed on a grid.

## FUTURE OPPORTUNITIES FOR WIND ENERGY IN NORTH AMERICA

From the experiences of the wind industry in Europe, it pays to watch the regulatory landscape. While the current investment climate looks favorable with a five-year extension to the PTC and support at the state level, large-scale projects that rely on large-scale infrastructure and long-term guarantees of government support could potentially be disrupted. Other factors such as local planning regu-

lations, environmental considerations, and infrastructure capacity for new projects should also be taken into account.

The issues that face an individual project will depend on contextual factors such as the scale of the development and the type of turbines used, but some general points can be applied. Large-scale onshore wind farms are at greater risk of delays or cancellations in construction with higher risks of planning issues and disruptions in government support.

Small-scale onshore installations, on the other hand, are relatively low-cost, easy to install, effective in a wide variety of locations, and can be used in conjunction with other technologies. This means that a diverse market for them is likely to continue even if government support is withdrawn or in areas where such support is not provided on a local level.

Studying and comparing the ways in which Europe and North America have managed the development and deployment of wind power while navigating technical, political, and economic challenges can provide insights to avoid some of the potential pitfalls that can beset projects and help to harness the wind in both regions. ↗

To learn more about renewable energy and energy efficiency through training courses, go to [www.EUenergycentre.org](http://www.EUenergycentre.org).

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# inFOCUS

## SUPPORTING PROBLEM RESOLUTION IN O&M WITH TEMPORARY INSTRUMENTATION

By Jesse Graeter and Zhiwei Zhang

The purpose of a measurement system is to provide the quantitative data necessary to make educated decisions. In the wind energy sector, temporary measurement methods are often utilized with wind turbines due to the large scale of components, remote location, and dozens of turbines making up a single wind power plant. The measurements, analysis, and interpretations support the owners and operators to better understand the behavior and reliability of the machines so that critical decisions can be made to optimize O&M cost. Temporary measurements can be as simple as using a scale to measure distance, while temporary instrumentation systems may record measurements at 25,000 samples per second from multiple sensors. Some common examples of temporary measurements (load measurement on the main shaft, vibration measurement on the gearbox, etc.) on a typical wind turbine drivetrain are shown in Figure 1.

Wind turbine owners and operators are beginning to use temporary instrumentation systems to measure wind turbine loads in assessing OEM-offered performance and to make modifications that will increase a wind farm's annual energy production (AEP). Such instrumentation systems include blade modifications (i.e., vortex generators and tip extensions), micro-siting, and turbine controller software upgrades. While increased AEP is tempting to the owner, it comes with the uncertain-

ty of negatively affecting the loads on the drivetrain. Increased loads could potentially reduce key component lives or cause premature failures. Some operators are choosing to validate the OEM's modifications by measuring the main shaft torque and bending, which can be supported by use of data loggers and strain gauges, which can often be installed uptower in one day (as shown in Figure 2). The measurement period is continuous for multiple weeks, ideally before and after the performance modification. Sometimes the measurement is conducted on multiple turbines on the same site for neighbor turbine comparison. The data is remotely accessed over cellular network and analyzed for torque, tilt, and yaw moments in time series, frequency spectrums, and load distribution diagrams (LDD). The typical and unusual loading events will be identified and processed. Combined with SCADA data analysis, the operating parameters can be examined during periods of unusual loading, such as peak and transient loads. The detailed measurement and processing programs can be based on the recommendations from IEC 61400-13, which is a standard created by the International Electrotechnical Commission (IEC) that describes the measurement of fundamental structural loads on wind turbines for the purpose of the load simulation model validation. In some applications, measurements have to be repeated multiple times to reduce the statistical uncertainty due

to the stochastic character of the site conditions. An example of measured torque and bending moment can be found in Figure 3.

Temporary measurements are also often used during failure root cause analysis (RCA) to determine primary failure cause and corrective action to increase the O&M efficiency through targeted work planning. The results can also improve the value of the failure data and support the com-





Romax

munication with the turbine OEMs. Failures of wind turbine components can be costly, especially if impacting a batch or an entire fleet. A cause and effect exercise, as shown in Figure 4, can be used to identify all possible causes and a strategy for addressing each of them. Temporary measurement systems can be used to investigate the more complex contributors to the failure. Relatively simple static measurements with dial indicators,

digital calipers, and laser measurement can determine the drivetrain alignment, mainframe mounting position, and bearing preload. Specialized data acquisition systems can be used to collect dynamic measurements while a turbine is operating. For example, Romax's portable vibration systems (PVS) can be used to assess rotor imbalance or shaft misalignments. Proximity sensors can monitor component displacements,

## ALSO IN THIS SECTION

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- 30** Conversation: Jim Mikel – Renew Energy Maintenance

such as the gearbox motion relative to the mainframe. As previously mentioned, measuring the main shaft torque and bending can also benefit an RCA investigation by comparing the load that the failed gearbox is undertaking with that in a neighbor healthy turbine.

In some instances, a simple physical dimension is desired, yet the limited access or large size of wind turbine components can make collecting these measurements a difficult task. The planetary stage is usually a challenging assembly for measurement and fault detection, and it is more expensive for maintenance and replacement. It is also more complicated than the other stages, as more gears and bearings and undertake higher, more complicated loads from the rotor side. For example, a planet gear tooth fracture, such as in Figure 5, was detected by Romax's PVS and later confirmed by borescope inspection. In the frequency spectrums in Figure 6, pronounced magnitudes can be found from the suspect gearbox (in black) at the repeating harmonics at planet gear rotation frequency compared with the healthy gearbox spectrum (in green). Romax monitoring engineers recommended that all planet gears and the sun gear be inspected at a complete 360-degree circumference, and the failure was found on one of the planet gears.

The ability to simply measure the length, width, and depth of the feature could be enough to responsibly manage the continued operation of the gearbox. A practical method is to take a surface impression replica, meaning a fast curing silicon applied to the gear or bearing surface. The sample can then be easily measured by a variety of equipment in the convenience of a laboratory, as shown in Figure 7. Repeat measurements can establish a rate of progression, hence the remaining life of the component. The ability to quantify the defect eliminates subjective speculation, enabling the turbine



Figure 1: Common wind turbine drivetrain temporary measurements



Figure 2: Wind turbine main shaft instrumented with strain gauges

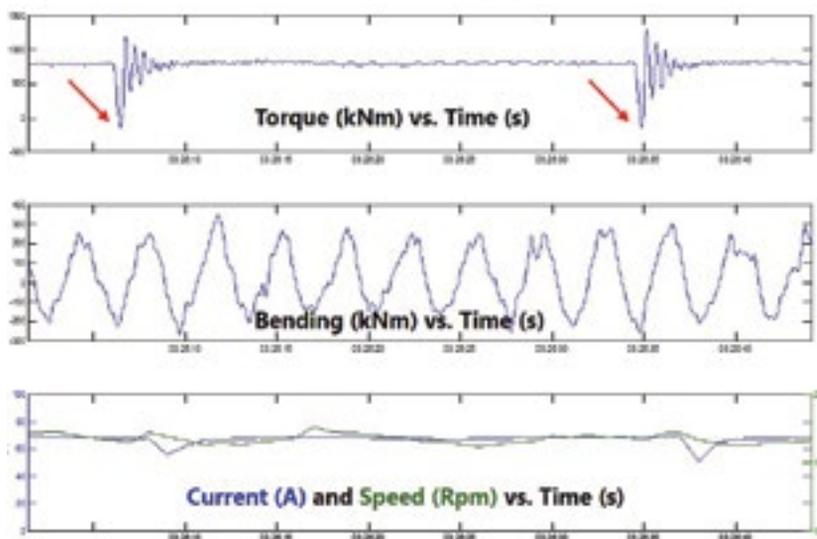


Figure 3: Measured torque reversal event with damped oscillations

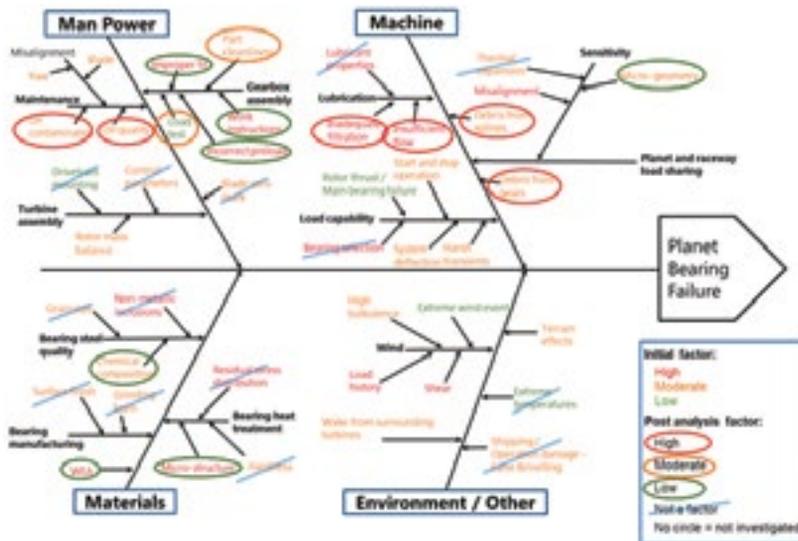


Figure 4: RCA fishbone diagram helps focus on which measurement can determine the cause of failure

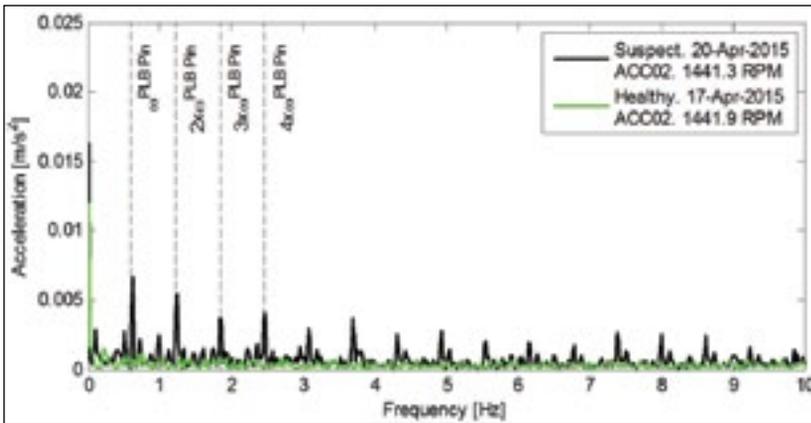


Figure 6: Repeating harmonics at planet gear rotation frequency (suspect versus healthy)

operator to make educated decisions in asset management.

The use of temporary measurement systems is a valuable tool for wind turbine owners and operators. O&M costs can be reduced by mitigating, or even preventing, damage. There is also the opportunity for significant time savings, as well as no upfront capital that's often associated with installing permanent equipment. In some instances, a wind farm's AEP can be increased where the role of the instrumentation is to confirm that the drivetrain loads are still acceptable. Temporary measurement systems can validate design changes or determine the cause of fleet-wide failures. It is ultimately about generating quantitative data for solving today's wind turbine problems. ✨



Figure 5: Example of a fractured tooth crack close to full liberation of the damaged area



Figure 7: Measurement of defect size on a silicon surface replica



# Key Factors in Successful Wind Farm Operations

By Jack Wallace

The organization of how things get done between the OEM, subcontractor, and owner can be quite different from wind farm to wind farm, but no matter what type of organization is in place or how old the site is, the main goal of wind farm operations is to have all of the turbines running anytime there is wind. Here, you'll find several points that may help your team improve your wind farm's operation.

## MINIMIZING DOWNTIME DURING WIND

An attempt to schedule all repairs and services during low to no wind or when the power has low value would be ideal. During transition periods of no wind, grid drops and direction changes can cause nuisance faults and unnecessary losses in production.

## WIND POWER PLANTS VERSUS INDUSTRIAL PLANTS

The main difference between a wind power plant and other types of industrial plants is the fact that we cannot predict or control our power source — the wind.

Another difference is that it is not feasible for the O&M side of the industry to visit each piece of machinery every week, especially if there are a large number of wind turbines in your plant spread out over miles of terrain. For other industries, the ability to visit all of your machinery as frequently as you like is the standard. Note that substandard work concerning the quality of care of your wind farm will quickly show in your turbines' power production.

## COMPARING MACHINE OUTPUTS ON A BI-MONTHLY OR MONTHLY BASIS

This is an easy way to see if all your machines are functioning as they should. The turbines will typically follow a trend, such as turbine A performing better than turbine B.

Monitoring systems such as SCADA have become an expected part of the wind turbine. But even so, proper and safe operations happen out in the field, not from a remote computer terminal. Remote resets can cause hazardous conditions and a loss of life or machine. Rules must be followed to prevent an unnecessary tragedy when using remote communication systems. At a minimum, the technician in the field should be in control of the task at hand.

## EMPLOYEES

The recommended number of maintenance employees depends on the size of the facility along with the type of machines in use.

In the 1980s, it was typical for wind farms with machines rated between 65 and 150 kW to run two-manned crews for each group of 80 to 130 machines. With the larger machines and taller towers, this is no longer possible. Today, some sites are not manned, but when work is commenced, it is usually with a minimum of two technicians for safety.

Management must weigh the cost of having additional personnel versus having a turbine turned off for extended periods of time due to manpower shortages.

The dangers of having too few trained personnel may also hamper your operations. It is safer to be slightly heavy on trained personnel than light when it concerns your operations. It is also recommended that more than one member of your team share critical knowledge needed to run them, or you may find yourself in a difficult situation should the one key employee leave.

## RECORD-KEEPING

Keeping a record of services is a required part of operations. It helps document work you do and allows you to find trends with the equipment. Of course, properly completed paperwork is always appreciated after the fact. Don't overburden your technicians with numerous forms to fill out. Keep it simple. Their time is best spent with the machines.

## INVENTORY AND TOOLS

I recommend keeping the minimum amount of inventory on site, but this really depends on the supply pipeline. Someone near Los Angeles has quicker access to most parts and tools than someone in the far reaches of North Dakota.

Additionally, most companies provide their techs with the tools, however, this is not a requirement. It's a good idea to take care of these tools, especially if your company is willing to provide them for you.

## DRIVING COMPANY TRUCKS

You must consider where and how to park on a wind farm. Good habits are formed by parking your vehicle facing into the wind and far enough away from areas

of turbine work to prevent damage or injury. The wind can rip back an unsuspected door or a tool can hit a parked truck.

### **HIGH WIND/FOUL WEATHER DAYS**

As long as it's safe, these are great days to perform technical training, fabrication, and rebuilding of parts, site cleanup, turbine noise and vibration checks, thermal checks (during high winds only), and any other work that has fallen behind that does not require that the turbines be shut off.

### **WELDING**

Welding in the field requires care and consideration of the vegetation and wind. Fireguards are always recommended and should be required. If it is windy, reschedule the work. If you cannot reschedule, place multiple fireguards and water trucks, water down the area where sparks will be, and stay alert.

In high winds, it is highly recommended that you reschedule welding and heavy grinding work to a day with less wind.

### **CLIMBING**

All climbing requires you to wear and use safety equipment that ties you to the turbine at all times. Some of today's machines are large enough to work in without climbing gear in certain sections of the machines. In these situations, there is no danger of falling, and climbing gear is optional. Most all other areas in these machines require that you stay tied in at all times.

Climbing below another climber places you in danger of falling objects. It is best to wait for the first climber to reach the top or close a section door before starting your climb. And if they drop something, you can bring it up.

Dangers exist when working on top of a machine with climbing gear. It's



Matt Wright/HHM

Example of a disconnect switch

crucial to keep all lanyards and loose clothing away from all shafts and motors and to treat all of these items as live or moving objects at all times, even when they're not.

Climbing should not be done if you are working alone.

### ELECTRICAL WORK

Electrical work requires training, especially since electrical work on metal structures adds additional safety concerns. Remember to follow standard electrical safety rules such as working with one hand while inside a cabinet with live power. Do not allow another worker to come in contact with you should you not be at the same potential. Whenever it is possible, work with the power off. Proper lock-out and tag-out procedures are essential. Unless the worker is trained to do so, no electrical troubleshooting should be allowed and no panels should be opened. Resetting faults and turning off a problematic machine should be the extent of electrical work for the untrained worker.

Other unsuspecting hazards are in the controller. Although the machine may not be online, there may still be potential on the power conductors. There has been an increase in power electronics used in wind. These devices require extra precautions as there can be stored power or voltage potential with minimal current still on the circuit. This means that even if the turbine is turned off, but is still with power, it may be unsafe to touch. So, "off" doesn't mean off or that it's safe to touch until the disconnect for that circuit is shut off. With some turbine manufacturers, "off" does not necessarily mean anything is turned off until the pad mount transformer is off.

The same may be true if uninterruptible power supplies (UPS) are in use. It is critical to only work on electrical equipment after it has been confirmed with a test meter that the power is off.



The dangers of moving objects illustrated by a gearbox with an exposed brake disc and high-speed shaft

### MOVING OBJECTS

Dangerous areas on turbines that consist of rotating objects include (but are not limited to) the blades, rotor, low-speed shafts, high-speed shafts, yaw systems, cooling fans, yaw motor cooling fans, hydraulic pumps, nacelle cover activators, hydraulic rams, and other pinch points.

### HOISTING SYSTEMS

Most dangers with hoisting tools are to the person on the ground. It's best to send up multiple loads of tools instead of one extremely heavy load. Don't overload your tool bags, and don't stand directly below a tool being hoisted. It's recommended that you watch the load as it is attached and moved to ensure you know if something falls and where.

### COMMUNICATIONS BETWEEN THE TOP AND BOTTOM OF THE TURBINE

Radios are the recommended form of communication from top to bottom. Cell phones are also handy. The days of yelling up and down the tower are over, for the most part, due to the in-

creased heights of the new wind turbines. It is impossible to hear anyone from atop a 60-meter or 200-plus-foot tower with any wind blowing.

Standing in the drop zone of a wind turbine that is being worked on may be hazardous. The person on top of the wind turbine is in the most danger concerning work, so he should be in charge of the repair or service procedure. This includes calling off the repair for safety concerns. The ground man is expected to support his efforts by gathering the requested tools and supplies and possibly controlling the wind turbine functions as requested.

There are many aspects and skills required to run a wind farm safely and productively. You could easily do crane work, electrical work, and stand out on the front of a hub all in one day's work. That's what makes working on a wind farm so exciting and fulfilling. I recommend open communication between all of the operations and maintenance team. They will be much more productive and safer when knowledge is shared. ↵

# LAUFER WIND'S RADAR-ACTIVATED OBSTRUCTION LIGHTING SYSTEM MEETS FAA PERFORMANCE

Following the Federal Aviation Administration's (FAA) testing and introduction of new performance guidelines, Laufer Wind is now making its patented Aircraft Detection System (ADS) available in the United States. The ADS is a radar-activated obstruction lighting system designed to turn blinking lights atop wind turbines and tall towers on or off based on the presence or absence of aircraft in the vicinity. This technology allows "lights out" for up to 98 percent of the night, which significantly reduces the towers' visual impacts on surrounding communities.

Last month, the FAA published an updated Advisory Circular 70/7460-1L that set forth standards for marking and lighting obstructions that affect the National Airspace System. The FAA added a new Chapter 14, introducing performance guidelines for radar-activated lighting technologies known as Aircraft Detection Lighting Systems (ADLS).

In a June 2014 demonstration at the National Renewable Energy Laboratory in Boulder, Colorado, FAA researchers conducted flight tests against a Laufer Wind ADS installation configured to control lights on multiple wind turbines and a meteorological tower. An FAA technical note published in October 2015 confirmed that Laufer Wind's ADS meets FAA requirements for aircraft detection lighting systems.

Several wind farms in the U.S. have been permitted with requirements by local governments to include ADLS technology. Laufer Wind said it expects to provide systems for wind farm and communication towers both operational and those still in development.

According to the FAA technical note, "due to the number of existing telecommunications towers and wind turbines, combined with expected future construction, the number of obstructions that have these required lighting fixtures has greatly increased. As a result, it has created a light pollution nuisance to residents living near these obstructions. Using an ADLS could have a positive impact on this problem, while still providing a sufficient level of safety for pilots operating at night in the vicinity of these obstructions."

The report also notes that "the ability to turn off lights when they are not needed could have a positive impact on reducing the number of avian fatalities."

"Radar-activated lighting is an effective tool for wind farm developers and tower owners to assist with permitting and to reduce the impact in local communities and on wildlife," said Eric Laufer, president of Laufer Wind. "We are especially excited to be the only vendor to have received a technical note from the FAA confirming our system's ability to meet the new ADLS requirements."



Laufer Wind's dome-covered radar on a Met tower at the National Renewable Energy Laboratory (NREL)

Laufer, an aeronautical engineer and pilot, began working on the technology several years ago when a wind farm project faced community opposition over lighting impacts.

"This has been an eight-year project of development and testing, and it serves as a model of how the public and private sectors can work cooperatively to the benefit of communities across the country," Laufer said. ↙

— Source: Laufer Wind

For more information, go to [www.lauferwind.com](http://www.lauferwind.com).

# inFOCUS

## WIND ENERGY IMPACTED BY NEW FEDERAL AVIATION ADMINISTRATION REGULATIONS

By Jason Fohr

As wind energy evolved in the United States and turbines appeared in trafficked airspace, the Federal Aviation Administration (FAA) worked to adapt existing regulations governing aviation obstruction lighting and marking to a new dynamic in vertical structures — rotating blades. A new FAA Advisory Circular (70/7460-1L) published in December 2015 illustrates an intensified effort to increase visibility of wind turbines for pilots of low-flying aircraft. This amplified focus also includes guidance for additional marking for turbine owners seeking to limit liability exposure beyond that afforded by full compliance to federal regulations.

### MET TOWERS

The genesis of a typical wind farm begins with the investigation stage, usually with the placement of tower-supporting meteorological instruments to determine if the area is suitable for the development of a wind farm. These meteorological (MET) towers are often easily and swiftly erected with foundations that are much simpler than those required for a full-scale communication or broadcast tower with some that are even mounted on temporary mobile supports.

This inherent ability for rapid deployment, coupled with the lack of marking, created an unforeseen danger to low-flying aircraft. In the course of one or two days, a MET tower ranging from 60 to 199 feet above ground level (AGL) can be erected, posing a particular hazard to low-flying aircraft such as crop dusters who could encounter a tower directly in their path where none had previously existed.

Although standard FAA marking requirements normally do not address towers under 200 feet AGL in the absence of an airfield, airport, or other anomaly within 5 nautical miles of the determined site, to ensure pilot safety and prevent future incidents, several organizations, including the National Agricultural Aviation Association (NAAA), urged legislation on a state level to require marking (and often lighting) of MET towers.

In 2011, the National Transportation and Safety Board issued a safety alert for pilots who may fly at these heights, and the FAA also released guidelines for suggested

marking. The FAA AC 70/7460-1L includes a distinct set of guidelines for marking MET towers in Section 2.7. These regulations include aviation orange and white paint bands on the tower structure and high-visibility sleeves and/or spherical markers on guy support wires.

The described MET tower marking is regarded as “voluntary” versus “required” by the FAA. However, many states have enacted statutes requiring the marking of MET towers. Currently in place as of January 2016: California, Colorado, Idaho, Kansas, Missouri, Montana, Nebraska, North Dakota, Oklahoma, South Dakota, Texas, Washington, and Wyoming. Sixteen other states currently have similarly proposed legislation on the docket. While they are rare, retroactive requirements for pre-existing structures are not unheard of, which could affect many older towers. Owners are strongly urged to research marking requirements on a state-by-state basis. In the absence of federal or state requirements, voluntarily marking pre-existing MET towers in accordance with these recently published FAA guidelines may reduce the tower owner’s exposure to liability and avoid local pressure to install lighting on the structure.

### REVISED GUIDELINES FOR WIND TURBINES AND WIND FARMS

With the advancement of wind farms and turbine technology, the FAA began to address the need for proper marking of these structures as early as 1985 when it released AC 70/7460-1G and in 2007 when it devoted a separate chapter to wind turbine marking in AC 70/7460-1K Chg 2.



International Tower Lighting, LLC  
IFH-1710-000 wind turbine obstruction lighting system, Type L-864(L), red LED (open)

The newly released AC 70/7460-1L takes the marking and lighting of wind energy structures to a new level including more descriptive verbiage in Chapter 13 and four pages of illustrations in Appendix A. Aircraft Detection Lighting Systems (ADLS, or “radar” systems), which are sometimes associated with wind farms, have also been separated in Chapter 14. The FAA consulted several knowledgeable sources in the field of wind energy in an

effort to address current and future needs, including taller structures and more elaborate farm designs.

#### KEY REVISIONS

- Inspection and Monitoring: A visual inspection of obstruction light lenses is required at maximum intervals of 24 months. Though it is not a new requirement, daily monitoring logs for the lighting should be maintained

<sup>1</sup> Note: All structures and wind farms with a previously assigned determination are still governed by their original respective advisory circular named in said determination unless or until a change is made by the owner (change of heights, major shift of coordinates, additional turbines added to the farm) or other directive(s) are received from the FAA. This is commonly described as “grandfathering.”

International Tower Lighting, LLC



IFH-1710-000 wind turbine obstruction lighting system, Type L-864(L), red LED (closed)

as well. Replacement criteria for beacons or lenses are also included.

- **Measurement:** One key clarification in the AC 70/7460-1L is the measurement of the overall height of a wind turbine as depicted in Figure A-23 of Appendix A: “Turbine height is determined from the top of the rotor while at top dead center.” The illustration clearly indicates the measurement is from ground to the tip of the blade in its most skyward presentation. This differs from many previous interpretations that indicated this measurement should be to the top of the hub or nacelle.
- **Lighting:** Though not every structure in the wind farm is required to have obstruction lighting, section 13.8 addresses the “Lighting of Wind Turbines During the Construction Phase” and states “to ensure proper conspicuity of turbines at night during construction, all turbines should be lighted with temporary lighting once they reach a height of 200 feet (61 m) or greater until the permanent lighting configuration is turned on.” This section further describes detailed temporary lighting requirements as well.
- **Farm Configurations:** Wind farm configurations are separated into linear, cluster, and grid with associated marking requirements. Acceptable colors for wind tur-

bines are now described in the European-based RAL color standard to accommodate the off-white colors of equipment commonly imported to the U.S. Voluntary marking for snow-prone areas has been established in an effort by the FAA to maintain uniformity and reduce potential confusion to pilots.

- **L-810 Marker Synchronization:** When combined with L-864 medium-intensity lighting on structures over 699 feet AGL under the new guidelines, L-810 obstruction lighting (“side marker lights”) must flash in synchronized fashion with the other lighting on the structure. This also means the L-810 will be considered a “flashing obstruction light” as covered in Section 2.4.2 of the advisory circular, meaning any failure will require NOTAM (Notice To Airmen), which, according to the FAA, is a notice or advisory distributed by means of telecommunication containing information concerning the establishment, conditions, or change in any aeronautical facility, service, procedure, or hazard. The timely knowledge of which is essential to personnel and systems concerned with flight operations.
- **Aircraft Detection Lighting Systems (ADLS):** While ADLS may not be financially feasible in the case of a smaller wind farm, they may be a necessary investment

at larger farms. These systems are designed to detect any approaching aircraft within a proximity that could possibly result in an impact with the turbine.

The lighting system is normally not activated with the exception of a short test period each day. Once the approaching aircraft is detected, the system will normally send an audible alarm over all aviation-approved radio channels advising the pilot of the obstruction, and then immediately activate the lighting system. While this type of system may initially seem to be highly attractive due to the public appeal and energy savings from being chiefly inactive, it is relatively expensive to install and set up. Flybys must be performed using fixed-wing and rotor-blade aircraft to the activation function. Sensitivity to movement by other objects must be adjusted. The system was fine-tuned to filter and eliminate these distractions. Additional fly-bys were performed in a final test prior to declaring the accurate and safe performance of the system.

Although costs to install, fine-tune, and test the ADLS are significant, the long-term benefits may prove in some areas to be worth the investment. Such systems are designed to address concerns for community and environmental safety, particularly in the interest of protecting population centers, natural attractions, coastlines, lakes, or large bodies of water and migratory birds and other wildlife that are drawn to red obstruction lighting.

**ACCESSING THE INFORMATION**

In conclusion, becoming familiar with the new FAA AC 70/7460-1L is a priority for everyone in the wind energy industry. Designed to address current safety challenges and to keep pace with anticipated future advancements, the circular is available free of



The MKR-LTE1-01R single obstruction light integrates visible red LEDs and infrared LEDs into a single L-810(L). Infrared energy (IR) can enhance compatibility with aviator's night vision imaging systems (ANVIS) and night vision goggles (NVG). Precision-molded Fresnel optics produce a low ground scatter tower lighting solution. The die cast aluminum base provides 3/4-inch conduit hubs for side or bottom mounting. Multiple 9kA MOVs and a 20kA gas plasma discharge tube provide robust surge suppression.

charge to view or download through the FAA website. Go to [www.faa.gov](http://www.faa.gov). Once at the home page, click on the Regulations & Policies tab. In the search bar, type in the current advisory circular pertaining to this article — "70/7460-IL." Click on "Obstruction Marking and Lighting." From there, download the AC 70/7460-IL PDF. ↵

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# PROFILE

## Vaisala Inc.

*For 80 years, Vaisala has been a global provider of reliable environmental and industrial measurement equipment and services for a range of industries. More recently, it has established itself as a leading provider of these services in the wind industry.*

By Anna Claire Howard

While Vaisala may still be a newer name in the wind energy industry, it is a household name for meteorological agencies around the world. The company was founded in 1936 — when meteorology was in its infancy — by Dr. Vilho Väisälä, a Finnish professor who first commercialized the weather balloon in the 1930s. Almost a century later, Vaisala now delivers a range of state-of-the-art measurement devices and services that provide the foundation for most public weather information.

Vaisala began its work in the energy sector in 1983 by helping utilities mitigate the impact of weather on transmission systems, particularly lightning and icing. In 2013, Vaisala expanded into the renewable energy market through the acquisition of Second Wind, the manufacturer of the Triton sonic wind profiler and other wind measurement systems, as well as 3TIER, a global renewable energy assessment and forecasting consulting firm. Both companies have been active in the industry for decades and bring Vaisala a strong team of field-tested experts who have helped it more effectively serve renewable energy customers. Vaisala currently employs 1,600 professionals and has 30 offices in 16 countries



Vaisala's Triton® wind profiler is an advanced remote sensing system that provides accurate wind measurement data across the entire blade sweep of today's largest wind turbines.

that support customers in more than 150 countries. Its primary manufacturing facilities are in Helsinki, Finland, and Boulder, Colorado.

“Our engineering focus is designing highly reliable devices that can handle 24/7 operation in any environment to support industries where

weather has a major influence on operations, safety, and profitability,” said Pascal Storck, former president and COO of 3TIER and current global manager of energy services at Vaisala. “Weather, of course, has a strong and growing impact on the renewable energy industry. Our clients turn to us to help them measure, understand, and ultimately predict weather and climate impacts on their business. Our weather expertise allows our wind customers to site and operate projects efficiently and profitably by adapting to environmental challenges. We help our customers to fully understand and leverage the wind resource, or fuel, of a project.”

According to Storck, Vaisala works with its customers throughout the entire life cycle of a wind project — from greenfield prospecting to due diligence and operations — by providing measurement equipment and consulting services. In the early stages of a project, the company’s technologies can help accelerate development and reduce performance risk in each step of the resource assessment process.

Take Vaisala’s Triton wind profiler, for example. According to Storck, this mobile, ground-based system can be rapidly deployed to capture wind information at heights up to 200 meters using state-of-the-art SoDAR technology. Triton’s reputation for accuracy and dependability in remote, off-grid locations has made it one of the most trusted remote sensing systems in the wind industry.

“The Triton is a good example of something that sets us apart,” Storck said. “Since it can be used as a mobile meteorological tower, operators can use it to monitor the free-stream wind flow at many locations across their wind farm quickly and easily to better understand atmospheric stability and wind shear.”

Another example would be Vaisala’s Nomad 3 data logger that was released last year, which, according to Storck, has proven to be reliable in the field while remaining incredibly lightweight and user-friendly for easy installation and low maintenance.

“For projects that are already online, wind operators use our weather equipment and information to make decisions that drive performance, improve safety, and protect assets,” Storck said. “This includes industry-leading wind power forecasting, lightning data, and a range of weather sensors for condition monitoring.”

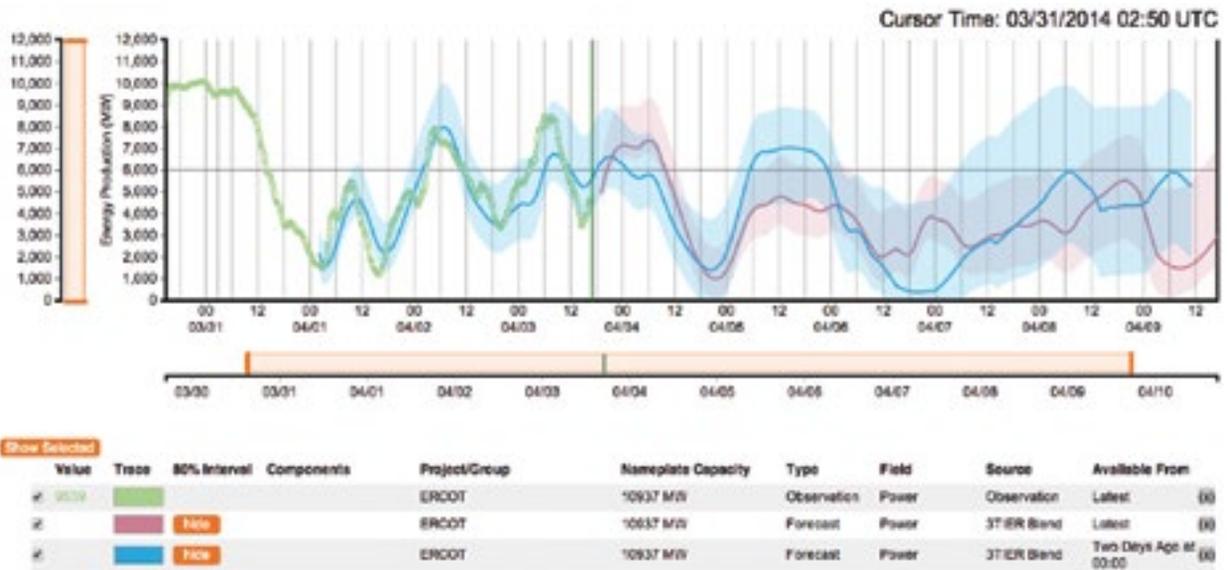
Vaisala has a comprehensive view of mission-critical monitoring requirements in the power industry. It can manufacture the equipment and offer installation expertise to provide accurate, reliable on-site data

and complement these field measurements with weather and energy forecasting and lightning monitoring services, which in turn enables its clients to justify investments in upgrades and new equipment and perform predictive maintenance scheduling as well as financial and operational risk management.

“A key area where we support customers is identifying and categorizing performance losses to spot problem turbines at wind projects,” Storck said. “On the modeling side, I would say we have been a true thought leader. We were among the first — if not the first — to provide clients with performance reconciliation and seasonal forecasts across their entire portfolio for making operational improvements and doing financial planning. A major advantage of our modeling technology is



Nomad 3 data logger



Vaisala 3TIER forecast dashboard

that we have the most experience in combining modeled resource data with site observations to accurately translate weather informa-

tion into power output. We can do this across the whole project, turbine-by-turbine, or across a client's entire portfolio of assets."

Vaisala is able to minimize the overall cost for its customers with the wide range of products and services it offers.

"On the development side, a few examples would be helping clients determine early on whether to abandon a marginal project site before major investments have been made," Storck said. "We also design meteorological campaigns and conduct resource assessments so that our clients get the most out of the information collected. This determines a project's performance uncertainty, whether or not it secures project capital, and how favorable the financing terms are that it receives from the investor. Also, as you can imagine, lightning can cause a large amount of damage to turbines. Our high precision lightning network helps quickly identify and assess damage, cutting down on man-hours for inspection time and allowing customers to spot and repair problem blades early on. If they are able to catch damage early at a single blade, this saves hun-

dreds of thousands of dollars since replacement costs are tenfold higher than repair costs."

Because Vaisala not only manufactures equipment, but also provides installation and maintenance services, it has a solid understanding of the challenges that engineers and wind technicians face on the job.

"We take these scenarios back to our design teams so that the investments we make each year in product improvements are always the most practical and game-changing upgrades," Storck said. "That's why we are regularly adding product features that reduce field time and maintenance, increase usability, or improve reliability in extreme conditions."

On the operations side, Vaisala's forecasts help schedulers participate in energy markets and avoid huge imbalance penalties by more accurately predicting the wind power that projects will deliver to the grid.

Recently, Vaisala announced that it plans to conduct a wind study in the southeastern region of the United States—an area of the world that has remained almost entirely unde-

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veloped in wind energy generation due to its reputation for low wind resources compared to the rest of the country.

“Today’s taller turbines could make utility-scale wind projects a solid investment prospect for the industry,” Storck said. “Project siting and financial modeling, however, require reliable wind data at the height modern turbines operate, which isn’t broadly available across the southeastern U.S.”

To solve this problem and help lay the groundwork for wind development in the region, Vaisala is partnering with several Southeastern Wind Coalition members, including Southern Company and Santee Cooper, to evaluate utility-scale wind potential in their core operating areas. The final result will be a wind resource database of the Southeast, which will be available

to the coalition’s members, as well as a publicly available wind resource map at high altitudes.

“In order to complete our study, we are combining our remote sensing technology and mesoscale modeling capabilities to produce a wind resource database of the Southeast and a publicly available wind resource map at high altitudes,” Storck said. “To complete this work, we are first installing Triton wind profilers in select locations to collect quality-controlled data at high heights. The technology is well-suited for this project since it can be installed quickly without the permits required of tall towers and collects data across the entire swept area of a turbine. We will then use these measurements to conduct a high-resolution spatial analysis of the region using our advanced weather models.”

This is just one example of how the wind industry and companies like Vaisala are moving in the right direction. Following the recent five-year extension of the production tax credit (PTC) that has given the U.S. wind industry a major and much-needed economic boost to develop wind farms across the country, and given how long it takes to build a wind project from start to finish, Storck said this newfound stability and multi-year certainty is a critical milestone for Vaisala and the wind energy market.

“Much of our work is with developers, and while we are fortunate that we have a global footprint and can support customers around the world, the U.S. is one of our largest markets, so this stability is crucial to our business,” Storck said. ↗

For more information, go to [www.vaisala.com/energy](http://www.vaisala.com/energy).

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# CONVERSATION

## Jim Mikel

President

Renew Energy Maintenance

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### Please tell us about how Renew Energy Maintenance got started in the wind industry.

Renew was founded in 2009 by the current management team made up of energy industry veterans who have worked together for the past 17-plus years with the same goals and work ethic in mind. We raised a modest amount of private equity in 2009 to fund the startup that has thus grown into the largest independent service provider in the wind industry with sales expected to be over \$40 million in 2016.

We started in construction support and have leveraged that service into one of the broadest service portfolios in the industry. Renew now performs work for 19 of the top 25 wind asset owners, both nationally and internationally.

Renew is built on a solid ethical foundation. We believe in straight talk

and accountability with our customers, employees, and shareholders. Our business philosophy can be described in the words of Jim Owen, author of “What Wall Street Can Learn from the Code of the West.” Inspired by the working cowboy’s core principles of honesty, loyalty, and courage, these values are simple, timeless, and compelling for the entire team.

Along with our company’s culture, we can attribute our success to our experienced management team, skilled technicians, high-quality work, innovative solutions, extensive service portfolio, and ability to meet customers’ specific needs.

### How does Renew set itself apart from other ISPs in the wind market?

Renew has one of the broadest service portfolios in the industry that allows us to be a one-stop shop. Our service portfolio includes construction and field services, specialty field services, drivetrain remanufacturing services (MW and KW), long-term O&M services, supply chain services, asset management, 24/7 remote monitoring, operation control, engineering, blade services that were acquired in 2014, and mobile oil change services/fluids that were acquired in 2015. We also have a deep knowledge of the wind industry that positions us to provide this broad service offering in comparison to some of our smaller competitors.

### How can wind farm owners and operators benefit from working with Renew?

We are very customer focused. By working closely with wind farm owners and customers on product improvements such as uptower repairs, component upgrades, and flexible scheduling, we are able to provide innovative, cost-effective, and long-term solutions that meet their needs and budgets. This is a strong, coordinated effort between the customer, vendors, suppliers, and us.

We make a special effort to integrate with our customers to meet their needs. We have entered into long-term agreements with product/service vendors for improved pricing. We have also invested nearly \$4 million in inventory so we can better serve them. This positions us to provide exceptional service that maximizes uptime and minimizes costs.

We provide our customers with long-term solutions and provide challenging career opportunities for our employees. Renew is committed to serving the wind industry and has invested over \$20 million over the past six years to serve it.

### What are some of the challenges Renew has faced in the wind industry, and how was it able to overcome them?

One of the challenges the industry faces is providing cost-effective ma-

job corrective services in the field. We have accepted the challenge by integrating our services to provide crane, component, and labor services all from Renew. We manage the logistics and weather risk for our customers on a job of this nature. The wind industry has recognized our ability to provide this service as an alternative to the OEMs.

**Renew recently acquired Broadwind Energy's wind turbine services business. How will this affect its role in the wind industry?**

The acquisition of Broadwind Energy was our third in the past 12 months, and it added Howard, South Dakota, and Abilene, Texas, to our service locations along with approximately 35 employees. This transaction also

added two full-load test stands to our drivetrain capabilities — a 1-kilowatt full-load test stand that will remain located in Howard and a 3-MW full-load test stand currently located in Abilene that we intend to move to our Sioux Falls, South Dakota, location in 2016. It also doubles our blade repair and gearbox oil change capabilities and expands our service footprint with the Abilene location, which allows us to better serve our customers in the Southwest region.

**What can the industry expect to see out of Renew going forward?**

This year, we expect to be aggressive because the extension gives the industry some government policy certainty. This certainty allows the industry to plan accordingly on

the construction side, which will be helpful to our customers. New construction expands and ages the installed base, which creates more opportunity for us.

Our primary strategy is to grow organically by expanding and strengthening our current service portfolio. We expect to grow another 25 percent this year with a strong focus on growing our asset management services to include 24/7 remote monitoring as well as our supply chain service offerings. We are also excited about our growth opportunities because 2016 will be the first year that 50 percent of the installed base will be over 5 years old. Our focus is on the installed base that is 5 years or older. You can also expect us to expand our service locations in future years. ↴

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# MAINTENANCE

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## SIEMENS RECEIVES MAJOR U.S. ORDER FROM WESTAR ENERGY FOR 280-MW WIND PROJECT



Siemens

122 Siemens wind turbines for the Western Plains Wind Farm; the project will feature Siemens SWT-2.3-108 wind turbines capable of generating clean energy to power approximately 100,000 average U.S. homes.

Siemens has recently been awarded an order from Westar Energy, Inc. to supply, support, install, and provide service for 122 wind turbines at the Western Plains Wind Farm project to be located near Spearville, Kansas. Installation of the wind turbines is scheduled to begin in early summer 2016 with the start of operations expected by early 2017. The service and maintenance provided by Siemens will include the company's advanced remote monitoring and diagnostics.

The wind turbine blades for this project will be manufactured at the Siemens blade facility in Fort Madison, Iowa. The nacelles will be assembled at the Siemens facility in Hutchinson, Kansas. In the United States, Kansas is a national leader in wind power with wind generating enough electricity to power nearly 1 million homes. Siemens has made a significant commitment to wind energy in the U.S. with over 5,000 Siemens wind turbines installed in the U.S. to date, capable of producing clean

power for more than 2.5 million households. The 280-MW Western Plains project is expected to create enough clean energy to power approximately 100,000 average U.S. homes. The project will feature Siemens SWT-2.3-108 wind turbines, each with a power rating of 2.3 MW and 53-meter blades.

"Wind power is becoming an increasingly important part of the U.S. energy mix," said Thomas Richterich, CEO of Onshore in the Siemens Wind Power and Renewables Division. "We are looking forward to working with Westar Energy on this large and important project. Continued technological innovation to drive down cost along with recent congressional action providing long-term certainty for renewable energy sets the stage for continued wind power growth in America." ↗

— Source: Siemens

For more information, go to [www.siemens.com/wind](http://www.siemens.com/wind).

# CONDITION MONITORING WORKING WITH O&MS ON THEIR TERMS

By Jeff Walkup

A recent report by the American Wind Energy Association (AWEA) indicates that 2015 truly was a banner year for the industry as wind accounted for 47 percent of new generation. During this past year, the United States added a total of 14,468 MW to its installed capacity. Wind added more capacity in 2015 than any other energy source, followed by natural gas at 35 percent and solar at 14 percent.

As the wind O&M industry matures, owners are becoming more educated and wiser to their post-warranty options, helping to create a clear shift in the O&M market where OEMs and ISPs will need to re-define their role and demonstrate new strategies to meet their increasing demands. As things move forward, a large number of owners are transitioning to a self-perform model for scheduled maintenances and small correctives. However, many are not planning to take on major components straight away, so the emphasis will be on making an old asset run better while lowering the cost of maintenance and increasing power output through new technology and data analysis. Yet the question remains of how can we—who live and work in this strategically important field—bring better tools, enhanced pricing, and quicker output to the table.

Recently, I have had business development conversations with large-scale utility producers and O&Ms who all share some of the same sentiments I expressed above. In addition to the productivity of a wind turbine, wind farm operators are increasingly interested in reducing their life-cycle costs through new services and equipment. Below are

10 of the most common interests I heard during those collaborations:

1. More discussion surrounding remote monitoring, new preventative maintenance models, better use of condition monitoring, improved data analysis, and better systems that allow integration of all data into one system to eliminate redundancy in paperwork as well as incomplete and missing records (i.e., vibration or grease and oil analysis with SCADA and maintenance records)
2. Better benchmarking for industry standards and data mining for performance measuring
3. Standards and best practice applications to include inspection guidelines, troubleshooting guidance, and consolidated reporting
4. Reduction in reliance of cranes
5. Implementation of drones
6. More focus on component end-of-life, reliability, and reduced downtime
7. Better pricing among the competition
8. Awareness to CapEx and OpEx budgets as turbines approach end of warranty
9. Ease of use for systems and integration into ERP/CMMS as well as the elimination of cumbersome paperwork and missing and inaccurate information
10. Effective business case creation that justifies adding costly new systems

The last point strikes me as the most prudent of the concerns from my wind industry counterparts. As many of us would agree, in order to justify the purchase and incorpora-

tion of the new and better systems that help an O&M to operate and achieve organizational goals, there must be an accurate financial business case in place that represents return on investments (ROI). Economic buyers who have buying authority will inevitably require an accurate and detailed documented process that showcases actual and internal information justifying why, when, and what is in it for them and the company they oversee. External facts and numbers are important from a 30,000-foot overview, but the power of their organizational financials cannot be overstated. It then falls into the hands of the O&M provider to spend time with the companies to better understand their needs and pain points, as well as to provide information that eases and assists them in building the justification to move forward with these solutions.

Just as 2015 has been an exciting time for the wind industry and renewables, 2016 and beyond should prove to contain tremendous opportunity for those who embrace the mindset of working smarter — not harder — to tap into the momentum. The recent passing of the five-year production tax credit (PTC) will continue to bring stability to the industry and allow investors to get behind the commitment to and completion of projects. This can bring balance to the logistics of the supply chain and accommodate the increase of good quality paying jobs that are so vital to the U.S. economy. Having clean, reliable sources of energy are key to national security and go hand-in-glove with energy independence. ↴

# INNOVATION

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## SENTIENT SCIENCE TAKES \$17 MILLION IN VENTURE FUNDING

Sentient Science, a leading provider of materials science-based life prediction and extension technology, recently announced a significant working capital infusion to add new products to its wind turbine operator fleet. Toba Capital selected Sentient Science as its first investment in materials science-based prediction software. Sentient has initially focused the DigitalClone technology on roller bearing-centric, rotating equipment delivering computational testing and asset management.

This investment will support accelerated growth through added sales, marketing, and product investments, along with international expansion. The financing supplements \$25 million in small business innovation research (SBIR) funding that had previously been competitively won from the Departments of Defense and Energy, the New York State Energy Research and Development Authority (NYSERDA), Defense Advanced Research Projects Agency (DARPA), and the National Science Foundation (NSF).

Sentient Science, which recently received the Tibbetts Award at the



Sentient Science

White House — the nation’s highest technology honor — will also add supplier and logistics services to its rapidly growing fleet of rotating equipment assets. DigitalClone models reduced the cost of energy by 1 cent per kilowatt per hour by providing three levels of asset and budget visibility, which is currently set at six to 36 months and 20 years. DigitalClone is a fundamental innovation in the market with its physical accuracy, high visibility, and low cost that

enables efficient life extension operations and vendor comparisons for mechanical power and drivetrains, including bearings, gears, and lubrication additives.

“Sentient Science’s DigitalClone software has eliminated the costs and the lengthy process associated with the physical testing of materials, components, systems, and fleets,” said Ward Thomas, chairman and CEO of Sentient Science. “How would your business be transformed if all of your decisions

### ALSO IN THIS SECTION

**36** DNV GL Issues Type Certificate for Siemens New 7-MW Offshore Wind Turbine

**37** Renewable Energy Record Achieved at London Array



Sentient Science



Sentient Science

were tested in real time and virtually for free? Our brilliant team of material scientists, developers, and market experts give operators and suppliers simulations of millions of scenarios tested 24 hours a day, seven-days a week, 365 days per year on every component of their rotating assets. Now, trillions of dollars in bearing-centric spending decisions can be made based on our lifing predictions, lowering the cost of sales and purchasing for our clients and improving outcomes equal to 13 percent of revenues.”

Sentient Science currently has more than 14,700 gearboxes under contract, and according to Thomas, this financing accelerates that momentum.

“Sentient Science pushes the envelope of software simulation far into what has been an expensive and wasteful hardware monopoly: testing by physically breaking,” said Vinny Smith, founder of Toba Capital. “Its material simulations replace hardware with no loss in accuracy. When they can do the same job, bits beat atoms every time — software is always more scalable and cost-effective than a machined alternative. We at Toba are thrilled to back Ward Thomas, the team of pioneering scientists lead by Dr. Nathan Bolander, and seasoned technology executives including Elias Tavaréz and Ed Wagner. We expect to lend signifi-

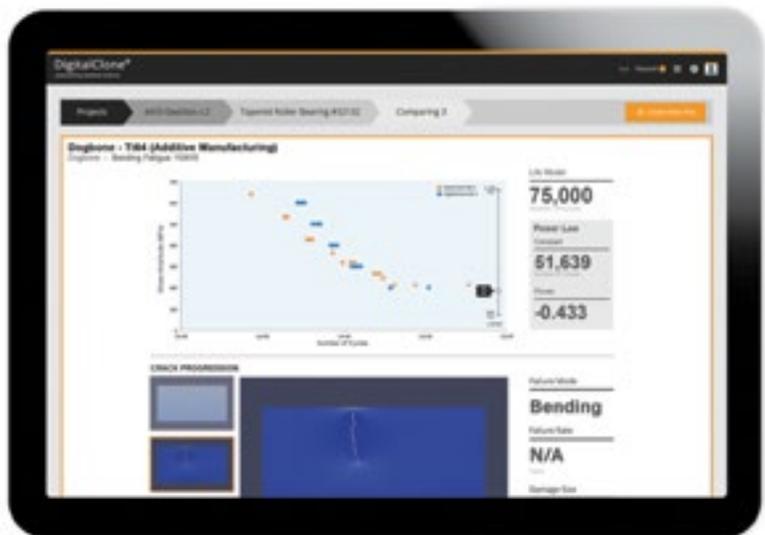
cant operational support and investment as Sentient Science becomes a dominant player in the industrial Internet.”

Sentient Science initially deployed and validated its computational testing solutions with the Department of Defense — the world’s largest equipment operator — predicting the future behavior of the most complex machines (bearings, jet engines, and gearboxes) on the Air Force F-35, the U.S. Army’s Apache and Black Hawk rotorcraft, and the Marine Corps’ Osprey programs with the world’s largest OEMs, including GE, Boeing, United Technologies, Textron, and Exxon. Based on the success of those flight certification

tests, the Department of Energy requested the use of Sentient Science’s computational testing solution for problematic wind turbine gearboxes that were failing prematurely in deployment. Sentient Science turned its attention to the renewables market in late 2014, and in just 15 months, it has captured contracts covering over 14,700 gearboxes in the U.S., Mexico, and Europe. With Toba’s investment, Sentient Science will expand its operations into more countries in Europe and China. ↘

— Source: Sentient Science

For more information, go to [sentientscience.com](http://sentientscience.com).



Sentient Science

## DNV GL ISSUES TYPE CERTIFICATE FOR SIEMENS NEW 7-MW OFFSHORE WIND TURBINE



DNV GL, the world’s largest resource of independent energy experts and certification body, recently awarded Siemens Wind Power with final type certification for its new 7-MW offshore wind turbine SWT-7.0-154, confirming full IEC-61400-22 compliance ahead of schedule.

The new award-winning Siemens model delivers nearly 10 percent more energy production than its predecessor under offshore wind conditions while retaining the same proven reliability. The new 7-MW offshore wind turbine has been developed by Siemens as an evolution of the company’s flagship offshore wind turbine — the SWT-6.0-154, which has already set new industry standards in terms of gearless turbine design.

As demand for offshore turbines to deliver higher power outputs to reduce the levelized cost of energy continues to increase, timelines to develop optimized types become increasingly tight. To meet industry and customer expectations, it was crucial for Siemens Wind Power that the newly developed SWT-7.0-154 is IEC type certified and that it reached the market on time. DNV GL’s optimized project management provided the type certification ahead of schedule, giving Siemens

(From left to right) Andreas Kamleitner, global head of department loads (DNV GL); Jonas Stenzel, head of global product and technology type certification (SWP); Axel Dombrowski, global head of mechanical engineering (DNV GL); Morten Rasmussen, head of technology (SWP); Esti Utami Povlsen, SWT-7.0-154 certification project manager (SWP); Kent Gerner Christensen, senior project manager D7 platform (SWP); Vicente Garcia Munoz, portfolio manager for offshore certification (SWP); and Mersudin Bajric, principal project manager type certification (DNV GL)

Wind Power a strong basis for the further development of the large direct drive turbines.

To confirm ultimate operational safety and reliability of the most innovative wind turbine on the market today, DNV GL’s expert understanding of the turbine’s advanced technical specifications was crucial. Building on experiences from the previous certification process of the 6-MW offshore wind turbine SWT-6.0-154 and the recent SWT-7.0-154 prototype certification, both sides have continued to work closely together on this project.

“Conscious of the current state of the industry it was vital we deliver this project on schedule,” said Stefan Haupt, global head of business development and sales for renewables certification at DNV GL. “We understand our customers’ time pressures and the demand to continuously bring the latest turbine innovations to the market. This is why optimized project management combined with in-depth technical expertise was vital for our work with Siemens, al-

lowing the company to confidently demonstrate the safety and reliability of their ground-breaking new 7-MW turbine.”

Vicente Garcia, portfolio manager for offshore certification at Siemens Wind Power, added, “We felt it was critical to rely on our long-lasting partnership with DNV GL as certification body in this upgrade of our D7 platform, as we were confident in their ability to help us reduce the final time to market. What’s more, the extensive collaboration during the initial scoping phase was a key factor for the final outcome of delivering the project to a successful result by obtaining type certificate ahead of schedule and provides a strong basis for further development of the large direct drive turbines.”

Moving forward, DNV GL has also been contracted to work with Siemens on the upgrade of the 7-MW turbine, including the power boost feature to increase the power output. ↘

— Source: DNV GL

For more information, go to [www.dnvgl.com](http://www.dnvgl.com).

# RENEWABLE ENERGY RECORD ACHIEVED AT LONDON ARRAY

London Array, the world's largest operational offshore wind farm, has set a new record for the amount of clean electricity produced by an offshore wind farm in a single calendar month.

In December 2015, London Array saw its 175 turbines generate 369,000 MWh of electricity — considerably above target and well above the previous best of 317,000 MWh set in November 2014. The capacity factor for the month, which saw average wind speeds of 11.9 m/s (27 mph), was 78.9 percent.

The two successive months of production brought net overall output for the year to some 2,500,000 MWh, enough to meet the needs of more than 600,000 U.K. households based on an average household consumption of 4,115 kWh per year.

“Both the monthly and annual figures are excellent results for London Array and show the contribution we are making to the country’s energy supply as well as the U.K.’s renewable energy targets,” said Jonathan Duffy, general manager of London Array. “Above average winds this winter have helped push production higher but that is only part of the story. We have a great team of people who support the operation and maintenance of the wind farm, and we have pushed hard over the past year to build on our earlier successes and develop our approach to turbine maintenance and repair. Together with key contractors DONG Energy and Siemens, we have focused on operational efficiency and expanding the amount of time our technicians are able to work offshore. This has helped ensure we extracted the maximum power from the wind and kept turbine availability above 98 percent over the winter. Our performance is also good news for the environment as it will have prevented the release



of some 1,075,000 tons of carbon dioxide in 2015, which is the main gas linked to climate change.”

— Source: London Array  
For more information, go to [www.londonarray.com](http://www.londonarray.com).

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# MANUFACTURING

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## GAMESA AGREES TO SUPPLY 30 MW TO MICHIGAN WIND FARM

Gamesa has recently signed a contract with Heritage Sustainable Energy to supply 30 MW as part of the second phase of the Big Turtle complex located in northeast Michigan. The agreement also encompasses the provision of operations and maintenance services for 12 years.

Under the terms of the agreement reached with Heritage Sustainable Energy, Gamesa will handle the transportation, installation, and commissioning of 14 of its G114-2.1-MW turbines. Delivery of the turbines is set to begin in August 2016 with the facility slated for commissioning in October.

The supply of these turbines will mark the completion of the Big Turtle 50-MW wind farm for which Gamesa already installed 10 G114-2.0-MW turbines in 2014. Big Turtle was the vehicle through which this new turbine model was introduced into the United States market, where it has since become a benchmark due to its ability to harness more energy at a lower cost at low and medium wind speed sites. In fact, the company has since signed orders for the supply of over 600 MW of this model between both the 2.0-MW and 2.1-MW versions in the U.S. alone. The global order book for this product stands at over 2,000 MW.

Gamesa has a strong presence in the U.S. where it has installed more than 4,100 MW at various wind complexes to date. ↴

— Source: Gamesa

For more information, go to [www.gamesacorp.com](http://www.gamesacorp.com).



G114-2.0 MW prototype

### ALSO IN THIS SECTION

**40** Vest-Fiber Expands Employment in Missouri

**41** Vestas Inaugurates Hub and Nacelle Factory in Brazil

# NORDEX TO DELIVER FIRST N100/3300 DELTA TURBINES TO IRELAND

Nordex recently obtained a new order for the construction of a 35-MW wind farm in Ireland. The company will be installing a total of 12 turbines to the Glencarbry wind farm for its customer John Laing Investments. The site is located close to the village of Hollyford in County Tipperary. Nordex will install seven N100/3300 and five N90/2500 wind turbines in Glencarbry.

With an average wind speed of 8 m/s, it is predicted that the turbines will produce 118 GW of electricity a year. Turbine deliveries are due to commence in October 2016. Following installation, Nordex will service the turbines for a period of 15 years having signed a premium service contract with John Laing.



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Together with Glencarbry and other projects currently under construction, Nordex will be increasing its installed capacity in Ireland to more than 700 MW. With its substantial potential for wind energy, the Emerald Isle is an important market

for the manufacturer, which is one of the leading suppliers of wind turbine generators there.

“Glencarbry is an important investment for John Laing Group, and we’re pleased that for the first time the turbines for one of our projects

are being supplied and maintained by Nordex,” said Ross McArthur, managing director of renewable energy for John Laing. “We’re looking forward to seeing the project fully operational in early 2017 and to the prospect of working together and delivering further projects with Nordex in the future.”

Nord/LB arranged the finance for this project.

“We are very pleased to have been able to support our client, the John Laing Group, with structuring the non-recourse debt package for the Glencarbry project as well as providing the financing for a project using Nordex turbine technology in the Irish market,” said Heiko Ludwig, managing director of Energy Europe for Nord/LB. ↙

— Source: Nordex

For more information, go to [www.nordex-online.com](http://www.nordex-online.com).

## VEST-FIBER EXPANDS EMPLOYMENT IN MISSOURI

Denmark-based Vest-Fiber recently announced an expansion of its employment in the United States due to the strength of its wind turbine industry. Headquartered in Tarm, Denmark, as a global provider of fiberglass components to manufacturers of wind turbines, the company is expanding its Moberly, Missouri, facility. The expansion will result in the creation of 30 new full-time positions in the coming months.

“An increase in the company’s customer demands has resulted in the need for additional quality craftsmen,” said Corey Mehaffy, president of Moberly Area Economic Development. “Fortunately, our region of Missouri has an established track record of a workforce capability of supporting the growth of strong companies.”

Founded in 2000, Vest-Fiber is a traditional supplier of small fiberglass products and services to the wind turbine industry. Two years later, at the request of its clients, Vest-Fiber made an additional investment to begin fiberglass-cutting operations to supply material in prepackaged kits ready for the assembly process. The new process lent itself to creating efficiencies in the client’s workflow in their manufacturing operations, creating a value the client could not afford to replicate.

The increase in the proliferation of wind energy led the management team at Vest-Fiber to look at the industry on a global basis. It was in 2010 that their first operations outside of Denmark were established.

After a search that encompassed several midwestern states, the company planted roots in

Moberly because it allows for easy access to existing clients in the wind corridor in the middle of the U.S. Available production facilities helped to reduce the start-up time of the new Vest-Fiber North American operations.

The Moberly location also provided an advantage to service new clients located on both the Eastern and Western seaboard of North America from one centrally located facility.

“Being located in the center of North America gives companies access to markets in the U.S., Canada, and Mexico,” said David Gaines, vice president of Moberly Area Economic Development. “There is a real value in logistics that companies through multiple industries can benefit from by being situated in the middle.”

When Vest-Fiber first opened the Moberly facility, the need was for approximately 30,000 square feet for pro-

duction space. In the last five years, Vest-Fiber's growth has demanded the need for 82,000 square feet of production space to keep pace with customer demand.

"This is the fourth company in the central and north-east Missouri region that has announced an expansion of employment," Mehaffy said. "This is a strong indicator that local, national, and international companies can successfully conduct business on a global basis from Missouri." ↵

— Source: Moberly Area Economic Development Corp.

For more information, go to [www.moberly-edc.com](http://www.moberly-edc.com).



## VESTAS INAUGURATES HUB AND NACELLE FACTORY IN BRAZIL

As part of its local production strategy, Vestas has inaugurated its hub and nacelle factory in Aquiraz, Brazil, at a ceremony attended by the governor of Ceará, Camilo Santana, and key stakeholders from the Brazilian wind energy sector.

The new factory is part of Vestas' plans to meet the increasing production demands in Brazil and Latin America, including the 376 MW of announced orders for projects in Brazil that Vestas received in 2015. In accordance with recent Brazilian Development Bank (BNDES) approval, Vestas expects to localize 70 percent of hub and nacelle manufacturing for the Brazilian market.

"With some of the best wind resources in the world, Brazil has a huge potential for wind power and remains one of Vestas' key strategic markets," said Rogério Zampronha, general manager for Vestas Brazil, while speaking at the inauguration. "Our investment in this factory is a key part of providing our customers a strong business case here and underlines Vestas' competitiveness in Brazil."

The factory will produce hubs and nacelles for the V110-2.0-MW turbine model that was recently honored as the Wind Turbine of 2015 under the category of onshore wind turbines up to 2.9 MW.

In addition to the factory, Vestas

has agreements with Aeris to produce blades and with ABB to produce generators locally, and it currently maintains 13 wind farms in Brazil, including the Xangri-lá (RS) wind farm that produces electricity for the Honda car manufacturing facility located in Sumaré, São Paulo.

Vestas has been present in the Brazilian market since 2000 and has since then installed 364 wind turbines that represent a total installed capacity of 713 MW. ↵

— Source: Vestas

For more information, go to [www.vestas.com](http://www.vestas.com).



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## ACCIONA ENERGY RENEWS U.S. INVESTMENTS WITH 93-MW TEXAS WIND FARM



Acciona Energy

Acciona Energy began construction work on the 93-MW San Roman Wind Farm, which is located near the southeast coast of Texas. It is the eighth wind farm owned by the company in the United States, bringing Acciona's U.S. wind power capacity to 721 MW. Acciona acquired the project from the developer Pioneer Green Energy.

Located in Cameron County, San Roman will be equipped with 31 Acciona Windpower AW125/3000

turbines. Each turbine has a rotor diameter of 125 meters and will be mounted on an 87.5-meter steel tower. The new wind farm will be operational by the end of 2016.

The San Roman Wind Farm will produce enough clean energy to power more than 30,000 U.S. homes. The electricity generated by the project will help create a more reliable power supply for Texas' Rio Grande Valley — an area that has suffered rolling blackouts in recent years due to a lack of local electric resources.

### ALSO IN THIS SECTION

**44** Pattern Energy Completes 150-MW Amazon Wind Farm in Indiana

**45** Invenery Announces Start of Commercial Operation for Prairie Breeze II Wind Energy Center



“The San Roman wind farm represents Acciona’s renewed investment activity in the important U.S. market,” said Acciona Energy North America CEO Ilya Hartmann. “We are working to grow our renewable energy portfolio in the U.S. and Canada and the San Roman project is an important step toward that goal.”

Greg Buis, president of Pioneer Green, added, “We are proud of the success this project achieved through the dedication of many different people, including local landowners and the teams working at Acciona and Pioneer Green. Due to the combined efforts of all those involved, the San Roman project will provide affordable, renewable, domestic energy for decades to come.”

The San Roman Wind Park will create roughly 80 full-time jobs during the construction phase and seven permanent jobs during the operations phase. Over its 25-year lifespan, the project is expected to pay more than \$30 million in local taxes to benefit entities such as the Cameron County schools, water districts, and hospitals. It is also expected to generate more than \$25 million in lease payments to local landowners. Acciona will also establish a scholarship fund and a community benefit fund to support the community.

The recent long-term extension of the federal production tax credit (PTC) is an important factor in Acciona’s decision to increase investment in U.S. wind energy projects. ↵

— Source: Acciona Energy

For more information, go to [www.acciona.us](http://www.acciona.us)



## PATTERN ENERGY COMPLETES 150-MW AMAZON WIND FARM IN INDIANA

Pattern Energy Group Inc. recently announced that construction has been completed for the 150-MW Amazon Wind Farm Fowler Ridge in Benton County, Indiana, and that the wind farm is now fully operational. The facility will sell 100 percent of the electricity produced to Amazon Web Services (AWS), which will supply the electricity to the electric grids that service its datacenters.

“It’s a privilege to team with AWS on the Amazon Wind Farm Fowler Ridge, demonstrating the strong and growing appetite for wind power from the country’s leading corporations,” said Mike Garland, president and CEO of Pattern Energy. “This facility was completed on schedule, and we are beginning 2016 with all 16 of our wind power facilities fully operational. Since our IPO, we have grown the portfolio by 119 percent, underscoring the value of our strategic relationship with Pattern Development and our ability to execute attractive third-party acquisitions. Our strong platform of fully contracted power facilities, combined with our identified ROFO acquisitions pipeline totaling 1,270 MW, puts Pattern Energy in an excellent position to contin-



ue growing its fleet and quarterly dividend.”

Jerry Hunter, vice president of infrastructure at AWS, added, “AWS has a long-term commitment to achieve 100-percent renewable energy usage for our global infrastructure footprint, and we continue to make progress towards this goal. We’re excited to announce with Pattern Energy that the Amazon Wind Farm Fowler Ridge is now live and producing electricity, bringing a new source of clean energy to the grids that power our datacenters.”

The Amazon Wind Farm Fowler Ridge consists of 65 Siemens 2.3-MW wind turbines with components including turbine blades, nacelles, towers, and transformers manufactured in the U.S. The 150-MW facility will create enough clean energy to power 46,000 homes each year, according to average annual residential energy use

data from the U.S. Energy Information Administration (EIA).

“Siemens is proud that workers at our factories in the Midwest produced the turbines for the Amazon Wind Farm Fowler Ridge, which continues an exciting trend of technology companies and major corporations turning to wind power for their energy needs,” said Jacob Andersen, CEO of Onshore Americas for Siemens’ wind power and renewables division. “As wind becomes an increasingly important part of our nation’s energy mix, we are pleased to partner once again with Pattern Energy to deliver sustainable and affordable wind energy.”

An average of 175 workers were on the site during construction, which was managed by Mortenson Construction, with up to 300 workers on-site during peak construction activity. There are 10 full-time permanent workers on-site to operate and maintain the facility. The

Amazon Wind Farm Fowler Ridge is expected to add an estimated \$45 million over 25 years to the regional economy through property taxes, landowner royalties, and support for local causes.

Pattern Energy has an owned interest of 116 MW, and institutional tax equity investors have acquired the balance. The facility is financed with all equity rather than project debt.

Pattern Energy acquired the Amazon Wind Farm Fowler Ridge from Pattern Energy Group LP (Pattern Development) in April 2015. Pattern Energy has rights of first offer to Pattern Development’s entire project development pipeline, which totals more than 5,900 MW. ↴

— Source: Pattern Energy

For more information, go to [patternenergy.com](http://patternenergy.com).

## INVENERGY ANNOUNCES START OF COMMERCIAL OPERATION FOR PRAIRIE BREEZE II WIND ENERGY CENTER

Invenergy Wind LLC recently announced the completion of construction and the start of commercial operation of its Prairie Breeze II Wind Energy Center in Antelope and Boone counties in Nebraska. The facility officially began operating in mid-December 2015.

Prairie Breeze II is located near the town of Elgin, approximately 100 miles northwest of Lincoln. The facility has the capacity to generate approximately 73 MW of power from 20 GE 1.79-MW wind turbines. Project output will be sold to the City of Grand Island, Nebraska, under a long-term power purchase agreement (PPA).

“We’re pleased to begin operating the second phase of our Prairie Breeze Wind Energy Center,” said Mick Baird, Invenergy’s vice president of business development for the west region. “When complete, Prairie Breeze will provide more than 300 MW of clean energy to our customers in Nebraska — a state with tremendous wind resources.”

Prairie Breeze II is the second phase of Invenergy’s Prairie Breeze Wind Energy Center. Prairie Breeze

I, a 201-MW facility in Antelope and Boone counties, began operation in 2014. Prairie Breeze III — a 36-MW facility in Antelope County — completed financial close in the fourth quarter of 2015 and is currently under construction. TerraForm Power, Inc. will acquire approximately 90 percent of Prairie Breeze II and III as part of the second closing of the acquisition of wind power plants from Invenergy announced in December 2015. The second closing is expected to occur in the second quarter of 2016 after Prairie Breeze III commences operations.

A full-time staff of 18 Invenergy employees will operate and maintain the entire Prairie Breeze Wind Energy Center facility. All phases will bring significant economic benefit to the local community through job creation and tax revenue that will continue throughout the life of the projects. ↴

— Source: Invenergy

For more information, go to [www.invenergyllc.com](http://www.invenergyllc.com).

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Contact:

Jim D. Mason, CEcD, EDPF • 580-225-3230  
masonj@elkcity.com • **www.elkcity.com**

# WIND SYSTEMS

*Giving Wind  
Direction*

**David C. Cooper**  
Publisher  
david@msimktg.com  
ext. 200

**Chad Morrison**  
Associate Publisher  
chad@msimktg.com  
ext. 202

## EDITORIAL DEPARTMENT

**Molly Rogers**  
Editor  
molly@msimktg.com  
ext. 205

**Anna Claire Howard**  
Associate Editor  
annaclaire@windssystemsmag.com  
ext. 204

## SALES DEPARTMENT

**Mike Barker**  
Regional Sales Manager  
mike@windssystemsmag.com  
ext. 203

**Tom McNulty**  
Regional Sales Manager  
tom@windssystemsmag.com

## CIRCULATION DEPARTMENT

**Teresa Cooper**  
Manager  
info@windssystemsmag.com  
ext. 201

**Kassie Boggan**  
Coordinator  
kassie@msimktg.com  
ext. 209

**Jamie Willett**  
Assistant

## DESIGN DEPARTMENT

**Shane Bell**  
Creative Director  
design@windssystemsmag.com  
ext. 206

**Michele Hall**  
Graphic Designer  
michele@windssystemsmag.com  
ext. 210

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P. O. Box 1987 • Pelham, AL 35124  
(800) 366-2185 • (205) 380-1580 fax

**David C. Cooper**  
President  
david@msimktg.com  
ext. 200

**Chad Morrison**  
Vice President  
chad@msimktg.com  
ext. 202

**Teresa Cooper**  
Operations Director  
info@msimktg.com  
ext. 201

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# CROSSWINDS

## HOW BRAZILIAN WIND FARMS BENEFIT FROM GE'S LARGEST ACQUISITION

South America's vast Pampas stretch over three countries and cover an area larger than France. Farmers in the region have long discovered the appeal of the flat and fertile lowlands, and now wind farm operators in Brazil, the continent's largest economy, are taking a second look.

Although the first wind farm opened in Brazil in 1992, wind has not reached its full potential and supplies less than 5 percent of the country's electricity because the windswept plains often stretch far away from urban centers and lack the wires and infrastructure to bring the electricity they generate to customers. The Brazilian government is seeking to diversify the country's power base and has set a goal for wind to reach nearly 12 percent of national generation capacity by 2023. The country is aiming to meet this goal by demanding that new projects build their own transmission lines.

It's a tall order, but the challenge got easier last fall when GE acquired Alstom's grid and energy business. Both companies already rank among the world's largest makers of wind turbines, and with Alstom under one roof, GE now has the technology that can connect to the grid quickly.

The timing could hardly be better. Brazil makes more than two-thirds of its energy from large-scale hydro projects such as the massive Itaipu Dam on the Paraná River that holds a world record in hydropower generation. However, the country is going through its worst drought in four decades, causing electricity to be more expensive and driving up the frequency of blackouts.

Virna Araripe is an executive at Casa dos Ventos, which owns Brazil's largest portfolio of wind projects. In the past,



This Brazilian wind farm built by Casa dos Ventos uses GE wind turbines. A local artist designed a graphic for the tower of the 1,000th GE wind turbine installed in the country.

her company has bought a variety of GE turbines as well as Alstom turbines, substations, and power lines. She said the new GE wind turbine and grid technology mix made "a compelling package."

Wind also happens to be complementary to hydro, according to Araripe. That's because wind power in Brazil is typically fully dispatched to the grid, allowing hydro plants to hold water at dams to save for later in the year. Another hydro application called pumped-storage hydro uses electric pumps to move water into holding dams for storage when power is plentiful, at night, for example. The dam releases it to generate power when it's needed during peak hours or when wind and solar are not available. In both senses, wind and hydro can be thought of as balancing each other.

Wind projects are also relatively speedy compared to other means of generating power. A new Brazilian wind farm can typically start supplying renewable power within two years.

GE and Alstom have been conducting business in Brazil for decades. There were 1,000 GE wind turbines installed in Brazil as of September 2015. Alstom's high-voltage equipment works on the world's largest transmission line, the *Linhão do Madeira*, that runs for 1,420 miles from the Amazonian state of Rondônia to the state of São Paulo in the southeast. With Alstom's grid technology handling the wind power transmission requirement for new farms, their footprint could grow quickly.

Araripe said that she believes wind energy can eventually contribute up to 20 percent of Brazil's power needs. Casa dos Ventos is ramping up at a rapid pace, planning to have 1,140 MW of installed capacity online by the end of 2017. In five years, it plans to have installed power of 3,000 MW. ↵

— Source: GE Reports

For more information, go to [www.gereports.com](http://www.gereports.com).



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