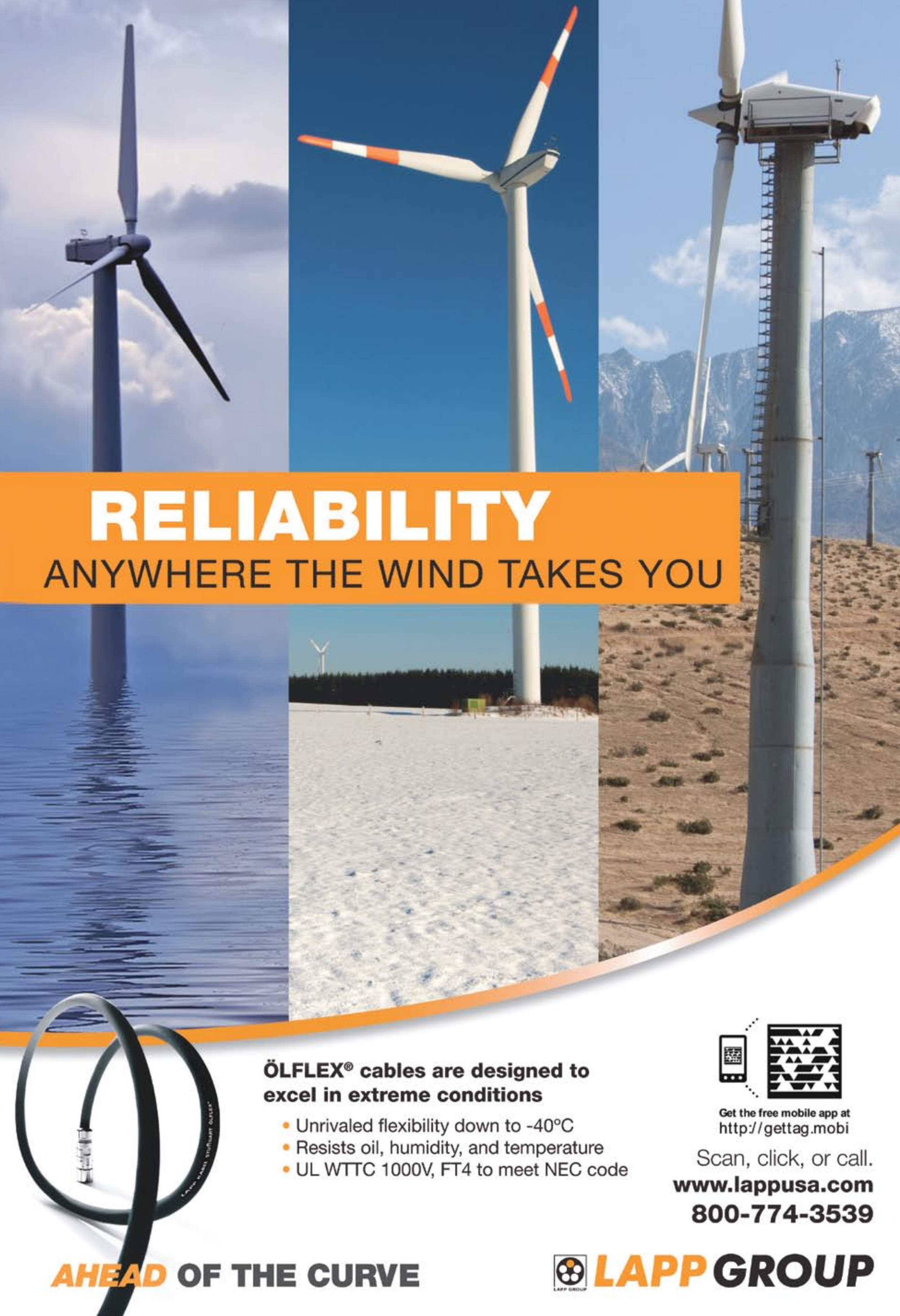
WIND SYSTEMS

OCTOBER 2011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FEATURES

OCTOBER 2011

DEPARTMENTS

VOLUME 3 NO. 26

RESOURCES

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EDLETTER

I'm writing this letter on my return flight from Las Vegas where I attended the inaugural Interactive Manufacturing eXperience (imX), which was an unqualified success. I'd like to thank Sandvik Coromant for their invitation, and congratulate both the Society of Manufacturing Engineers (SME) and the American Machine Tool Distributors' Association (AMTDA) for pulling off this first-time event so seamlessly. While there I learned about advanced machining technologies, which I look forward to sharing with you in upcoming issues. One had to do with manufacturing blades, which put me in mind of Susan Stewart's column in this issue of the magazine. She writes about a concept known as "adaptive blade design" that would actually allow blades to change shape in response to differing wind systems, increasing the amount of energy harnessed. This is very exciting to me, and just one example of the innovative thinking that characterizes this industry, hopefully leading to more-efficient designs and lowered production costs.

Speaking of innovation, Peter J.M. Clive of Sgurr Energy discusses cutting-edge techniques based on laser technologies that have led to "Second-Generation LiDAR," and Robert Mecarini of Alpine Ocean Seismic Survey explains how "Data Drives Offshore Development." The Eaton Corporation's James J. Benke describes the enhanced capabilities inherent in its newly developed "Medium-Voltage Circuit Protection," and Frank Moskob of Freudenberg Simrit GmbH & Co. shares his company's tailored approach to developing "Sealing Solutions for Wind." And perhaps it's the boy still lurking somewhere inside, but I found "Automated Turbine Inspection" by Donald Effren of AutoCopter to be a particularly delightful read. I'd be willing to bet that you will, too.

I'd like to welcome Michael Graska of the Professional Logistics Group to our pages, and thank him for an excellent installment of PLG's logistics column. Ron Krizan of the NAES Corp. has contributed another excellent construction column, this month targeting turbine icing, and on a somewhat related note Merritt Brown of Rev1 Renewables discusses how cold weather affects team performance in his maintenance column, this being the first of a two-part series. Transcat's Wind Turbine Tools division is our profile – I'd like to thank Jay Woychick for sharing the company's story with me – and John Boorman, director of sales at Availon, Inc., is our Q&A subject.

Just as I opened by mentioning the recent imX show, I'd like to encourage those of you who are involved in gear manufacturing to attend Gear Expo November 1-3 in Cincinnati [www.gearexpo.com]. Held by our friends at the American Gear Manufacturers Association, this is the country's premier event devoted specifically to gear manufacturing and related industries. All the serious players will be there, as will we promoting *Wind System's* sister publication *Gear Solutions* magazine [www.gearsolutions.com], and there will be much to be learned about these components so central to the wind energy industry. We'll be at booth #311, and I hope to see you there!

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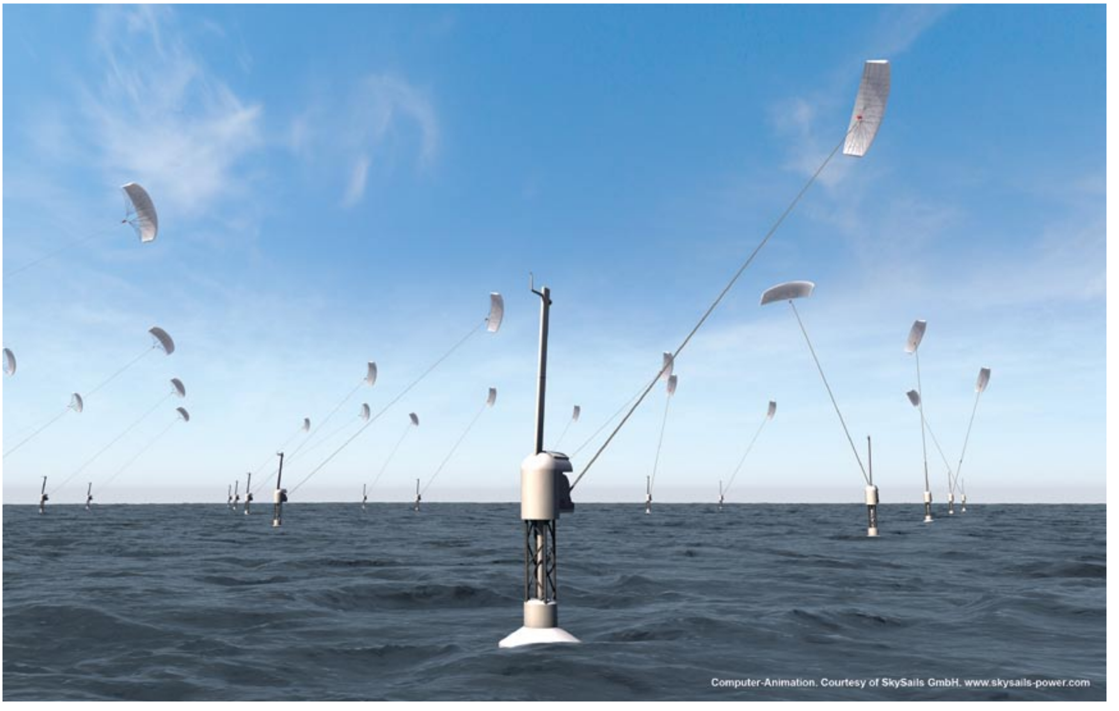


FIRST HIGH ALTITUDE WIND ENERGY REPORT FROM GL GARRAD HASSAN

Clean energy continues to grow, with renewable sources playing an ever greater role. Wind power generation, having expanded offshore, is now not only looking out but up. International renewable energy consultancy GL Garrad Hassan has issued the first market report that analyzes the burgeoning new industry of High Altitude Wind Energy (HAWE). HAWE systems are designed to tap into the high velocity, stable air currents that exist at altitudes anywhere from 200m to 20km above the earth; a source for generating cheaper and more abundant electricity than current wind technology.

The report looks at the potential of high altitude winds as an energy source, the current technologies within the sector and their potential as mature systems. As well as assessing individual technologies and the companies developing them, the report addresses the technical and regulatory challenges faced by the industry and the likelihood of its success.

As this emerging industry has grown, a cottage-like mentality with small entrepreneurs and inventors has flourished with a diverse array of systems types at various stages of development. Small and real scale prototypes from many developers are currently in active development. The report identifies 22 companies that have already developed or have announced their intention to develop prototypes including kites, kytoons and aerostats, and gliders or sailplanes with turbines or airfoils attached. In Europe and America these developers are beginning to see an influx of investment from both private and governmental partners and the report looks at the potential for investor involvement at the nascent stages of this industry.

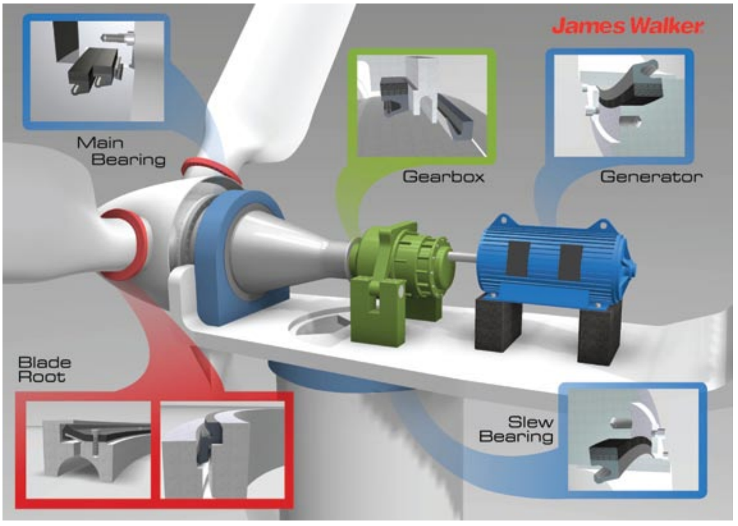
The basis for a HAWE system is relatively simple; a tethered object flying at altitude uses a mechanical system to harness the kinetic energy from the wind. The design of the object, the extraction mechanism and the tethering system, varies considerably among the many systems in development. The system might take the form of a kite, a parachute or rotating balloon, or a fixed wing, and be tethered in parallel on a floating platform offshore. GL Garrad Hassan's report looks at the prototypes, the potential of the major players and the challenges that need to be met for the technology to flourish.

HAWE systems have the potential to take energy generation from wind into a new dimension, unlocking resources with far greater potential energy than so far realized. With investment bringing more visibility to the industry, and the first full scale systems soon on the horizon the GL Garrad Hassan report is a valuable tool for those seeking to gain an overview of this new market segment. It can be ordered online at www.gl-garradhassan.com.

SEALING SOLUTIONS FROM JAMES WALKER

Wind power can supply large amounts of clean electricity at a sensible cost, but there remains an acute need to iron out the hurdles the industry still faces. Downtime and unplanned maintenance is expensive, time-consuming, and prevents efficient wind power production. Few turbines reach the end of their life cycle without repairs, as such, operators need to anticipate problems to minimize costs. One way of preventing such problems arising is to use turbine components that are reliable, efficient, and cost effective.

Small components such as seals are often overlooked to an OEM's detriment. Ineffective seals in wind turbines fail to adequately protect the bearing. Lubricant leakages not only cause blade staining and cleaning to be required, but leakages inside the turbine can cause components to fail. Inadequate seals allowing the ingress of particles into the bearing compromises performance and accelerates equipment failure. Above all, a compromised seal is costly to replace. Not only is there the cost of a replacement seal to consider, but the question of labor costs and how to fit the new seal, and the loss of revenue for the period when the turbine is inoperative. Seal manufacturing specialists have developed designs to provide solutions to the problem. James Walker has a number of on-site joining solutions, such as the Walkersele OSJ-2, that offer the same integrity, life and performance as the seal fitted during manufacture by an OEM. Effective on-site joined sealing technology can be used on many of the bearings on a wind turbine and timely seal replacement reduces lubricant loss whilst maintaining low friction to extend component life and improve reliability.



James Walker engineers have a wealth of experience in on-site servicing and can replace a variety of seals on-site, with the minimum of disassembly to minimize the loss of energy production. "As a global sealing supplier we aim to deliver high value to customers by providing reliable products with an extended life expectancy that remove the problems faced by the industry," says Barry Deeley, wind industry marketing manager. "The on-site joined technologies reduce maintenance costs and downtime that in turn increases the ability to generate electricity and lower lifetime costs for customers."

The James Walker Group is a global manufacturing group operating through two strategic business units: Sealing Products & Services, and Rail Systems & Products. It has more than 50 production, engineering, distribution, and customer support sites worldwide and operates in over 100 countries. Learn more at www.jameswalker.biz/windenergy

AVAILON NAMED DISTRIBUTOR FOR SCHUNK GRAPHITE TECHNOLOGY

Availon, Inc., has been named a distributor for Schunk Graphite Technology LLC (SGT). Availon will now offer customers products from Schunk including brush holders, carbon brushes, slip rings, and other components critical for the reliable operation and higher availability of wind turbines.

Steve Thompson, Availon North America's president, says that "Both Availon and Schunk have a successful history in Europe working together in the challenging wind industry market. Now we share the common goal of advancing the growth of wind energy in the United States and Canada. It is only natural that we are joining forces to offer better service and state-of-the art parts to our customers."

John Boorman, Availon North America's director of sales, adds that "Schunk's brush holders and carbon brushes will play significant roles in implementing one of the money-saving upgrades offered by Availon. The brush holder upgrade decreases the time required to replace brushes and prevents small parts from being lost in the slip ring compartment during the replacement process. The innovative brush configuration reduces irregular wear and extends service life up to 50 percent."

Availon, Inc. specializes in parts and services for GE, Vestas, and Siemens turbines and is expanding to other turbine types. In addition to being a primary supplier for SSB and Duradrive parts, Availon is also an exclusive vendor for Bachmann, Leonard+Bauer, and Convertec parts. The Availon global portfolio includes spare parts supply and management, end of warranty inspections, individual turbine optimization, turbine upgrades, field services, remote monitoring, and operations and maintenance.

Availon is a part of the Availon GmbH family. Availon has business units in the United States, Germany, Spain, and Italy. Currently Availon operates throughout North America and Europe and is expanding into other regions as well. Availon is the first independent wind turbine service provider to be both ISO 9001 certified and fully certified by Germanischer Lloyd in staff training, troubleshooting, and repair processes. Schunk Graphite Technology LLC is a globally-active technology group, comprising more than 60 companies in 28 countries in the core markets of carbon technology and ceramics, environmental simulation technology and climate technology, sintered metal technology, and ultrasonic welding technology. The Schunk Group is a technology leader in these fields. Go online to www.availon.com or www.schunkgraphite.com.

NEW PRESIDENT AND CHAIRMAN AT ALPINE OCEAN SEISMIC SURVEY

Alpine Ocean Seismic Survey announces that Robert Mecarini has been promoted to president of the company, and Gino Mecarini

assumed the role of chairman. This planned succession enables Robert to take on all day-to-day responsibilities of the company, and for Gino Mecarini to provide ongoing consultation while transitioning toward retirement.

"As a father and son team we have had the luxury of time to make this transition," says Robert Mecarini. "Alpine Ocean has been a family run company for more than 20 years, and I look forward to continuing on the successful path that my father has established."

"The time is right for this transition. For all intents and purposes Robert has been running the company, and it is time for us to make it formal," says Gino Mecarini. "The company is profitable, has a solid financial partner, and exciting projects on the horizon. Robert is ready to take the company to the next level."

Gino Mecarini has been with the company for 45 years, and became president when he purchased it from its original owners more than 20 years ago. In 2009, he sold a controlling interest to Gardline Marine Sciences Group, a UK-based marine services company, to enable Alpine to expand its services portfolio and have access to capital for growth. Robert Mecarini joined Alpine in 1991 as a deckhand, and has since worked for the company in every capacity, including as navigator and project manager, before most recently serving as executive vice president. The financial investment from Gardline enabled the company to launch R/V Shearwater, a 110-foot multi-use research vessel designed specifically to support the fast-growing U.S. market for offshore renewable energy projects, including tidal and wind. The partnership also enables Alpine to expand its portfolio of marine services to include environmental data acquisition and geotechnical services. To learn more call (201) 768-8000 or visit www.alpineocean.com.

Ron Krizan, P.E.
NAES Corporation

Anyone approaching a wind turbine under conditions where icing may form needs to know how to identify and protect themselves from shedding ice.

BLADE ICING IS A UNIQUE SAFETY CHALLENGE on wind farms that occurs on both existing and new facilities still under construction. Understanding and preparing for the risks will not only get your employees home safely, but also put procedures in place that maximize productivity during an icing event.

Icing typically occurs when the ambient temperature is just a few degrees below freezing, where it is just cold enough for the precipitation or even fog to freeze as it comes in contact with the wind turbine. As the moisture freezes it starts to form a thickening layer, especially over the leading edge of the blades while the turbine is in use. When enough ice builds up the blade may quickly "shed" the thin ice layer. This shedding is usually spurred on when the temperature warms to just above the freezing mark. It is not uncommon for the ice chunks to weigh anywhere from several ounces to more than 20 pounds. When you factor in that the blade tips may be traveling close to 150mph and are located several hundred feet in the air, you can get a feel for the potentially lethal projectile that has a radius of almost 1,000 feet. Normally the damage is confined to a relatively small radius stemming from the base of the turbine. Witnessed firsthand it can be a sobering reminder of the power of gravity. Crushed turbine steps, seriously damaged transformers and junction boxes, and even severe damage to the nacelle fiberglass illustrate the destructive power of falling ice.

First and foremost, anyone approaching a wind turbine under conditions where icing may form needs to know how to identify and then properly approach a turbine to protect themselves from shedding ice. While most wind farm operators understand the dangers, contractors and the general public may not realize the potential risks since they are not exposed to them on a regular basis.

There are many warning signs that indicate potential icing conditions may exist. The most obvious, however, is to simply pay attention to your surroundings. If snow and ice are clinging to buildings, trees, and vehicles it is a good indication that the blades are also accumulating them as well. If approaching a turbine for the first time, start by staying a safe distance away, typically 1000 feet, and use a pair of binoculars to look the blades and the nacelle over very carefully for ice. Ice is extremely hard to spot with the naked eye at longer distances; however one trick is to pay attention to inconsistencies on the blades, especially along the leading edge, and look for small icicles clinging along the bottom of the nacelle or radiator area. If you do spot ice or even potential ice, do not hesitate to shut down the turbine if you must approach it. Even after the tower is shut down a smaller radius of 300 feet is typically required while investigating for potential ice. This is to compensate for any wind drift that may carry the ice away from the tower as it falls.

Staff already in the tower may not be acutely aware of weather changes that may have occurred outside. If changing weather is expected to be a concern, procedures should be in place to notify employees without having them exit the turbine to visually check for ice. The use of a prearranged spotter and radios is usually the cleanest way to spot any potential threats.

Once the turbine is taken off line and ice is found, work with the site safety lead to determine a proper way to approach the turbine base. As with any safety issue, identifying it is only half the solution. Using common sense and following a pre-approved safety plan will ensure that everyone remains safe.

Examples of items that may be included in a comprehensive safety plan could include procedures for remotely yawing the nacelle so that the rotor either faces away from approaching workers or away from expensive and critical equipment, such as ground transformers or junction boxes, if the turbines are offline and shedding large amounts of ice.

Shedding ice isn't the only safety issue that may occur during an icing incident. A plan should be in place in dealing with stationary ice or snow that may accumulate on top of the nacelle. Even with the appropriate safety equipment, 150 feet in the air is not the place to try and walk on a slick surface. We all need to look out for, and educate each other, on the very unique risks that are inherent to the wind farm construction that we perform.

Ron Krizan, P.E., is engineering manager for NAES Corporation, the world's leading provider of comprehensive services to industries that generate or consume power. He can be reached at ron.krizan@naes.com. Go online to www.naes.com.

Merritt Brown
Rev1 Power Services, Inc.

MAINTENANCE

Cold weather can impact the reliability of a wind project, as well as the productivity of its service team. This first in a two-part series examines how preseason preparations benefit both.

LEAVING BEHIND THE MEMORABLE heat wave of 2011, it won't be long before our offices at 300 feet off the ground become standing popsicles. As warm summer months give way to freezing temperatures, snowstorms, and ice storms, the harsh winter working environment will subject technicians to a variety of conditions in which to perform their maintenance tasks. Preparing both the turbine and the technician is an important seasonal transition to assure safe and reliable winter service and operations.

In recent years more turbine manufacturers have introduced cold weather packages for their systems, allowing the installation of projects in regions that were previously restricted to milder climates. With such modifications turbines are able to sustain greater flexibility of operation in high wind and extreme low temperature environments, and can reliably restart following long shutdowns due to icing conditions. Undoubtedly, winter in many regions of the U.S. can be brutal. Manufacturers gain higher unit availability operating in these areas by integrating such add-ons as weather screens, nacelle heaters and improved internal airflow designs, gearbox heaters, heaters for controller cabinets and converters, and seasonal parameter changes that focus on temperature-sensitive components. When it comes to preparing a turbine for winter operation, the tasks include making a thorough preseason walkthrough to ensure these components are operating correctly and that weatherproofing plates and seals are in place.

Just as we do for our service vehicles, preseason checks should also involve testing the turbine coolant system, if liquid cooled, to ensure the proper amount of antifreeze for the expected ambient lows. Tower door seals, nacelle hatch seals, frame plugs, and hub and blade seals should all be in good shape. If you fail to inspect these locations, you may as well pack your snow shovel each time you climb since snow can penetrate almost any unprotected opening. Unless the nacelle is protected, snow will easily accumulate inside the nacelle and damage vital equipment. Verifying that greases and oils used in the turbine have been specified for the appropriate cold weather operation is also good practice, since viscosity of the lubricant is dependent upon its ambient temperature limitations. During a restart in cold weather, damage to gearbox internals can occur in the first few seconds of operation where oil is too thick and its flow is insufficient. In addition, greases that are not rated for low temperatures will become solidified, preventing the lubricant component from contacting the moving parts of the bearings.

Possibly the most-recognized winter hazard is severe icing. In the U.S. areas that see winter weather will likely experience at least one annual ice storm, and the types and amount of ice accumulation is often localized according to regions. Freezing rain in the northeast and rime ice in high elevations of the northwest are common, but such unforgettable storms as Kansas in 2005 and the Midwest in 2009 remind us that many areas of the country are susceptible to the hazards of winter ice. Winter ice storms are a serious event for a wind farm, imposing not only an equipment integrity concern but a personnel safety risk as well. Ice accumulation on wind turbine blades can interfere with anemometers and pitch control, increase loads on the rotor, affect vibration, and reduce energy capture. Special algorithms that shut down the turbine during icing conditions are typical in cold weather packages and should also be verified prior to the cold season. Such installed logic may recognize the loss of production from an airfoil profile change, less power output than expected from the anemometer reading, or higher output than the anemometer expected as an anticipated icing condition and will safely remove the turbine from service. While a turbine may sit idle during these periods, being unable to physically reach the turbine for maintenance for days on end can be standard practice in many parts of the country.

More importantly, ice throws from blades present a clear danger to technicians working near the turbine, so much so that ice conditions must be routinely monitored and safety policies enforced. Refresher training in safe work practices related to turbine icing should be part of the annual winter preseason checklist. If not already determined by the manufacture, the service provider should dictate a safe working distance on operating turbines during ice conditions and should specify that no work will be performed if icing conditions exist. On restart a turbine can throw ice chunks at distances of greater than 1,000 feet, presenting a safety hazard for people and property in the vicinity.

These preseason checks and refresher instructions can have significant payback during the winter months and lead to higher reliability and safety of the project. We'll continue our discussion to better prepare the service team for cold weather in the December issue of *Wind Systems* magazine.

Merritt Brown is vice president of Rev1 Renewables, an energy services company supporting wind, solar, and biomass clients worldwide. To learn more call (866) 738-1669 or go online to www.rev1renewables.com.

Susan W. Stewart, Ph.D.
Penn State Wind Energy

A new concept for designing blades is through adaptive blade technology, which may allow more energy to be captured and lower blade loads to be experienced.

WHAT IF A WIND TURBINE could change its shape with varying wind conditions to optimally capture the most power from the wind at each wind speed? What would these shape changes be, and what would the impact be on the cost of energy? These questions were the premise of a study conducted at Penn State by a former aerospace engineering student Leo Albanese, Professor Farhan Gandhi, and myself.

In the push for more environmentally friendly ways to produce energy, wind turbines are poised to make up a significant portion of this expanding market. However, many improvements in turbine technology are being examined in order to make these machines more productive, safer, and with a longer design life. One concept for designing blades is through adaptive blade technology that may allow more energy to be captured and lower blade loads to be experienced. In theory these changes could result in a lower cost of energy to be produced, which results in turbines being more economical in more situations. While research has gone into blade geometry changes that result in reduced loads being produced, not much (besides extendable radius blades) has gone into technology that directly increases energy production. The study provided an investigation into what types of adaptable geometry blades have potential for extracting increased energy from the wind flow. A tool using Blade Element Momentum Theory was developed in order to simulate different geometry changes on two research turbine models. Parametric studies were performed on design variables of two turbine designs to evaluate these variables' effects on power production and annual energy production for a specific wind resource condition. Finally, a study was performed combining the results of the power study with the results of a root bending moment study to see what blade configurations can maintain turbine power production while reducing blade root bending moments.

The two configurations studied were the WindPACT study 1.5MW turbine and a turbine design that resulted from an NREL study on 5MW configurations. Changes were made to the baseline twist distributions, root pitch settings, chord distributions, radial span, and airfoil characteristics at Region II wind speeds of 4, 6, 8, and 10 m/s. Each change was also simulated at a range of rotational speeds to ensure that if the geometry change altered the rotational speed at which optimal results occurred, the new optimums would be found. Also, each change that was examined made use of the baseline blade distributions scaled larger or smaller while keeping the other characteristics as unchanged as possible. Geometries that were optimal at each wind speed were then determined.

Some general trends were found in the results. Relative improvement in performance (or 3 percent improvement on an annual energy production basis) was found in varying the cross sectional characteristics and rpm at the lower wind speed of 4 m/s, however lower rpm startup conditions may limit the implementation of geometry changes for this operation range. As expected, changes in radius allowed for the most drastic increases in annual energy production on the order of 23 percent. However, with increased radius there are increased turbine loads that must be considered. Therefore, this study also calculated bending moments for the various design configurations. The study also examined the combination of pitch control with the geometry changes of twist value, chord variation, and radial expansion. This was done because it was noticed that adding positive pitch to the baseline blades decreased the bending moments produced, as well as the power produced. If the losses of power could be mitigated by the previous geometry changes while still realizing losses in bending moments, this would be very beneficial. At the rated speed of each turbine (where peak bending moments occur for each blade), each study produced root bending moment decreases of close to 10 percent or more for the 1.5MW turbine while at least maintaining power production. In fact, the radius study for this turbine saw bending moment decreases on the order of 14 percent. Larger decreases were available in some cases at speeds lower than the rated speed, showing promise for load reduction across the entire operating range. The 5MW turbine saw more modest results; the twist and radius studies saw bending moment reductions of 5 and 6 percent respectively, while the chord study could not produce a single result with negative changes in root bending moment while maintaining power production.

While much more work is needed to refine these concepts in order to come up with a useable geometry, the groundwork has been laid for this type of adaptive geometry blades to make an impact on wind turbine cost of energy.

Susan W. Stewart, Ph.D., is a research associate in aerospace engineering at The Pennsylvania State University and a member of its Wind Energy Program. Call (814) 863-0138, e-mail sstewart@psu.edu, or go to www.wind.psu.edu.

Seasoned travelers understand that rules change once borders are crossed. Successful logistics planning benefits from that realization, as well.

COMPANIES OFTEN FORGET SEEMINGLY simple things while handling the logistics of wind components within North America. What is assumed within U.S. borders doesn't necessarily hold true for Canada or Mexico. These assumptions can have painful consequences, especially with time-sensitive cargo.

I have found that often companies have less difficulty importing from another continent than across U.S. borders with Canada and Mexico. While distance and time required for trans-ocean shipments focuses the reality of what is required to execute the transaction, often this is not the case within North America where the cargo is most likely transported by rail or truck. One can easily assume that since rail or truck is being used, trans-border shipments should be straightforward. There are a couple of reasons why companies make such assumptions. One is NAFTA and the perception that all rules and regulations are the same for all three countries. Another is the relatively easy border crossing between countries. The fact is that it all comes down to the flow of material, money, and information.

Material: The cargo doesn't change, but the way it is transported may differ between countries. Material handling regulations will vary, so what is good enough in Mexico may not be approved in the U.S. Such differences often cause delays at the border.

Money: What currency should you use for financial transactions? This needs to be determined before a project is started. Local companies may want to be paid in local currency, while international companies may not. One needs to be able to handle cross-currency transaction efficiently so as not to delay shipment.

Information: This logistic flow is what I consider the most critical issue for project execution. Many a project has been delayed because the type and format of information between countries differ. Days can be lost because a master bill of lading differs in type of data required in one country versus what is required in another. This can be especially critical in Mexico because of the translation between Spanish and English. Personnel that handle the critical documents that allow flow of cargo usually work within strict guidelines and may have difficulty with minor errors. Often new paperwork has to be resubmitted rather than an error corrected on the original. Many shipments have been delayed because paperwork was not correctly submitted.

Information used for safely handling and securing cargo needs to be assimilated at the loading site. This means instructions and procedures created in one country need to be thoroughly understood in another. A rule that is assumed in U.S. may not be followed in Mexico since it is not the norm. Time has to be spent with the local personnel reviewing pertinent material handling and cargo securing information.

How are these unnecessary complications avoided? The answer is both simple and difficult. The simple part involves proper advance planning and analysis of the project. The difficult part is anticipating all the issues that may arise, and planning for them. Before the start of the project I suggest the following steps:

- Draft a plan for flow of material, money, and information. This can be as simple as one sheet of paper for each flow, or as complex as using formal project management tools.
- Enlist many people to collaborate during the creation of the plans. Doing this fills in the so-called holes in a plan.
- Create a contingency document for the project. This is what I call "if this happens, do this" document. You may not know all the answers if something goes wrong, but you probably know where to find the answers.
- Review the plans with all parties involved. Making sure the customs broker understands what is being shipped beforehand can save time while processing commercial invoices for clearance, for example, or that the banker understands your requirements for currency conversion can allow a smooth execution of the transaction.
- Having logistic personnel with country experience is critical. Relationships with Canadian and Mexican logistics expertise can make all the difference in a successful project.

Successful transportation projects depend on paying attention to the smallest details. Understanding this can make all the difference in the world.

Michael Graska is project leader with Professional Logistics Group. For more information go online to www.prologisticsgroup.com.

TRANSCAT, INC.

By Russ Willcutt

This company's Wind Turbine Tools business segment provides products and services that are tailored to the wind industry.

WHEN TRANSCAT ACQUIRED Westcon in 2008, it came with a pleasant surprise: a new market direction. "We were interested in the company because it had a quality calibration service lab and a product distribution warehouse for its test and measurement instrumentation located in the Pacific Northwest," according to Jay Woychick, vice president of wind energy commercial operations. "What we didn't know was that they were also involved in servicing the wind industry. The owner didn't want to mention that until he knew we were serious."

They were quite serious, as a matter of fact. So much so that Transcat purchased Wind Turbine Tools (WTT) a mere two years later, in December of 2010. In addition to a calibration lab, WTT also brought torque and hydraulic expertise into the mix. "From my perspective, there are very few companies, if any, that can provide the depth and breadth of products that we offer in addition to the calibration services that go with it," Woychick says. "We also have been named the factory authorized U.S. calibration and repair service center for Stahlwille tools. The whole Transcat team pulled together to earn Stahlwille's trust, which we see as quite an endorsement."

From an external standpoint, Transcat's sales team is responsible for meeting with major wind companies including OEMs, utilities, and third-party providers to ascertain their needs, which are then shared with other Transcat departments. Working with calibration operations, call center staff, and the purchasing department, Transcat's sales team makes sure each department is crystal clear on what needs to be delivered to their wind clients and how to do it. "Our calibration operations need to understand customer specific calibration requirements," Woychick says, "and our call center personnel require training to be prepared to answer any question a wind customer might ask, while purchasing focuses on the importance of short lead times and matters of a logistical nature."

As for sales, Transcat's wind representatives, having over 50 years of calibration and tooling experience, are conversant not only on the calibration services provided, but also products used in customized kitting. As any wind professional knows – especially those involved in construction, tower erection, and O&M work – if you don't have the right tools and supplies for the job, then the project stalls and you're losing money. Transcat meets with its clients, learns exactly which tools they require, makes suggestions when appropriate, and then adjusts inventory to allow for quick kit shipments to job sites throughout North America.

"Every customer plan we develop is different," Woychick explains. "For instance, a lot of the companies we work with are headquartered overseas, so they're familiar with foreign tools. One customer was experiencing long lead times for repairs. We were able to get the tools' specifications and then embarked on a 'form, fit, and function' program to change them over to tools that have a network of repair facilities in the U.S., because that's going to be a lot easier for them over the long term. We worked with one particular OEM in that way and switched out 10 different tools that are working a lot better for them. But we do this for domestic clients as well, suggesting the best tools for their application based on our years of experience. Sometimes a tool that's more expensive to purchase actually saves money in the long run because it doesn't require as much maintenance as a cheaper tool would."

In addition to providing its partners with the right tools, Transcat also helps them manage inventory with its CalTrak online asset management system. The system makes it possible to check on the status or location of equipment that has been shipped to a lab for calibration. Data sheets, certificates, and asset listings are available to be viewed or downloaded 24/7. Progress can be tracked, and custom calibration intervals and maintenance schedules are posted to ensure that tools and equipment are kept current. In addition, CalTrak automatically issues a reminder when equipment is due for recalibration. Data is certified to comply with the strictest quality standards, and all data sheets are controlled, standardized documents. "And it's CFR compliant, which means that you have electronic signatures and paperless certs," Woychick says. "For example, if a site is being audited they can go online, and since our system is CFR compliant, the auditors will accept the fact that everything's electronic."

With 17 calibration centers located strategically across the country, Transcat is well-positioned to meet the demanding requirements of the wind industry. "We have grown in a very thoughtful way, making sure our acquisitions make sense and that the companies joining the Transcat family meshed well with our core competencies and philosophy," Woychick says. "We look forward to supporting this growing industry for many years to come."

Call (800) 779-5289 or visit online at www.transcat.com.

DATA DRIVES OFFSHORE DEVELOPMENT

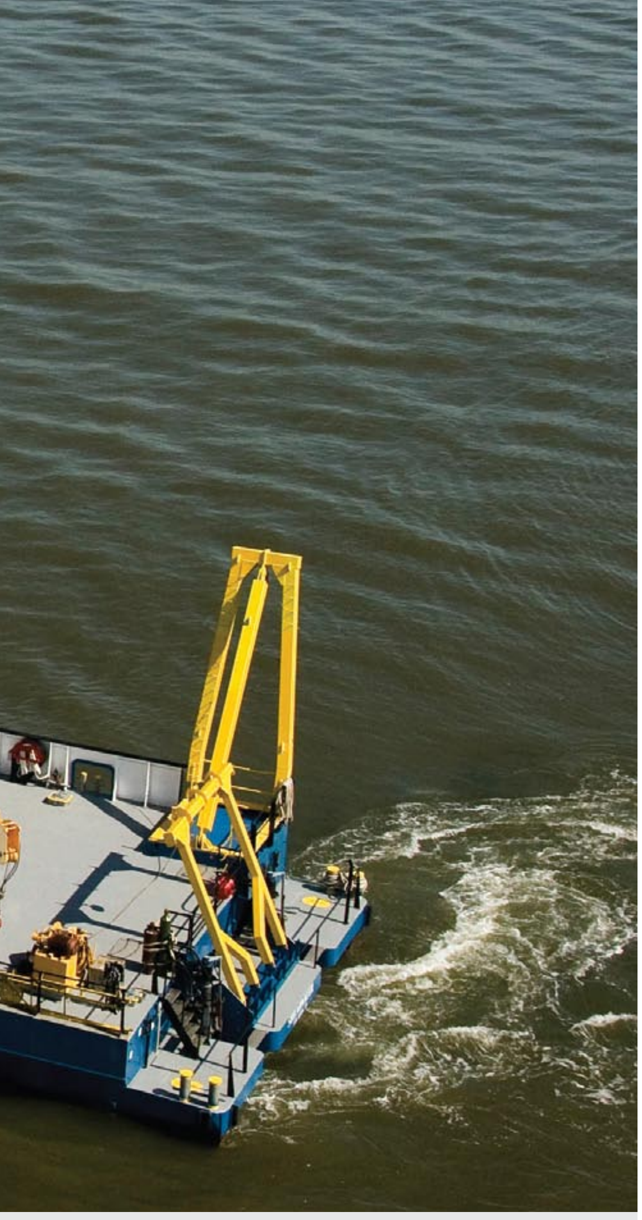
First-generation wind projects off the U.S. coastline demand data sets that feed EISs, enable wind characterization, and help streamline complex development requirements.

By Robert Mecarini

Robert Mecarini is president of Alpine Ocean Seismic Survey, Inc. For more information visit www.alpineocean.com.

WIND ENERGY OFF U.S. COASTLINES holds enormous promise. The U.S. Department of Energy estimates offshore wind capacity—generated in the Pacific, Hawaiian Islands, Gulf, Atlantic, and Great Lakes regions—at 4,150GW. While this projection represents total gross resource potential that doesn't account for exclusion zones or siting issues, it is four times the current generating capacity of the U.S. electric power system's 1,028GW. Beyond production capacity offshore wind has proximity value. With the 28 Great Lakes and coastal states in the continental U.S. consuming more than 75 percent of the country's electricity, offshore wind would significantly reduce transmission costs based on adjacency to high-electricity demand centers.

However, the promise of offshore wind generated along our vast coastline is just that, for the U.S. has yet to place a single commercial turbine in the water. Public opposition aside, conflicting state and federal regulatory guidelines and immature permitting processes have slowed efforts to build the nation's first offshore farm. These complexities, combined with the lack of a federal Renewable Energy Standard and long-term production tax



credits, discourage much-needed investment.

Still, the untapped bounty is hard to ignore. The East Coast, particularly, has attracted the attention of developers who've pushed forward with permitting and related development phase efforts including marine surveys, wind resource characterization, power-purchase agreement (PPA) negotiations, leasing, and financing. For example, Cape Wind recently received its final permit after a decade-long slow boil, though it still faces financing and legal challenges, while Fishermen's Energy projects off the New Jersey coast and Deepwater Wind projects off Rhode Island continue to make headway. Fishermen's has in place all its N.J. state permits for its demonstration project in state waters and is awaiting approval from the New Jersey Board of Public Utilities of its OREC (offshore renewable energy certificate) application, while Deepwater has negotiated the PPA for its Block Island demo site and is conducting survey studies so it can obtain its permits.

The multi-layered issues that have slowed offshore efforts, particularly the Cape Wind project, have catalyzed federal and state agencies to shorten the development phase. One stated objective of recent initiatives announced by the DOE and Department of the Interior (DOI) is to streamline permitting processes, which they acknowledge are overly complicated. Not only are these processes untested by project stakeholders, including permitting bodies themselves, they suffer from a lack of baseline site data. While project development with its various permitting stages accounts for a small percentage of offshore wind's estimated total lifecycle costs, these efforts have thus far consumed an inordinate amount of time and resources, and with the vast majority of ongoing work still in the development phase, it's where project efficiency efforts should currently focus (see fig. 1).

"Offshore oil projects get permits in less than two years, but the offshore wind permitting process has so far taken up to nine years," says Paul Williamson, director of the Maine Wind Industry Initiative, a multi-industry supply chain collaborative focused on developing the state's wind energy resources. He cites the fact that the permitting process currently requires that developers invest in gathering survey data for an environmental impact statement (EIS) just to set up the meteorological tower or buoy to measure a proposed site's wind resources. And then, if these resources are deemed viable, they have to conduct another EIS to pursue construction permits. "Oil developers don't have these environmental requirements."

Site selection and permitting takes into account a multitude of environmental, commercial, recreational, navigational, archaeological, and competing use factors. With offshore wind in its infancy there's insufficient wind resource, seabed, and other site data to create the baseline needed to streamline future projects. As part of its Offshore Wind Innovation and Demonstration (OSWInD) initiative, DOE has stated it will work to coordinate data sets collected across a range of marine projects and create national databases for shared use by developers and other entities. But with permitting currently hampered by a shortage of this critical site data, the focus is turning to expedient data acquisition. Collecting the complex data sets required by BOEMRE (Bureau of Ocean Energy Management, Regulation, and Enforcement) in federal waters, the U.S. Army Corps of Engineers in state waters, and a range of other groups, requires a marine research team highly experienced not only in marine

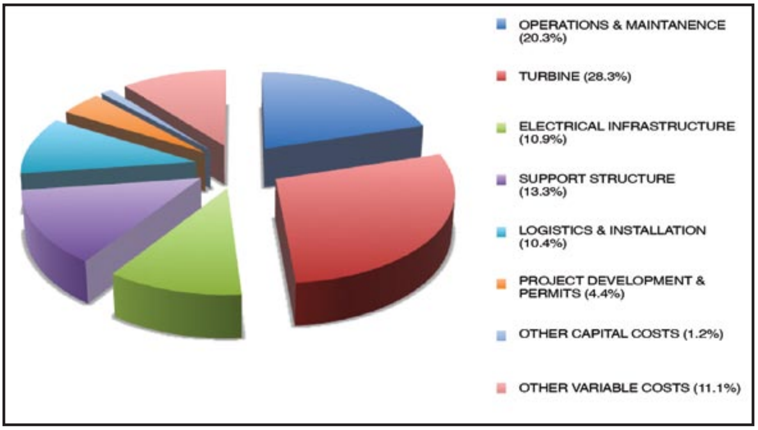


Fig. 1: Estimated lifecycle cost breakdown for offshore wind projects.

data acquisition, but in partnering with developers and other service providers to provide the best-quality data sets cost effectively.

As these teams increasingly collect and archive critical data across different projects, best practices for permitting and other aspects of the offshore wind development phase will emerge. With baselines in place and best practices to build on, developers, agencies, and other stakeholders will be positioned to work together to shrink project timelines, reduce costs, ease PPA negotiations, encourage investment, and spur development of the materials supply chain that will provide turbine components, foundation structures, cabling, installation ships and O&M vessels, and related elements.

A CHALLENGING GOAL

With broad estimates of more than 5,200MW of energy in first-generation offshore development underway in the Atlantic and Gulf of Mexico, developers—and the regulating agencies themselves—have seen the challenges caused by immature permitting processes and other development-centric regulations. Freshwater efforts in the Great Lakes won't have to deal with federal regulations but will likely face their own intra-state regulatory issues. Projects in the Great Lakes include a pilot by Lake Erie Energy Development Corp. (LEEDCo), which has 20-30MW under development in Lake Erie's Ohio waters. Through this effort stakeholders expect to gain experience with regulatory requirements and foster collaboration among permitting agencies as they move to larger project scenarios of 1,500MW up to 5,000MW. In addition, the New York Power Authority is reviewing proposals for 120-150MW of development in Lake Erie and/or Lake Ontario as part of its Great Lakes Offshore Wind (GLOW) initiative. First-generation offshore ocean efforts and projected energy output are outlined in fig. 2.

In spite of its highly publicized problems, Cape Wind offered valuable insight into development phase difficulties, driving new federal initiatives and funding to speed projects. "Cape Wind was unique, with some very well-financed opposition to getting it in the water," says Dan Shreve, director of MAKE Consulting, a Boston-based market intelligence and advisory group focused on wind energy. "We don't expect those particular problems to be repeated, and they also catalyzed movement to streamline development processes [for site selection and leasing]."

For example, in the aftermath of Cape Wind, DOI, as part of its Smart from the Start Initiative, instituted a program to ease site selection and leasing by creating Wind Energy Areas (WEAs). Through the program, BOEMRE identifies specific zones suitable for development based on such criteria as water depth, proximity to seacoast, and navigational hazards, and packages pre-approved leases. Thus far the agency has identified four mid-Atlantic development zones on the Outer Continental Shelf (OCS)—off Delaware, Maryland, New Jersey, and Virginia—for commercial leasing by developers and has announced it would do so for sites off Massachusetts, Rhode Island, and North Carolina. It has initiated processes for both competitive and non-competitive leasing proposals and is expected to begin the commercial leasing process as early as next year.

After a WEA bid is accepted, the developer must then seek BOEMRE approval for several consecutive phases, each of which depends on satisfactory data. Based on exclusive rights to the leased area it submits its development plan; a site assessment plan for deploying meteorological towers or buoys for wind resource characterization; and finally a construction and operations plan, to which it attaches detailed site characterization data captured through oceanographic, geotechnical, geophysical, environmental, and archaeological surveys.

"Permitting is seen as a major impediment to offshore wind because Cape Wind had a way of coloring the entire process as inherently impossible, but that view is getting tempered through recent efforts to streamline permitting," says Jesse Broehl, advisor at MAKE Consulting. To date, it has taken up to nine years for developers to get full permitting in part because they had to do two EISs: one to get approval for the meteorological tower or buoy, and a second to pursue construction. The DOI is moving to allow conditional use permits to install met towers without conducting a full

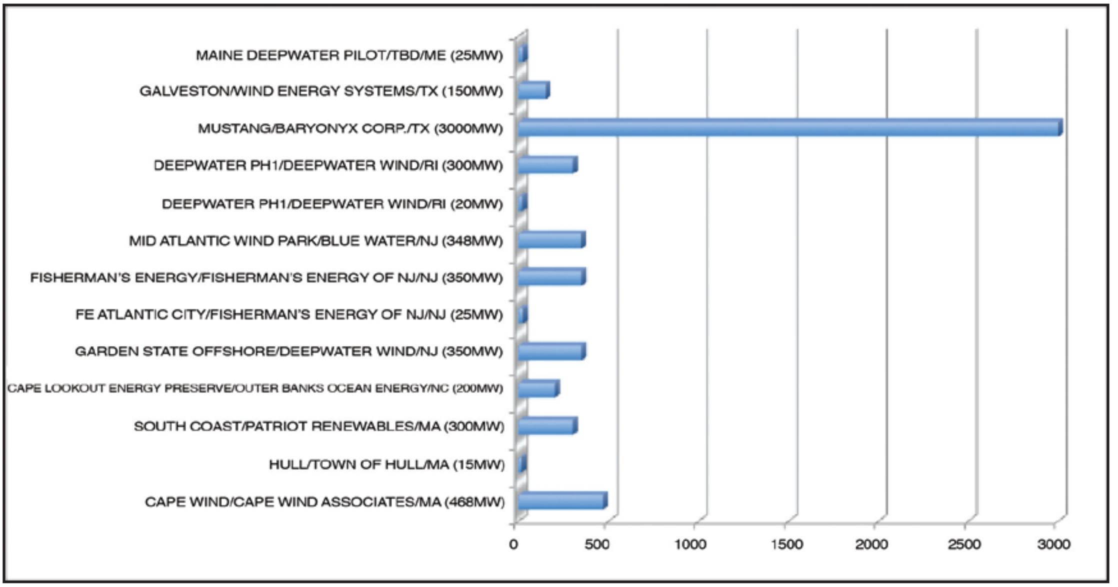


Fig. 2: First-generation Atlantic/Gulf of Mexico offshore development.

front-end EIS, which Broehl says "should knock two to three years off the permitting process."

THE MORE DATA THE BETTER

Each phase of an offshore wind farm lifecycle—from development, to turbines and transmission infrastructure construction, to full operations and, finally, to decommissioning—requires an enormous amount of marine survey data. Based on hard lessons learned in oil and gas projects, and more recently offshore wind projects in Europe, developers have learned that the more data they gather, the better chance the proj-

Fig. 3: The *Shearwater* was designed to work in marine conditions ranging from turbid coastal waters, rivers, and bays to deeper waters offshore.

ect will meet budget projections and timeline deliverables.

Given the challenges inherent in conducting data acquisition in dynamic and unpredictable marine conditions, developers must be able to rely on experienced research teams that emphasize data quality, efficiency, and safety as they employ the latest survey techniques to meet state and federal regulatory requirements. If developers cut corners on front-end data acquisition there's a good chance they'll suffer consequences down the road, as experience in gas and oil development has proven. While data acquisition accounts for a small percentage of overall wind project costs, an effort that is properly funded and thoroughly and efficiently conducted quickly pays for itself. Moreover, comprehensive data sets deliver exponentially larger financial benefits because they can, for example, prevent the need to remobilize personnel, vessels, and related assets caused by insufficient data for permitting and other requirements. In other words sound, sufficient data collection is relatively cheap insurance for protecting stakeholder investments.

For research teams to fully exploit their collective experience to gather the best possible data sets, they require a platform with state-of-the-art survey and deployment equipment, hardware, and software technologies. Though teams might be able to lease research vessels from universities or temporarily retrofit other-use vessels for survey activity, these approaches can negatively affect costs and efficiency. University research vessels, for example, are typically booked for university projects and therefore aren't readily available for commercial work. And commercial research vessels already working in the Gulf on oil and gas projects might not have the financial incentive to leave the area, where they can currently charge up to a third more than they can for wind projects off the East Coast.

The best possible scenario is to hire coordinated data acquisition teams experienced in wind energy projects and get them onboard a dedicated survey research vessel, optimally one on which they've already worked gathering multiple-use data. The conditions in which these vessels must operate demand strong seakeeping in both shallow and deeper waters, superior positioning capabilities, line-keeping performance, and ideally a propulsion system that provides tight maneuverability with little noise disturbance. For surveying activity the vessel should be outfitted with dedicated cranes and winches, and incorporate progressive design modifications that enable numerous approaches to equipment deployment for geotechnical, geophysical, environmental, hydrographic, archaeological, and oceanographic surveys.

To maximize project efficiencies, research vessels should also be equipped for extended periods at sea—providing overnight accommodations, freshwater and fuel reserves, and onboard laboratories—to mitigate the costs and time incurred when traveling between a port and study sites. A laboratory with onboard data processing is particularly advantageous, as it allows for realtime data assessment. Onboard data analysis is a cost and efficiency differentiator for any offshore project, since it allows research teams to determine if a survey design needs to be modified while they're already mobilized; for example, if survey data reveals that a cable route should be remapped. If teams demobilize and then determine through subsequent data analysis that they need to modify designs, they face a costly remobilization effort.

DON'T REINVENT THE WHEELHOUSE

As part of the OSWInD initiative, DOE is working with DOI to coordinate efforts to help offshore projects deliver a targeted 54GW of offshore wind generating capacity by 2030, at a cost of $0.07 per kWh. It's an ambitious goal given progress to date and the challenges involved. Agencies, developers, and other stakeholders must collaborate to shrink development stages to get projects into operation, or they can't prove that offshore wind energy can be delivered at competitive price points.

The agencies' joint National Offshore Wind Strategy plan includes an initial $50.5 million to fund proposals that encourage development of wind assets by improving technology and removing market barriers—including the lack of baseline marine and wind resource data—that drive up costs. And as part of Smart from the Start, BOEMRE recently announced that it is preparing a draft environmental assessment (EA) to gather public and other stakeholder comment on environmental impact before issuing commercial leases for potential WEAs. These EAs, according to BOEMRE, can potentially streamline efforts by helping agencies determine whether more comprehensive EISs are required before projects can move forward with preliminary wind resource characterization.

Stakeholders should also leverage lessons learned in offshore oil and gas projects and European wind installations to gather marine data in the most efficient, cost-effective ways possible. Reinventing data collection processes for U.S. offshore wind projects is cost-prohibitive and wasteful when best practices from oil and gas sectors and existing wind installations can be adapted.

The offshore wind industry benefits from a mindset that combines engineering and environmental innovation to drive next-generation energy technologies and production. While immaturity in the U.S. market has slowed projects, development efforts continue, delivering survey data necessary for wind characterization, turbine design, cable transmission routes, air and sea navigation, environmental impact, and a multitude of related assessments. Comprehensive national databases built from these studies will help provide the information needed to design an offshore infrastructure capable of cost-effectively delivering the output the U.S. requires to create a sustainable energy portfolio.

SEALING SOLUTIONS FOR WIND

Seal suppliers must recognize and understand the challenges faced by the wind industry in order to identify and develop the proper sealing solutions for current and future applications.

By Frank Moskob

Frank Moskob is European application engineering manager at Freudenberg Simrit GmbH & Co. KG. Go online to www.simrit.com.

WITH GLOBAL WIND CAPACITY increasing by 22 percent in 2010 alone, according to the Global Wind Energy Council, this budding industry is currently undergoing a period of rapid growth and globalization. To help foster this continued development, suppliers to the wind-power industry need to understand the key trends and challenges associated with generating wind energy.

The wind-power industry must continue to seek new ways to increase the lifespan and reliability of wind turbines. Wind turbines not only require extreme protection against weather and mechanical forces, but also solutions that are long-lived and robust since no one wants to provide maintenance for an offshore system twice a week. As many engineers know, machines are only as good as their parts, and it is often the case that the smallest of components have the potential to have the largest influence on the lifespan and reliability of the entire system.

Sealing—the act of preventing something from escaping or entering—is just one example of how a somewhat simple concept can play a critical role in the successful workings of the overall system.


Assorted seals in the nacelle.

From a basic O-ring seal to more complex multi-part sealing systems, the simple act of "keeping something in or out" is a vital aspect in the proper function of wind turbines.

But with sealing, like many other functions within a wind turbine, you are only able to control one aspect of the process: in this case, the seal or sealing system. Other factors such as the counter surface (roughness, hardness), conditions of use (vibrations, shaft eccentricities), environmental conditions (extreme heat or cold), internal media (oil and grease) and so on are uncontrollable, and even unpredictable at times. As a result seal suppliers must recognize and understand these challenges in order to identify and develop the proper sealing solutions for the current and future applications and their accompanying environments.

A SINGULAR INDUSTRY

The effort to develop and implement sealing solutions that maximize service life, while also minimizing costly downtime, can be influenced by a number of outside factors including environmental conditions (extreme temperatures, ozone containments, ultraviolet (UV) rays, and salty air) and surface characteristics, as well as external media and lubrication requirements.

Whether onshore or offshore, wind turbines need to withstand large-scale temperature changes. As a result sealing components need to be made with materials that are able to withstand these extreme fluctuations, especially extreme cold, without comprising shape, structure, or sealing ability. This makes the choice of material a critical component in the development of a proper sealing system.

In addition to extreme temperatures, these machines are also subject to a variety of harsh conditions on a daily basis. UV rays that affect a component's rubber matrix and material characteristics and ozone containments that cause material cracks and breakdown, as well as geographic-specific conditions such as salty air, are all at odds against the proper sealing of a wind turbine. Further, the system's surface conditions can also impact performance and seal behavior. The accurate evaluation of surface characteristics can provide engineers the needed information to better select or develop the best solution for the given application.

Finally, internal media such as the oil and grease used for lubrication pose a particular challenge to sealing systems. Improper lubrication can cause increased friction and wear, which can result in decreased seal life as well as increased maintenance requirements.

To address these conditions wind turbine sealing suppliers are working to advance current technologies, as well as create new designs and systems, to prolong the service life of the overall system. The following will identify four unique wind-power challenges and discuss how sealing suppliers have successfully developed, or are working to develop, solutions to meet these evolving needs.

WIND INDUSTRY CHALLENGE #1

- The Challenge: Sealing and protecting the pitch and yaw bearings of wind turbine generators.
- The Obstacles: High-pressure peaks in grease; tight fit (especially at low temperatures); and weather and media exposure.
- The Solution: Next generation material solutions

and customer-specific profile seal designs that combine multiple disciplines to achieve the extreme sealing protection needed for this application.

New sealing material and design innovations are driven by the consistently evolving needs of the industry. As a result, there is an array of pitch seal options available to fit the specific geometries of various pitch bearings applications. A crucial element in addressing pitch and yaw bearing sealing challenges is improved materials solutions. Even more than design enhancements, material innovations are key to properly addressing wind-power sealing challenges, as the quality of elastomeric sealing materials is decisive for the functional reliability of the wind turbine generator.

Many factors can influence a material's sealing ability and the service life of the overall system including mechanical loads, temperatures, greases and other media, ozone, and salt water. As a result, materials for wind-power sealing need to be durable, compatible with oil and grease lubricants, resistant to UV rays, the ozone, salty water, and more.

Two examples of industry-specific material solutions are the newly enhanced line of nitrile butadiene rubber (NBR) Ventoguard™ materials that have been specifically designed to offer superior low

Fig. 1: Simrit seals in a wind turbine.

Fig. 2: Simrit profile seal cutaway.

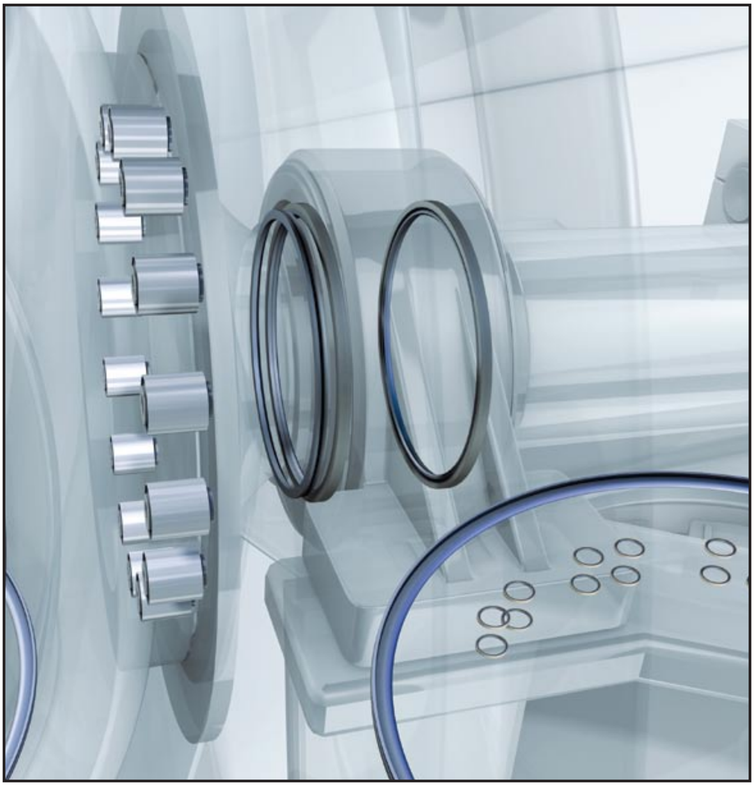


Fig. 3: Seals protect junctions between system components.

compression set (which is a direct measure for its durability as it determines the elastomeric lasting), grease and ozone resistance, and low-temperature capability. Ventoguard 453 and Ventoguard 454 are the next generation of Simrit's line of established NBR materials designed for use in slewing bearing profile seals in wind turbines. Each material was developed to address a specific wind power-related challenge with the ultimate goal of helping prolong the maintenance cycle of the sealing application.

Ventoguard 453 is a premium material that offers excellent cold flexibility, very good compression set, and demonstrates superior aging in several greases, including Klüber, Fuchs, and Mobil. Simrit's Ventoguard 454, also a new premium material, provides superior compression set and

Fig. 4: Another view of Simrit seals in a turbine.

Fig. 5: Seals from Simrit have a wide variety of applications.

is optimized for use in Shell Rhodina BBZ greases.

In addition to material improvements, a seal's design is also evolving to meet the sealing requirements of the wind-power industry. As an example, Simrit has developed customer-specific profile seals targeted for large bearing movement that, due to a more subtle sealing lip contour, offers increased flexibility. This flexibility is particularly important as it helps ensure the proper performance during large changes in sealing gap caused by extreme operating conditions—windstorms or strong gusts of wind, for example.

The design incorporated an enlarged sealing bead for the rotating bearing rings, which reduces the profile movement considerably. This next-generation profile provides an enhanced groove fit to also increase the profile's pressure resistance.

WIND INDUSTRY CHALLENGE #2

- The Challenge: Ensuring consistent and reliable sealing of wind turbine transmissions.
- The Obstacles: Long-term, reliable sealing of the critically important main gear transmissions of wind turbines.
- The Solution: Labyrinth seals, a dynamically working seal that uses centripetal effects of fluids to prevent leakage.

Labyrinth seals work as a contactless and frictionless solution that provide extreme service life (20 years in some cases) and require little if any service/maintenance. For decades metal labyrinths have been an established solution for a variety of industries. For the wind industry metal labyrinths have shown to be difficult to assemble, especially at the bigger shaft diameter used in turbines.

One example of supplier innovation is the recently developed polytetrafluoroethylene (PTFE) labyrinth seal, which was specifically designed for large gearbox applications. Simrit is currently the only manufacturer of this type of seal. The Radiamatic RCD seal—which stands for reject, collect, and drain, the three key principles of function in what are known as liquid-collecting labyrinth seals—is a highly efficient solution that offers the prospect of a service life spanning several decades. The seal consists of two parts and features a rotating inner ring and a stationary outer ring. The inner ring is open (optionally) and kept in place on the shaft by springs that adjust to axial movements. The outer ring sits securely in the housing bore. Designed specifically to meet customers' application requirements, the seal is adaptable to various designs and easy to assemble.

The main components of the seal are made of PTFE, which means that they are chemically resistant to additive oils, are ozone resistant and slow to age, all of which are relevant for wind turbine gears. This, in conjunction with the non-contact operation of this sealing solution in wind turbine gears, means that the service life of these seals is expected to last several decades.

WIND INDUSTRY CHALLENGE #3

- The Challenge: Preventing the contamination of elements in the main bearing seal.
- The Obstacles: External media such as dust, dirt and salty air.
- The Solution: Innovative designs that incorporate new features, such as dust lips, to address wind-specific challenges.

Simrit worked to examine current designs of competitors to identify and improve their points of weakness. What resulted was the Simmerring Radiamatic R55 seal with a dirt deflector, which combines the main sealing and pre-sealing function into one design.

Previously used in steel mills, the design—which will be introduced to the wind industry shortly—consists of a static part made of rubber and fabric, as well as a seal lip made of rubber and containing a garter spring. The new design is compatible with mineral oils and greases. The solution also offers increased lifetime and better wear resistance, higher chemical, ozone and salty air resistance, and ease of assembly.

WIND INDUSTRY CHALLENGE #4

- The Challenge: Long-term, reliable sealing for harsh wind environments.
- The Obstacles: Extreme temperatures, dirt and dust, ozone, UV rays, etc.
- The Solution: Development and use of durable materials that extend the life of the seal and system.

One example of an evolved solution that addresses the extreme environmental challenges associated with the wind industry is the Simmerring Enviromatic seal, which offers excellent protection against both dust and salty air. This innovative solution was created using a small line contact of seal lip, contrary to the standard use of V-rings, to guarantee protection of the main seal. Uniquely, the seal operates with the separate functions in individualized, optimized parts.

Working to strengthen the sealing lip of previous V-ring designs, Simrit developed its Enviromatic seal as a premium solution. By incorporating the improved HNBR material Ventoguard 467 and optimizing the design using finite element analysis, the new solution offers improved stiffness, contour, and function that results in more reliable protection and increased wear resistance.

CONCLUSION

During this time of rapid growth and evolution, wind-power suppliers are tasked with continually driving the development of solutions that address the unique needs of this extreme industry. Adding to the complexity is the sheer size of wind turbines as well as the difficult service conditions, especially in offshore locations.

With the ultimate goal of increasing reliability and lifespan always top of mind, new products and systems need to be expertly constructed and tested, as only the most superior of innovations will allow the wind industry to continue to grow at its current pace.

MEDIUM-VOLTAGE CIRCUIT PROTECTION

Medium-voltage circuit breakers from Eaton with enhanced capabilities and industry leading protective and monitoring devices make it easier to get generated power into the distribution system.

By James J. Benke

James J. Benke is an engineering manager at Eaton. Go online to www.eaton.com.

IN THE UNITED STATES TODAY the total wind fleet stands at approximately 41,000MW, creating enough clean energy to supply 10 million homes. In the first part of this year 1,100MW of new capacity was installed. At the same time about half the power consumed in the United States today is generated with coal. Nuclear is next at 20 percent, natural gas at 18 percent, and hydroelectric at 7 percent. Together, renewable sources like wind and solar make up only 2 percent of all the power generated in the United States. As wind power is the fastest growing sector in the global power generation industry it is projected to continue in the same trajectory.

Our collective demand for power continues to increase, and in the next 20 years our demand for energy is expected to double. To meet our ever increasing energy needs, new and improved alternative and renewable energy sources are becoming an extremely viable solution verses the past. Wind power is a critical part of the solution.

ROBUST, RELIABLE CIRCUIT PROTECTION

Simply put, wind power is remote and variable. Wind resources are often far from significant mar-

kets and plant output varies with wind conditions, creating a variety of public and electrical industry challenges. As wind projects need to be at the site of the wind source, the generation location is often remotely located from the electric load, and there is often reliance on long-distance transmission. Wind farms require a complex collection of equipment that needs to work together efficiently so as to generate electricity and transmit it to the grid. Industry leading manufacturers are engineering equipment able to address the unique needs of wind power applications.

Medium-voltage circuit breakers with enhanced capabilities and industry leading protective and monitoring devices make it easier to get generated power into the system, so that it can be distributed and used. While addressing the requirements of wind turbine applications there are circuit breakers engineered to improve uptime, reliability, and sustainability while enhancing safety.

CIRCUIT PROTECTION FOR WIND

Fundamentally, wind turbines convert the energy captured from wind into electricity. A turbine captures wind's kinetic energy and converts it into electricity through the action of blades, which are connected to a generator. The generator converts the blade's rotational movement into electricity at low or medium voltage. Typically this voltage for small- and mid-sized wind applications ranges from 500 to 700 volts (V), although utility-scale turbines are capable of generating thousands of volts. From the generator, electricity flows through heavy electric cables to a substation transformer, which increases the voltage of the electric power to a distribution voltage. The distribution voltage is usually in the thousands of volts range; a common distribution voltage range is 15 kilovolts (kV) to 38 kV. From the transformer, the distribution power flows to a collection point, where the power can be combined with other turbines. In some cases the electricity is utilized locally, though it is typically sent to a substation where the voltage is increased to a high transmission level for efficient delivery to faraway cities and facilities.

EIGHT KEY CHARACTERISTICS

With the right equipment and support, wind farms are able to lower lifecycle costs. Remotely located equipment should be selected based on its reputation for minimal downtime, operational longevity, extended maintenance requirements, and extra performance capabilities.

As the design and operation of wind plant power systems has unique challenges, electrical equipment manufacturers can help address these concerns. Intermittent power generation can pose problems for the supporting electrical equipment, which may not be designed to cater to these notable variations. Evaluating and monitoring processes of all electrical systems within wind plants should focus on a range of issues, including: the unpredictable nature of wind power, remote locations, frequent generator operation, voltage regulation, frequency considerations, thermal and fault issues, system dynamics including capacitor operations, reactive power management, event analysis, and system and equipment performance.

Specifically, medium-voltage vacuum circuit breakers can address the rigorous requirements of

Fig. 1: The Eaton VCP-Wind circuit breaker.

wind turbine applications and improve uptime, reliability, and sustainability, while enhancing safety. Specific considerations for specifying such circuit breakers include:

1) Proven Technology: Incorporating proven vacuum interrupting technology, medium-voltage circuit breakers should be designed to reliably switch normal and high-stress currents. A global manufacturer, Eaton is applying more than 80 years of innovation and experience to its circuit protection solutions for wind power applications.
2) Green and SF6 Free: Avoid use of Sulfur Hexafluoride (SF6), which poses environmental and safety concerns. SF6 is a colorless, non-flammable gas often used in circuit breaker applications above 38kV. It is finding its way into lower voltages in the U.S. in the form of as insulated switchgear (GIS), which uses SF6 for its insulation system. In the case a leakage occurs during system operation, or if cleanup is required after equipment failure, toxic byproducts can be produced, and SF6 poses safety concerns. Further, dismantling and disposing of circuit breakers that rely on SF6 can result in similar exposure. If there is excessive moisture, toxic byproducts can be produced during the course of normal arc interruption. Today you do not need to rely on SF6 gas for insulation materials. A leading power management company, Eaton developed industry leading vacuum interrupting technology that requires no cooling or ventilation systems, and avoids the use of SF6. Eaton has been solid-insulation technology in a wide range of applications for more than 50 years.
3) Compact Footprint: Using compact circuit breakers can mean that the switchgear footprint is compact as well, by enabling the voltage transformers to be in the top compartment of the switchgear. For example, Eaton VCP-Wind breakers allow the assembly to be mounted above the breaker to save space.
4) Remote Racking for Enhanced Safety: Remote racking devices connect to breakers and allow personnel to insert and remove them while standing outside the arc flash protection boundary. Eaton engineered remote racking devices to increase distance between the operator and the front of the switchgear lineup during racking operations, putting 25 feet between the operator and the switchgear.
5) Protected Components Reduce Maintenance: Pole units that are encapsulated protect high-voltage components from the environment. The Eaton VCP-Wind breaker is engineered to require reduced maintenance over the product lifecycle.
6) Easy Access: A direct roll-in configuration, like that of Eaton VCP-Wind breakers, makes it easier to handle and relocate the breaker.
7) Customized Design: Circuit breakers engineered for wind applications can be customized to accommodate specific installations with the right accessories, making it easier to integrate the breaker into a switchgear design. For example, Eaton engineered:

- Spouts accommodate the mounting of six sets of current transformers per phase;
- Distinct latch positions for disconnect, test and enclosure;
- Coding pins so that only breakers of the correct ratings can be inserted into the enclosure;
- Trip-free interlocks prevent moving a closed breaker into or out of a the connect position;
- Self-aligning and coupling primary

Fig. 2: Medium-voltage vacuum circuit breakers improve uptime, reliability, and sustainability, while enhancing safety.

and secondary disconnecting devices.

8) Certified to Meet and Exceed Requirements: Since wind is relatively new to the generation market, policies, opinions, and available electrical equipment have a tendency to favor older and long-established generation techniques. Be confident your equipment is rated to meet and exceed minimum requirements. Eaton VCP-Wind circuit breakers meet American National Standards Institute (ANSI) and Institute of Electrical and Electronics Engineers (IEEE) C37.09 standards.

Eaton is investing significant resources into developing a wide range of solutions to meet the demands of the wind power industry. Building on more than 80 years of circuit breaker innovation, Eaton engineered circuit breakers to specifically accommodate for the conditions in wind power applications. Designed for wind farm collector substations, the Eaton VCP-Wind breakers help to improve system reliability, efficiency, sustainability, and enhance safety.

SECOND-GENERATION LiDAR

Cutting edge techniques based on laser technologies have led to second-generation LiDAR systems, according to the experts at SgurrEnergy.

By Peter J.M. Clive

Peter J.M. Clive is technical development officer at SgurrEnergy Ltd. He can be reached at peter.clive@sgurrenergy.com. Visit online at www.sgurrenergy.com.

THE SUCCESSFUL DEVELOPMENT of wind power projects requires reliable projections of the productivity and longevity of the assets being installed. The wind itself is a complex, variable, and intermittent resource, however, which introduces a high degree of uncertainty into any prediction. Recently, cutting edge techniques based on laser technology have been pioneered which tackle key contributions to this uncertainty.

KNOWING THE UNKNOWNS

Project uncertainty can be broadly described using two categories. Typically, wind data are acquired from instruments on a met mast at a location somewhere on the project site and the conditions at other proposed wind turbine locations are approximated from these data using wind flow models which represent the influence of the terrain, obstacles, and other wind turbines on the flow. The uncertainty introduced by these approximations is an example of what might be termed "space-domain" uncertainty, which arises because our data obtained via measurements do not directly represent the full spatial extent of the wind power project, just the mast location. Another example of space-domain uncertainty is the extrapolation of

measurements to heights above the top of the mast.

"Time-domain" uncertainty occurs because our datasets do not directly represent the full life cycle of the project, but rather a short term measurement campaign of one or two years during which data have been acquired. This uncertainty can be reduced by comparing the short term data from the project site with data obtained over the same period at another reference site for which longer term data are available. The relationship between the sites established using the short term data is then applied to the long term data to form the basis of predictions of the resource available for exploitation over the life of the project.

Progress in reducing time-domain uncertainty is slow and piecemeal, relying on the adoption of ever more sophisticated statistical and mathematical techniques to tease from the short term data information that can be applied to long term projections. However, dramatic reductions in space-domain uncertainty are now available as a result of LiDAR technology which enables significant improvement in our understanding of flow across the site in the space-domain. This is important since the level of uncertainty pertaining to a project determines the level of annual energy production that can be taken to be sufficiently reliable to service the debts raised to finance the project.

RISE OF THE VIRTUAL MAST

For a few years now the limitation of masts, in terms of being restricted to a single location rather than acquiring data from multiple locations across the project site, has been mitigated to some extent by the adoption of first-generation remote sensing solutions. These have been seen as "virtual masts"—robust, compact, portable solutions that can be simply and easily deployed to locations of interest to acquire mast-like data using sonic or laser probes. In this way they remotely measure the wind at height, for example, to distinguish which of two differing model predictions most accurately represents reality. As a result the contribution to project uncertainty from the influence of the terrain can be reduced. More recently LiDARs, which use laser technology, have been seen as offering a greater degree of flexibility and accuracy than SoDARs, while at the same time SoDARs, which use sound pulses, do not represent the same expense.

SECOND-GENERATION LIDAR

The laser beams used by LiDARs interact with the wind in such a way that a single beam does not provide a measurement of the wind speed; rather, the data from multiple beam orientations must be processed in combination to derive a wind velocity vector. If a single device is used to achieve these beam orientations by scanning the beam, then the beams necessarily diverge from the device and define a volume in space. One important consequence of this is that if the flow is not uniform, for example, as a result of the influence of complex terrain, the wind velocity will vary within this volume, exposing each individual beam to different velocities such that a single unambiguous wind velocity cannot be derived from the resulting measurements.

This issue was one of the principal motivations for the development of the second-generation of LiDARs for wind power applications. First-generation LiDARs have a single degree of freedom. This limits the range of beam orientation they can use. Second-generation LiDARs have two degrees of freedom: both the azimuth and elevation angle of the beam can be adjusted, and so the beam can point anywhere unencumbered by restrictions and implement any pattern of beam orientations, or "scan geometry," including the one most suitable for any given application. So whereas first-generation devices are limited to surveying the wind immediately above them like virtual masts, second-generation LiDARs can measure anywhere within the range of their laser. And whereas first-generation LiDARs must use models in complex terrain to approximate the non-uniformity of the flow within the volumes defined by their scan geometries so that they can adjust their measurements to compensate for it, second-generation LiDARs directly measure these inhomogeneities, and so do not compromise the priority of direct measurement over model approximation by adjusting any measurements.

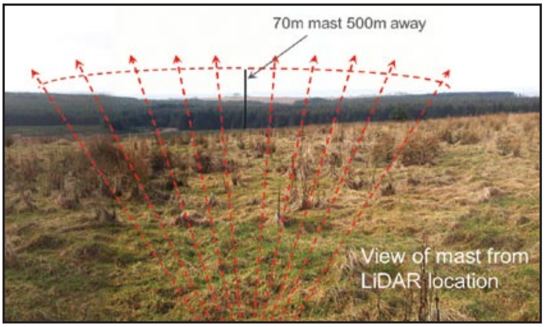


Fig. 1: Arc scan geometry.

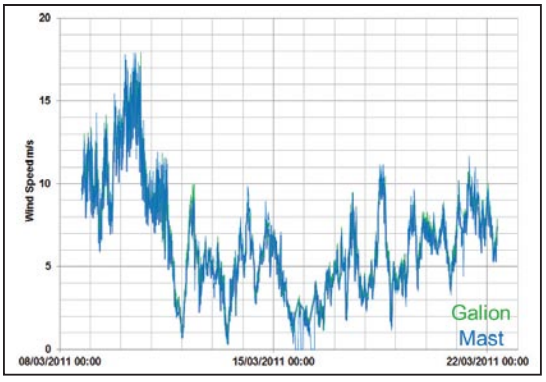


Fig. 2: Arc scan comparison, with mast.

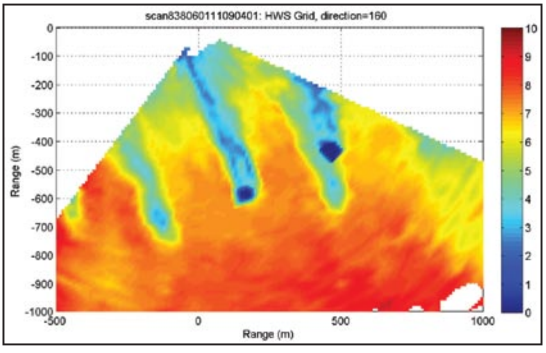


Fig. 3: Plan view of waked wind flow.

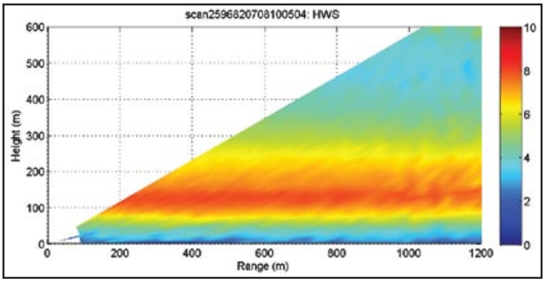


Fig. 4: Low-level jet.

THE ARC SCAN

An example of a second-generation scan geometry is the arc scan. This involves varying the direction of the beam through a range of bearings, or azimuths, while maintaining a constant low elevation angle, close to horizontal, to measure the wind some distance from the device. Figure 1 shows an example of this. Laser beams are shown emitted from the device location to scan through a reference mast located 500 meters away. The wind speed time series measured over a two-week period by the mast and the second-generation LiDAR are compared in fig. 2, where the mast data is shown in blue and the LiDAR in green. Excellent agreement is observed. Indeed the arc scan measurements easily satisfy all published acceptance criteria for the performance of first-generation devices installed immediately adjacent to the mast, except in this instance the measurement has been made from a distance of 500 meters away using second-generation techniques.

FROM PIXEL TO PICTURE

Comparison studies to determine the extent to which remote sensing devices replicate the capabilities of mast mounted anemometry will always be necessary as long as only mast mounted instruments can be assessed under controlled conditions in wind tunnels which have been inspected and certified as compliant with national standards, since this establishes the traceability of the accuracy of field measurements. Nevertheless, a mast only provides a single pixel of the more complete picture that represents flow across the entire project site. Second-generation instruments deliver this complete picture. Figure 3 shows a plan view of wind turbine wakes directly measured using a second-generation LiDAR that has scanned its beam across the site over the course of about one minute. Here we see the accuracy demonstrated above for an individual pixel by the arc scan extended to the visualisation of flow across an entire site.

PRODUCTIVITY AND LONGEVITY

The complex nature of the wind has significant consequences beyond the predictability of power production. Some resources are relatively benign: the loads imposed on a hydro plant in the routinely inspected and maintained confines of a turbine hall are constant and predictable. In comparison, the loads the wind imposes on wind turbines, of which there are many more situated in locations that present access challenges, are much more severe. In comparison to other resources, the wind is constantly trying to break our machines. The urgency with which we must increase the sophistication of our assessments of the loads imposed by the wind on wind turbines is only rendered more intense by the creeping inadequacy of the models and methods we currently use which, while useful hitherto, are gross oversimplifications in relation to the conditions prevailing across the rotors of the larger machines now being developed and installed. The kind of detailed, precise, and accurate representation of flow across an entire site illustrated by fig. 3 contains critical information that is indispensable for the assessment of site suitability.

Whereas fig. 3 illustrates a plan view of wind flow, a vertical cross-section can also provide useful insights. Figure 4 shows a wind shear anomaly known as a low level jet surveyed using this technique. The color scale shows the wind speed. High wind speeds are observed at one height while lower wind speeds are seen above and below it. The variation of wind speed with height can impose serious loads on a wind turbine. In this instance the low level jet was observed in a location in mid-plains U.S., where its diurnal evolution during the summer months results in a short period of 10 minute to half an hour during which turbine killing loads are imposed across the rotor. The low level jet rises and becomes more intense during the course of the morning and imposes its most extreme wind shear loads on the rotor and drive train as it passes the top tip of the rotor. The comprehensive investigation of this phenomenon has only been made possible by the advent of second-generation LiDAR.

COMPLEX TERRAIN ISSUES

The silver bullet that dispenses with the issues that plague first-generation devices in complex terrain is the implementation of a convergent scan geometry. Rather than use beam orientations that diverge from a single device to define a volume within which flow inhomogeneity can be manifested, we can use multiple second-generation devices to direct our beam orientations to converge at a point. This is illustrated in fig. 5, where data are presented comparing measurements made using three LiDARS implementing a convergent scan geometry with a reference mast. At heights where more than one reference instrument is installed on the mast it is seen that the LiDAR measurement lies between the reference measurements; that is, the LiDAR agrees with the reference instruments better than the reference instruments agree with each other.

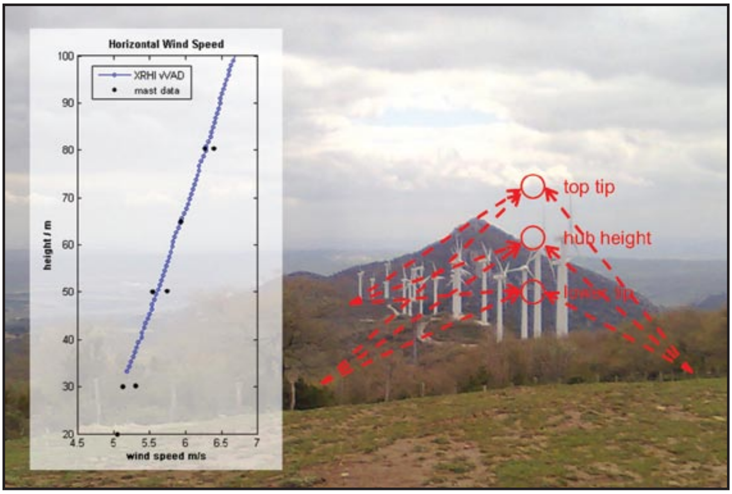


Fig. 5: Convergent scan geometry and results.

LOOKING FORWARD

The need to deliver the greatest reduction in project uncertainty for a given investment in data acquisition will continue to entail the operation of different kinds of instrument used in the manner that most effectively exploits their respective complementary strengths. The main cost of a mast is incurred during installation, and so these are most useful for acquiring a year or more of data. In addition they are well understood and so are good reference instruments to which other devices can be compared on site to verify their performance. SoDARs are relatively inexpensive and have low power consumption, and so they have an important role to play in any measurement campaign.

In many instances when the cost-benefit of using a LiDAR in a virtual mast role to acquire a single pixel of data is analyzed, it is found that better value can be achieved using a real mast. Achieving optimal cost-benefit of LiDAR requires that it is used to do things that are difficult or impossible to achieve otherwise. In general the possibility of acquiring the complete picture as opposed to an individual pixel indicates we must ultimately dispense with the mast analogy to unlock the value of LiDAR. Only then can we realize the ambition to eliminate project uncertainty that arises due to our incomplete understanding of flow across the site, leaving only uncertainty due to the intrinsic variability of wind over time.

AUTOMATED TURBINE INSPECTION

AutoCopter unmanned inspection devices are a new way to inspect wind turbines, increasing the number of daily inspections while eliminating the risk of personal injury.

By Donald Effren

Donald Effren is president of the AutoCopter Corporation. Call (704) 835-0314 or go online to www.autocopter.net.

THE ABILITY TO INSPECT A WIND TURBINE without the risk of personal injury is only one of the benefits of the new AutoCopter™ industrial strength, unmanned radio controlled helicopter. We have already demonstrated the benefits of this tool with cell tower and transmission wire inspections, so wind turbines were a natural area of our focus.

To provide a little background, we began with roof inspections of hail damage, and we then moved to aerial photos and videos of farms. We next worked with cell tower companies, and then with the utility companies. The AutoCopter provides the aerial platform for any type of viewing and recording, for determining present conditions, and/or for documentation of completed repairs and inspections, etc. With over 200,000 turbines in the world—and almost 50,000 in the United States, with the numbers growing—we felt the market was a good one for us to enter. In preparing for this article we found that there is a shortage of climbers, resulting in inspection schedules that are difficult to keep. We believe that our solution will be warmly received. We also found that the industry needs proper training, the need for safer methods to conduct the inspections, and the reduction of danger of the overall inspection process.

In terms of their dimensions, AutoCopters are 62” long, 20” tall, and they will fly to the necessary height required for wind turbine inspections. The ability to survey the area from above provides an “eye in the sky” perspective on current conditions or damages. Stabilized software, and AutoPilot software models are available. Features include full auto take-off, waypoint (GPS) tracking, and auto landing. The ability to know the exact location of the camera at any given moment allows for complete documentation while the inspection is in progress.

Our original vision was to be the alternative to the manned helicopter. We have the ability to provide close-up aerial visibility, and to record it without the risk of injury to personnel. The fact that our UAV helicopter costs less than two dollars per hour to fly, will fly all day on a five-gallon can of gasoline, and produce the same visual results as a manned helicopter has been one major reason for our success.

FLEXIBILE FLIGHT

Within five minutes of unloading the AutoCopter it can be at the top of the wind turbine, carefully examining the structure and the blades from any angle. As it flies it is filming in HD video. The ground control station receives live video and is able to see what the helicopter sees as it flies. While this is being done all personnel are safely on the ground, incurring no risk whatsoever.

We know that the wind turbine inspection process also requires an internal check of the mechanical and electric heart of the turbine. The AutoCopter can climb to the top in less than 10 seconds, provide aerial shots from above, and methodically view and record from top to bottom. The overall process time is reduced and the results of the inspection are improved because they are recorded in one or two formats: HD video, and infrared/thermal. In addition, the process of observing and recording each turbine blade does not require repositioning the blades after the system has been stopped and turned off. They can be filmed wherever they cease rotation, which helps to reduce downtime. The foundation area directly around the turbine will also be captured on film for immediate analysis.

MAXIMIZING MANPOWER

We see this “power tool” as an addition to the arsenal of tools and skilled operatives in the wind building and maintenance company’s toolbox. Training takes less than three days, inspection capabilities will be enhanced, your risk of personal injury will be dramatically reduced, and you will be able to allocate staffing ways not possible before.

From a simple staffing viewpoint, the operator of the AutoCopter does not need to be a climber or a technician. He or she can be a less costly remote-control helicopter pilot trained for the tasks required. The areas of concern are the flight, recording, video downloads, and creation of the DVD. A recorded history of each wind turbine inspection will be available on the site for future inspections, in the office, and at the client’s location. This would help to expand the limited supply of climbers, thus enhancing the abilities of the inspection team/company. There is also the ability to view and record the condition of bolts, cables, ladders, paint, oil spills, and safety equipment in minutes. Once the exteriors have been viewed, filmed, and analyzed, the AutoCopter crew—both man and machine—can move on to the next location.

We realize it would be illogical to think that the climber could be removed from the equation. We also know our “power tool” would help to expand existing resources, dramatically shortening part of the inspection process and allowing for a different focus for the climbers. Additionally, the cost is reduced and the quality of the inspections has actually been improved because the helicopter uses better optics to view and record what it sees. The additional benefit is that the AutoCopter does not get cold or tired, or need strength and agility to observe the surface. What now takes half a day manually will take only 15 minutes with the AutoCopter, at most. The need for cranes on location might be reduced, and tighter scheduling can be incorporated if the inspections are reduced from weeks to days.

SAFE STRATEGY

Perhaps the most important feature of utilizing the AutoCopter is the ability to keep people on the ground for the entire exterior inspection process. While the helicopter is flying and recording, the images are being sent to the "ground control station" for observation. Skilled technicians can monitor the flight and ask the pilot to go back or to zoom in as it flies. Because the GPS location and altitude are visible on the ground control station as it flies, you can pinpoint the areas needing attention, repair, or just another look.

When and if repairs are needed, the team knows the exact location on the turbine. Because it is GPS enabled, it also points to the repair's exact location on the turbine. The inspection team has looked at it up close while still on the ground and knows exactly what tools and materials are needed before they climb the tower. The ability to reduce the number of climbs would have a beneficial effect on personnel and safety.

The need for inspection often conflicts with tightening budgets and the resistance to taking the unit out of service. When taking pictures from the ground you're looking up, which can't provide the same view as if you were at eye level. How would you get pictures from above as part of the routine inspection before the AutoCopter? Slight leaks might be visible in the air but not from a ground camera, because of the angle or location.

Fig. 1: The AutoCopter™ industrial strength, unmanned radio controlled helicopter (UAV).

Fig. 2: Uptower climbs can be minimized with AutoCopter "advance scouting" missions.

Fig. 3: The blades don't have to be repositioned for inspection using the AutoCopter.

Fig. 4: Once the AutoCopter has made its inspection, the technician knows exactly what tools and supplies will be required.

INCREASED EFFICIENCY

For the turbine to maintain the maximum output, the blades need to be inspected and maintained regularly. If blade maintenance is a critical factor and would benefit from more frequent inspection schedules, there is now the possibility to send someone to inspect, armed with this new power tool and record conditions.

With the growing number of wind turbines operating out of warranty this poses additional worry, because they must be serviced more frequently. It would not be too costly to send man and machine for a quick check after lightning or hail storms, for example. And since time equals money, the following scenario detailing the inspection of 45 turbines might be useful to consider:

PLAN A

- Inspection and shutdown on August 1 forward;
- Inspect the wind turbines, typically two per day;
- Projected total time for inspections is 22-plus days (min.);
- As external damages are discovered, they would be repaired;
- If internal repairs would be needed, they would be repaired;
- Timeframe of total group inspection varies as requirements dictate.

PLAN B

- Planned inspection and shutdown on August 1 forward;
- Inspect all units first with the AutoCopter'
- By August 3, all exterior inspections are complete;
- In less than two days (plan for 10-12 minutes per turbine inspection) all turbines are inspected;
- The results have been recorded, documented, and archived on DVD;
- Images of damages found can be forwarded to the home office for repair provisions, if not available in the field;
- While the internal inspections still remain, all exterior inspections are completed and any repairs needed can be started;
- The knowledge of the condition of the exteriors of the towers and blades before the end of the second day will enhance planning and staffing.

So, in less than three days 45 turbines have been inspected. If the results are that six of the 45 have exterior damage and are in need of repair, and four have items to watch but do not represent an immediate need, the time spent in the field is reduced. Therefore, if you take Plan B into consideration you would inspect four per hour, with the inspection of 28 per day (seven hours of inspection), resulting in 140 per week. Assuming bad weather and other variables, one man travels to sites for 120 working days per year. With a total of 3,360 wind turbines inspected, if you assume a cost of $400 per day—$200 pay plus $200 expenses—the cost for all 120 days is $48,000, and the cost per turbine inspection is under $15.00. We believe this is a number that deserves some attention.

Fig. 5: While the helicopter is in flight, the images are sent to the "ground control station," seen here.

INFRARED RECORDING

Our work using an HD video and the infrared/thermal camera with a fire department in Europe expanded our capabilities to add this inspection tool to the aerial platform. The structure flaws result in temperature variations and are shown on film. A complete infrared/thermal recording can be done while the HD video is recording. This does not extend the time of flight because both cameras are recording at the same time. Maintenance and repair schedules can be amended after such a thorough inspection, helping to prioritize maintenance and reduce repairs.

LAST CALL

When a turbine is constructed the need to evaluate the condition before it is turned over might be helped by the aerial inspection of the AutoCopter. A physical and infrared/thermal evaluation while the contractor is watching the ground control station might help confirm questions, issues, and mutual agreements.

When a turbine warranty is about to expire, the "last call" for issues both visible and hidden is important for the cash flow future of the turbine. The ability to predict and prevent costs is important. How much better is it to be able to illustrate on film the issues requiring attention and/or repair? Because the film is recorded to DVD there is a written, embedded date and time stamp that meets the best evidence rule as a legal document, all the way up to the Supreme Court. If you had an Infrared benchmark record and you provided an end of warranty record, how do you think your complaint might be received? It also eliminates the process of handwritten notes and visual inspections with geo-referenced, recorded video that captures critical information meeting annual inspection requirements.

Based in Charlotte, North Carolina, the AutoCopter Corp. help solve problems on four continents in various applications: cell tower inspection, real estate, agriculture, industrial inspections, firefighting, search and rescue, observation and surveillance. The company's products are easy to use, designed for use in the field, and ready to use when shipped. Just uncrate, add gasoline, and you're on top of the wind turbine in seconds.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ADINDEX

John Boorman
director of sales/Availon, Inc.

COULD YOU GIVE US A BRIEF HISTORY OF YOUR COMPANY?

Certainly. Availon was originally known as the SSB Companies, and it was launched in 1972 in Germany. It began as a specialty electrical shop, and one day in the early nineties they were approached by a company that was manufacturing what eventually became the GE 1.5MW wind turbine, which is now the workhorse of the U.S. wind fleet. They first asked SSB to provide the pitch motor for the system, and they liked it so much they eventually asked them to build the entire pitch system, including the controls. So we've been involved in wind throughout Europe ever since. We entered the North American market in 2009, and we've grown according to a three-phase plan. First we just provided parts for pitch systems, and then we moved into full-tower parts. We then entered into what we refer to as our "high-tech services" phase, conducting end of warranty inspections, engineered solutions, and product upgrades. In the third phase we became a full-service O&M provider, handling scheduled and emergency maintenance, uptower gearbox repair, blade inspections, and 24/7 remote condition monitoring. Shane Sterling is our director of O&M business development, and he's been traveling the country in recent months making our existing clients aware of this new capability and introducing ourselves to potential customers, or partners as we like to think of them. We specialize in MW-class turbines, and we work with OEMs including GE, Vestas, Siemens, Suzlon, Gamesa, Nordex, and many others. Actually, we're the only GL-certified independent service provider for both Vestas and the GE 1.5MW turbines. So we provide full-tower parts, high-tech engineering, end of warranty inspections, and complete O&M services.

END OF WARRANTY INSPECTIONS ARE SO IMPORTANT, ESPECIALLY AT THIS POINT IN TIME THROUGHOUT NORTH AMERICA. WHY DO YOU REFER TO IT AS "HIGH-TECH," THOUGH?

That's because our engineers are involved in these inspections, actually going uptower and performing the work themselves. I'm a mechanical engineer myself, so I know how engineers relish a challenge, so when ours detect a problem we encourage them to follow the links all the way to the solution. This has obvious benefits, of course, because an engineer is equipped to detect problems others might not see, so we can alert the owner in case the same problem is occurring in other turbines, or even OEMs so they can check their design specs. Quite often, if you find a problem in one turbine, you'll start to see the same thing in others of the same make and age, so you can really save a lot of money and frustration by addressing it as soon as possible. Another thing our engineers do is upgrade turbines that are experiencing systemic problems, or that have dated technology or components. They will actually design parts that correct these problems, which is an incredible asset to our customers. And we have an exchange program with our German counterparts where we send our technicians and engineers to work with them for six to eight weeks, and they send their engineers to visit with us for that long as well. One reason that's so important is because the European wind industry is about 10 years ahead of us here in North America, so we want to take advantage of their expertise as a knowledge resource.

I WOULD THINK ALL OF THIS WOULD GIVE YOUR CUSTOMERS A GREAT DEAL OF CONFIDENCE IN YOUR ABILITIES. YOU'RE CLEARLY TAKING IT VERY SERIOUSLY.

We definitely are, and we wanted to enter the renewables market in the right spirit, as well. Our North American operations are based in Rochester, New York, and we have a satellite location in Sweetwater, Texas. In Europe we have sites in Germany, Italy, and Spain. We our best to source the products that we can from local sources in order to lower our carbon footprint. At the same time we're always looking to expand our product line and service offerings. We were just named a distributor for Schunk Graphite Technology in North America, so it's all about becoming a "one-stop shop" for our customers. My job is to get out there, learn about the challenges they face, and then come back with a solution that will help them to achieve their goals. And one of those goals is to maximize the return on the investment our partners have made. If the average service life of a wind turbine is 20 years, and we can extend that by five years, then a certain portion of that uptime will be clear profit. So between Shane's expertise in finance and business development, mine in mechanical engineering and sales, and the expertise of our wind technicians and enginers – along with our excellent products, of course – we're an excellent resource for our partners in the wind industry.

To learn more: Call (515) 986-9101 or visit www.availon.com.