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A Model for Offshore
Innovation

**MAXIMIZING WIND
ENERGY YIELD**

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Seco Tools, Inc.



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BY RUSS WILLCUTT

Rooted in academia, and powered by the entrepreneurial spirit of its founders, this company has developed CMM technologies that are the industry standard.



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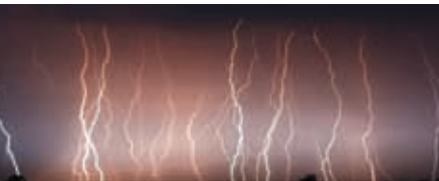
Cable design and performance is as important as other wind farm components, providing power transmission and distribution. Dow Wire & Cable makes the connection.



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We strive to create and deliver educational events that capture the energy of the rapidly expanding wind market and offer necessary opportunities for organizations to learn and network with fellow wind professionals.

The revenue generated from AWEA events is used to advance the wind industry through policy analysis and promotion, to ensure wind industry interests are addressed in renewable energy legislation, to communicate the benefits of wind energy to all. **ONLY AWEA puts your dollars to work advancing the wind energy industry. Join us at our upcoming events!**

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AWEA Wind Power Project Siting Workshop

March 1 – 2, 2011 ▶ Kansas City, MO

AWEA Wind Power Supply Chain Workshop

March 24, 2011 ▶ Little Rock, AR

AWEA Wind Power Finance & Investment Workshop

April 7 – 8, 2011 ▶ New York, NY

For More Information: www.awea.org/events



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EDLETTER

As the wind industry comes into its own throughout North America, it's always a good idea to remember that much can be learned from the existing models found overseas. Not only is the wind market more mature there, knowledge and experience has been amassed in areas such as offshore site development, which is only in its beginning stages in the United States. One example is found in "A Model for Offshore Innovation," a fine article contributed by Tom Lamb, who is head of renewable energy at Scottish Development International. In the article he describes how Scotland is planning to meet its goal of deriving 80 percent of its electricity from renewable sources by the year 2020. As a leader in the development of deepwater offshore wind farms, there are many lessons to be learned from Scotland that can be applied in the North American wind market.

The rest of our lineup is equally strong, continuing with "The Critical Nature of Cable Design" by Ram Ramachandran of Dow Wire & Cable, who points to the importance of choosing reliable cable for designing and manufacturing wind systems. As a perfect companion piece, Rick Thompson of American Electric Technologies, Inc. (AETI), explains why electrical systems testing during wind farm construction are critical to the project's success in "Best Practices for Electrical Startups." Greg Efthimiou of Duke Energy shares production efficiency tips in "Maximizing Wind Energy Yield," Mike McMullen of PowerGuard Insurance Services discusses the importance of understanding and managing wind turbine warranty exposure in "Twisting in the Warranty Winds," and Roland Kewitsch of Schenck Balancing & Diagnostic Systems seeks to help you avoid unnecessary downtime in "Increasing Uptime with Remote Monitoring." Finally, Nikki Hembury of Vaisala encourages you to obtain and rely on business-critical weather data in "Lightning Detection for Turbine Protection."

Columnist Jose R. Zayas of Sandia National Laboratories writes about offshore developments in his technology column, and Mike Smith, P.E., of Hayward Baker describes how augered piles are used on construction projects. Discussing maintenance issues, Merritt Brown of Rev1 Renewables shares tips on avoiding vandalism in remote locations, and Hüseyin Kizilagac of BDP Project Logistics explains why attention should be paid to the availability of transportation and logistics equipment in the coming years, especially in North America. FARO Technologies, known worldwide as a premier provider of CMM and other technologies, is our profile, and Bob Billger—strategic accounts manager at Seco Tools—outlines the company's commitment to designing wind-specific tooling.

As we conclude our second year of production I would like to thank all of you who have contributed to the magazine from an editorial standpoint, and also to encourage those of you with story ideas to contact me to discuss what we can do together. I look forward to hearing from you in the coming year!



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VECTORA TRANSPORTATION AWARDED MAJOR WIND FARM LOGISTICS PROJECTS

Vectora Transportation, LLC, has been selected by Invenergy Wind LLC to provide multi-modal turbine transportation, handling, and related services for various wind farm projects in the United States. Deliveries will involve 134 complete turbines including nacelles, towers, blades, hubs, and ancillary parts, which Vectora will transport from nearly a dozen different origins in eastern Canada. The shipments will be among the largest wind logistics projects in 2010 due to the distance of travel and number of components involved.

“We are pleased to be working with one of the largest and most respected developers in North America,” says Vectora Transportation President Christopher Ball. “For a complex project such as this, our multi-modal approach allowed us to reduce their overall project transportation cost and also provide the reliability of inventory staging close to the wind farms.”

Utilizing a multi-modal approach optimized for cost and service efficiency Vectora will ship components via water, rail, and truck, utilizing the Great Lakes for marine transport, key railroad partners, and selected specialized trucking partners.



Companies wishing to submit materials for inclusion in this section should contact Russ Willcutt at russ@windssystemsmag.com. Releases accompanied by color images will be given first consideration.

Shipments originate at Vectora's distribution center at the Port of Cacouna, Quebec, as well as various rail transloading points.

In order to support Invenergy's demanding construction schedules, as well as other customer projects, Vectora has established a new multi-modal distribution center at the Port of Indiana-Burns Harbor. The distribution center at Burns Harbor will support both inbound and outbound rail, marine, and truck shipments, and provide forward-positioning of inventory for Midwest wind farm construction activity. The deepwater port at Burns Harbor accommodates both barge and deep-sea vessels and provides access to all Class I railroads. Learn more by visiting www.vectoratransportation.com.

DUKE ENERGY COMPLETES FOURTH WYOMING WIND FARM

Duke Energy's Top of the World Windpower Project near Casper, Wyoming, is now online and producing clean, renewable electricity. The 200MW wind farm, located in Converse County, supplies wind energy to PacifiCorp under the terms of a 20-year power purchase agreement. The 110 wind turbines that comprise the project are capable of producing enough electricity to power approximately 60,000 homes.

With Top of the World now producing electricity, Duke Energy has 935 MW of wind power in commercial operation. This figure will rise to nearly 1,000 MW when the 51-MW Kit Carson Windpower Project in eastern Colorado comes online. In total, Duke Energy has committed more than \$1 billion since 2007 to build its wind power business. "The remarkable growth

of our commercial wind energy unit over the last three years illustrates our commitment to building a significant emissions-free power generation business," says Keith Trent, group executive and president of Duke Energy's Commercial Businesses. "Developing renewables projects under our low-risk business model will continue to be an important part of our company's future."

Top of the World is Duke Energy's fourth and largest wind farm in Wyoming. The company's 99-MW Campbell Hill Windpower Project in Converse County came online in 2009. Duke Energy also owns and operates two wind farms near Cheyenne: the 29-MW Happy Jack Windpower Project, which began commercial operation in 2008, and the 42-MW Silver Sage Windpower Project, which came on line in 2009. One of the turbine blades atop Tower 90 at Top of the World was inspected by President Barack Obama during his visit to

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the Siemens manufacturing facility in Fort Madison, Iowa, on April 27, 2010. Siemens supplied 44 wind turbines for Top of the World; General Electric supplied 66 turbines.

Duke Energy Generation Services (DEGS), part of Duke Energy's Commercial Businesses, is a leader in developing innovative renewable energy solutions, including wind, solar, and biopower projects. DEGS builds, owns, and operates electric generation for large energy consumers, municipalities, utilities, and industrial facilities. DEGS is also working to build commercial transmission capacity to help the U.S. meet its energy needs of the future. Learn more at www.duke-energy.com.

GAMESA AND NORTHPROP GRUMMAN JOIN FORCES IN OFFSHORE WIND

Gamesa and the Newport News Shipbuilding operations of Northrop Grumman Corporation have signed an agreement to work together on offshore wind technology. The agreement calls for the companies to cooperate on the launch of Gamesa's first G11X-5.0 MW offshore prototype in the United States, using Gamesa's multi-megawatt technology and Northrop Grumman Shipbuilding's broad experience in challenging marine environments.

Gamesa is currently designing and developing a G11X-5.0 MW offshore Wind Turbine (WTG) specifically for the marine environment and built upon the technologies already extensively tested and validated in the G10X-4.5 MW platform. Gamesa is teaming with Northrop Grumman Shipbuilding-Newport News to utilize their proven expertise in heavy load logistics, systems performance and reliability, and the applications of such technologies in the marine environment.

To install in the G11X-5.0 MW offshore prototype Gamesa and Northrop Grumman Shipbuilding are setting up an initial team of as many as 40 engineers in the Hampton Roads area of Virginia. This highly skilled team will perform all of the preliminary work required to install the prototype by Q4-2012, including site selection, permitting, final construction and installation of the prototype, and testing.

"Gamesa has said before that it intends to play a significant role in the offshore market to ensure that it can tap the demand generated in the Northern European market, specifically the United Kingdom, starting in 2015, as well in the United States," according to Dirk Matthys, CEO of Gamesa in the U.S. "Our alliance with Northrop Grumman Shipbuilding will give us the opportunity to test our technology on a short-term horizon, as well as to enhance and strengthen it, thanks to the skills and experience offered by a global leader in naval structures. This partnership

further demonstrates Gamesa's continuing commitment to and expansion in the North American market with both land and sea-based wind turbine technology."

This announcement comes as federal and state governments intensify their focus on developing offshore wind energy. Offshore wind projects totaling more than 5,000 megawatts have been proposed and are in the planning or development stages in the United States. The turbine and foundation systems created by Gamesa and Northrop Grumman Shipbuilding address the market's main concerns, namely efficiency of civil engineering infrastructures—the number-one investment expense in offshore wind—turbine reliability, low maintenance and servicing requirements, and minimizing the cost of generating electricity.

New generations of offshore turbine systems offering higher installed capacity will be required in order to meet the expected rising demand in the offshore wind energy market in the medium and long term. To this end Gamesa is already working on the rollout of another family of offshore turbines with a capacity of 6-7 MW, with a pre-series potentially available in 2014. More information is available by going to www.gamesacorp.com or www.northropgrumman.com.

NORDEX BEGINS PRODUCTION AT NEW ARKANSAS PLANT

Nordex has begun production at its newly built wind turbine manufacturing plant in Jonesboro, Arkansas. The plant's first production crew recently began assembling a wind turbine nacelle, which houses the engine and other key components and sits high atop the turbine tower. "Two years ago we announced our intention to make Nordex wind turbines in the U.S., for the U.S.," says Ralf Sigrist, president and CEO of Nordex USA, Inc. "Today we're putting our hands to the metal and doing it. We hope Congress will do the same by finally passing meaningful renewable energy legislation."

The first Jonesboro production crew completed a 10-week intensive training program at Nordex's flagship plant in Rostock, Germany. Training will continue during the early phase of production, with the team's German counterparts taking up residence in Jonesboro for several months to work alongside their new colleagues.

"There's no way to do this without international exchange," according to Joe Brenner, vice president of production. "Wind energy has tremendous potential in the U.S., but it's about more than just creating green jobs. We have to transfer expertise in order



to build a wind industry workforce. Nordex is investing in such a workforce and bringing the needed skills to America.”

Nordex broke ground on its manufacturing plant last September, pictured above, completing construction in July of this year. The company has hired 150 employees in the U.S. to date, including 42 in Jonesboro, and has plans to employ up to 1,000 nationally over four to five years. About 80 percent of the workforce in Jonesboro are locals. Construction on a second facility for assembling rotor blades is also planned for the future.

As a technological leader among suppliers of megawatt turbines, Nordex benefits particularly from the global trend towards large-scale wind turbines. The product range includes one of the largest series wind power systems in the world (N80/N90/N100, 2,500 kW) with more 1,300 of these turbines having been produced to date. This means that Nordex has a crucial edge in terms of experience in operating large turbines compared to most of its competitors in the sector. Overall, Nordex has installed a more than 4,200 turbines with a capacity in excess of 6,000 MW around the world. For more information visit www.nordex-online.com.

KORINDO WIND EARNS ISO 14001:2004 CERTIFICATION

Korindo Wind, an ISO 9001:2008 certified wind tower and monopile manufacturer, has earned ISO 14001:2004 certification for its environmental management systems. The certification is the result of an audit completed in September 2010 by Geneva-based SGS, a world leader in inspection, verification, testing and certification for companies in a range of industries. Korindo Wind is one of the few wind tower manufacturers in the world to earn the ISO 14001 certification.

“This International Organization for Standardization certification further validates Korindo Wind’s dedication to the values of stewardship and responsibility,” according to Ricky Seung, president of Los Angeles-based Kousa International, exclusive agent for Korindo Wind. “It’s important that companies engaged in renewable industries demonstrate this kind of commitment to sustainability and the health of the planet. Korindo Wind customers now have even greater assurances that, as we continue to manufacture one of the primary components for wind energy, we are continuously seeking innovative ways to limit the environmental impacts of our operations.”



ISO 14001:2004 provides a framework for a holistic, strategic approach to an organization's environmental policy, plans and actions. While the standard does not lay down specific levels of environmental performance, organizations must demonstrate a commitment to compliance with applicable environmental legislation and regulations, along with a commitment to continual improvement in their environmental management systems.

Korindo Wind, a division of The Korindo Group, has a technologically advanced plant in Ciwandan, Indonesia, that features a highly efficient linear production line with an annual capacity of 800 towers. The company also provides Precision LogisticsSM, a comprehensive, risk-free logistics solution based on Delivered Duty Paid (DDP) shipping. For more information go to www.korindowind.com.

SHAFT GROUNDING RING FROM ELECTRO STATIC TECHNOLOGY

By safely channeling harmful shaft currents away from bearings to ground, Electro Static Technology's

new AEGIS™ WTG wind turbine grounding ring prevents bearing damage that could otherwise cause generator failure, unplanned downtime, costly repairs, and lost revenues. Maintenance-free, effective at any RPM, and available for any size wind turbine generator, the ring is designed for OEM installation or easy up-tower retrofit.

High-frequency currents induced on the shafts of wind turbine generators can reach levels of 60 amps and 1200 volts or greater. If not diverted these currents will discharge through the generator's bearings, causing severe electrical damage that results in bearing failure and catastrophic turbine failure, sometimes in as little as six months or less. The AEGIS WTG's patented conductive microfiber technology effectively steers these currents away from the bearings and safely to ground.

The WTG is engineered to safely divert up to 120 amps of continuous shaft current at frequencies as high as 13.5 MHz and discharge up to 3000 volts (peak). Ideal for use as part of a preventive maintenance program to protect against premature bearing failures, it can be installed whenever bearings are replaced. For more information contact Adam Willwerth, sales and marketing manager, at (866) 738-1857 or sales@est-aegis.com. Go online to www.est-aegis.com.

NEW HIGH-TORQUE BRAKE FROM REXNORD/STEARNS

The Stearns® Division of Rexnord Industries, LLC, has launched a new high torque brake designed to easily fit into the drive system of any type of heavy industry equipment. The Series 7EC Electric Caliper brake is spring-set/electrically-released and is used for dynamic stopping, E-stop, and/or holding-only applications. The floating caliper design compliments a variety of tough industry

equipment including material handling systems, commercial elevators, industrial lifts, wind turbines, hillside trams, and lock-gate hoists for hydro-electric dams.

“Stearns is the number one supplier of spring-set electrically-released motor brakes in North America,” says Gary Zwick, Stearns product manager. “The new electric caliper brake will continue to bring our customers a top of the line product with efficient technology that outlasts the competition, meaning lower maintenance costs and increased productivity.”

Part of that efficiency is the brake’s ability to easily adapt to drive systems. The disc can be mounted in several locations including directly to a drive shaft (i.e. the disc can incorporate a hub with a QD bushing), bolted to a coupling hub, or directly to large motors since manufacturers can fit the disc to an extended shaft on accessory end of motor. High capacities in torque (500-5,000 lb.-ft.) and speed (up to 10,000 surface feet per minute) are also part of the product’s easy to use design. A high thermal capacity provides additional user versatility through the ability to incorporate gradual stops for high inertia loads.

The brake’s electrical operation eliminates the need for hydraulic or pneumatic components or systems, bringing users a simple, clean and low-maintenance installation. An optional environmental/corrosion protection package that meets IEEE 45 requirements for marine/maritime applications is also available. For more information go online to www.stearns.rexnord.com.

LUFFT ADDS MODBUS TO ITS COMMUNICATION STANDARDS

Lufft USA has announced the addition of MODBUS to its list of communication standards, making it one of the most flexible wind and weather assessment products on the market today. Lufft USA announced that its complete “WS” line of weather stations are now available with MODBUS data protocol in addition to SDI12, ASCII, UMB, NMEA, and analog.

MODBUS allows for communication between many devices connected to the same network, for example a system that measures temperature and humidity and communicates the results directly to a computer or programmable logic controller or PLC. MODBUS is often used to connect a supervisory computer, sensor, or group of sensors with a remote terminal unit (RTU) in supervisory control and data acquisition (SCADA) systems. Sensors that

communicate via MODBUS are commonly used in renewable energy, building automation, and other industrial processes. Lufft USA believes that the addition of this common method of industrial communication to its list of digital protocols will allow its weather stations to measure climate parameters with nearly any industrial project. For more information call Ann Pattison at (805) 963-7547 or go to www.lufftusa.com.

VESTAS TOWERS AMERICA CELEBRATES GRAND OPENING OF NEW FACILITY

Vestas Towers America, Inc., announces the grand opening of the world’s largest wind tower manufacturing plant. The new Pueblo, Colorado, facility features nearly 13 million square feet of space and eight miles of on-site railway tracks for the transport of materials and finished tower components. The opening of Vestas Towers gives Vestas, a global leader in wind turbine production, a substantial capability to address growing needs among North American wind power plants for reliable, high performance wind turbines.

U.S. Secretary of the Interior Ken Salazar joined a host of regional and local Colorado dignitaries, as well as president of Vestas Towers A/S Knud Bjarne Hansen and president of Vestas Americas Martha Wyrsh, in making

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the announcement during a ribbon cutting ceremony. Participants at the grand opening ceremony recognized a factory that currently employs more than 400 workers and is capable, at peak production, of producing 1,090 towers per year.

Vestas Towers America, Inc., has the ability to process more than 200,000 tons of steel per year, which is enough to build two bridges the size of the Golden Gate every year, or the equivalent of 28 Eiffel Towers. Locating the factory along major highway and railroad lines provides Vestas with the ability to meet customers' needs with locally managed logistical efficiencies, which translates directly to cost and environmental benefits.

"We are extremely pleased to simultaneously provide job opportunities for the local community and outstanding product for our customers made right here in Colorado," Hansen said. "We have deliberately located our factories in a central region in the U.S.—including our towers, nacelles, and blades plants—because regional centralization allows Vestas to build and ship locally in any direction needed in North America, and that translated to a direct competitive advantage for all of our stakeholders." Go to www.vestas.com.

3TIER RANKS AMONG FASTEST GROWING COMPANIES

3TIER®, a global leader in renewable energy information services, announces its recognition by both Deloitte and the *Puget Sound Business Journal* in two separate lists that rank companies based on fiscal year revenue growth. This is the third consecutive year that the company has earned this distinction from the *Puget Sound Business Journal*, receiving a rank of 49th among the top "100 Fastest-Growing Private Companies" in Washington State. This is the first time 3TIER has been ranked on the Deloitte Technology Fast 500™.

"3TIER and the other 2010 Technology Fast 500 winners forged ahead in a challenging economic environment to realize exceptional growth," says Phil Asmundson, vice chairman and Deloitte's U.S. technology, media, and telecommunications leader. "Deloitte commends 3TIER for this impressive accomplishment."

Both rankings are based on fiscal year revenue growth. The *Puget Sound Business Journal* ranks Washington companies over the last three years. The Deloitte Technology Fast 500 is an annual ranking of the fastest growing technology, media, telecommunications, life sciences, and clean technology companies in North America. This year's award winners were selected based on percentage of fiscal year revenue growth from 2005 to 2009.

During the period from 2005-2009, 3TIER grew 366 percent.

Kenneth Westrick, 3TIER's founder and CEO (see Q&A in February 2010 issue of *Wind Systems*), credits successful international expansion and continued product innovation as the drivers behind the growth. "Our international offices have built a strong reputation for 3TIER outside the U.S., and they have developed many key relationships which have really established us in the marketplace," he says. "This translates to increased sales revenue and market share. Our product development and delivery teams have also pushed forward aggressively to provide new offerings to serve the ever-changing renewable energy industry."

For more than 10 years 3TIER has helped clients make better decisions about their renewable energy investments. 3TIER uses its expertise about weather and climate to determine how both impact wind, solar, and hydro energy resources at specific locations around the world. 3TIER's suite of products work together to help clients pinpoint the best locations for renewable energy development, assess the long-term resource availability at a site to reduce risk, and forecast actual energy production over multiple time periods to promote efficient energy integration. Additionally, 3TIER's critical resource data often inform regional planning and policy as renewable energy accounts for an ever-greater percentage of the world's energy production portfolio.

"3TIER has proved itself to be one of the fastest growing tech companies in North America, and we are proud to honor them as one of the 2010 Technology Fast 500," says Mark Jensen, managing partner, venture capital services, Deloitte & Touche LLP. To learn more about 3TIER products and services visit www.3tier.com.

FARO AND CARL ZEISS FORM INNOVATIVE SOLUTIONS NETWORK

FARO Technologies, Inc., (see profile in this issue) and Carl Zeiss Industrial Metrology have launched the Innovative Solutions Network, a marketing, sales, and support collaboration in North America. Through the network these two leaders in metrology will provide a broader product solutions offering, including both traditional and portable CMMs. From the simplest to the most complex metrology measurements, the Innovative Solutions Network will offer customers access to more patented technologies, focused applications, and customer support programs and resources.

"The creation of the Innovative Solutions

Network will allow us to better serve our customers by providing them with a total metrology solution,” says David Morse, SVP and managing director of the Americas for FARO. “The technologies offered by both companies are among the most advanced equipment available today, and I am excited to see two world class companies like FARO and Carl Zeiss create such a comprehensive metrology solution.”

For years customers have benefited from the world-class support and training programs offered by both companies, along with the extensive knowledge and experience that comes with over 120 combined years of metrology development. Through the Innovative Solutions Network individuals interested in implementing a metrology solution will now have access to expert resources from both FARO and Carl Zeiss. “We are pleased to work with FARO in the launch of the Innovative Solutions Network,” says Greg Lee, president of Carl Zeiss Industrial Metrology. “Like us, their strength is in developing the key technologies needed to give customers the best solution. We believe it to be a great benefit to our existing customer base as well as for those who are considering a full metrology solution.” To learn more go to www.faro.com or www.zeiss.com/imt.

GL GARRAD HASSAN HELPS U.S. WIND ENERGY PROJECT NET BILLIONS

The Alta Wind Energy Center (AWEC) is located in the heart of one of the most proven wind resources in the United States—the Tehachapi-Mojave Wind Resource Area, in Kern County, California. To provide technical due diligence in support for the \$1.2 billion financing of four wind energy projects, Terra-Gen Power, LLC turns to local experts from GL Garrad Hassan. GL Garrad Hassan will also provide inspection and monitoring services throughout project construction, and technical support to underpin the leveraged lease, to be provided by Citibank, N.A. when commercial operations commence.

The independent technical due diligence review conducted by GL Garrad Hassan includes an assessment of the energy production at the site, a review of the site suitability, and a technical assessment of the plant, the equipment, and all of the material procurement, construction, and operation contracts. In addition, the experts analyzed project costs and carried out a full financial model review. GL Garrad Hassan’s final independent engineering and wind resource assessment reports served as a foundation to inform the 10 financial institutions involved in the project financing. Stuart

Murray, director of infrastructure and energy finance for Citigroup, says “We are very pleased with the quality of the technical due-diligence performed for us and the rest of the stakeholders on this project by the GL Garrad Hassan team. Their continued support will be instrumental in assuring construction quality and helping us to achieve a successful financial closing at commercial operation.”

The Alta Wind Energy Center is a 3,000 MW wind power development initiative. Construction commenced on the initial 150 MW Alta I project in March of this year and construction of the Alta II through V projects reviewed by GL Garrad Hassan (570 MW) started in July following financial closing. Commercial operation of the four phases is scheduled to occur in the first half of 2011. The term financing of Alta II-V is supported by a 144a bond issuance and structured as a leveraged lease whereby Citibank, N.A., will become the lessor to Terra-Gen at the start of commercial operations. Terra-Gen will manage and operate the wind projects under long-term agreements.

Phil Dutton, vice president of independent engineering at GL Garrad Hassan for the North American region, says “We are thrilled to be part of this groundbreaking project. Not only is its size significant both locally and nationally, it is also innovative in its use of the 144a bond issuance and leveraged lease type transaction, paving the way for similar financings for future renewable energy projects.”

GL Garrad Hassan is one of the world’s largest dedicated renewable energy consultancies and a recognized technical authority on the subject (see profile in September 2010 issue of *Wind Systems*). It offers independent technical and engineering services, products, and training courses to the onshore and offshore wind, wave, tidal, and solar sectors. Although the GL Garrad Hassan name is new, the company has a rich heritage. It is born of the integration of specialist companies that, united, form the renewable energy consulting division of the GL Group. GL Garrad Hassan is a consulting company; it has no equity stake in any device or project. This rule of operation is central to its philosophy, something which sets it apart from many of its competitors. For more information go to www.gl-garradhassan.com.

IBM COLLABORATES ON NEW WIND ENERGY TECHNOLOGIES

IBM announces that energy system supplier Alstom and Ikerlan-IK4, an energy technology research and development organization, are using IBM software to develop wind turbine

Continued on page 60 >

Used successfully on many types of structures, including high-rise buildings and nuclear power plants, augered piles are ideally suited for use in wind tower applications.

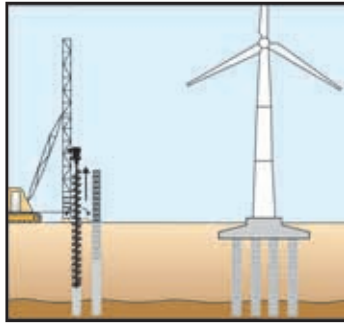
AUGER CAST PILES (augered or displacement)—also known as augered piles, augered cast in place (ACIP) piles, or continuous flight auger (CFA) piles—are a cost-effective deep foundation system that can be tailored to most soil, groundwater, and loading conditions.

The piles are normally installed using a crane with free-hanging leads, but can also be installed using low-headroom equipment for retrofitting existing structures. The augered piles are constructed by drilling to the required depth in one continuous process utilizing a hollow-stem, continuous-flight auger. Once the auger has reached the required depth, a high-strength sand/cement grout is pumped through the auger to the base of the auger in order to establish a pressure head of grout. After the pressure head of grout is established the auger is continuously withdrawn as the grout is pumped, ensuring the stability of the hole by maintaining the required pressure head of grout. Following the completion of the grouting and the withdrawal of the auger, the reinforcing steel is immediately placed into the fluid grout. The reinforcing steel consists of reinforcing bars or high-strength reinforcing bars (60 ksi, 75 ksi, or 150 ksi) installed either as single bars or tied in a cage that can be installed the full length of the pile, or in only the upper portion of the pile.

Augered piles are typically installed around the perimeter of tower foundations and are incorporated into a concrete pile cap. The piles are installed in diameters ranging from 12 inches to 36 inches and depths of up to 155 feet. Compressive capacities vary from 50 tons for smaller diameter piles to over 1,200 tons for the larger diameter piles with tension capacities typically 50-75 percent of the compression capacity. The larger diameter piles are generally used when it is necessary to resist high lateral load applications. Since augered piles develop a significant portion of their capacity through friction, they are able to develop a high-tension capacity as well as a high compression capacity,

which makes them ideal for tower applications.

Augered piles offer several advantages over driven piles. Since the piles are cast in place, there are no splices required, minimal noise and vibrations during installation, and they can be installed to the exact depth without protruding pile butts. Due to an increase in the interaction between the piles and the surrounding soils, the augered piles also offer the advantage of increased capacities over comparable driven piles. Depending on the subsurface conditions, the augered piles can be more cost-effective and quicker to install than drilled shafts of



similar capacity since augered piles are installed in a single continuous process versus the multiple passes required with the drilled shaft installation.

The design of the piles is performed by a qualified geotechnical engineer or design-build team and is verified by performing full-scale compression, tension, and/or lateral load testing. The pile installation is monitored by a full-time inspector who verifies that the

piles are installed to the design depth and that the proper grout volume for each pile is used. Samples of the grout are also tested to verify that it achieves the required unconfined compressive strength.

Recent advances in automated measuring equipment allow for the reliable monitoring of pile installation real-time. Sensors installed on the drill rig monitors depth, grout volumes, pump pressure, hydraulic pressure, and other important parameters. These sensors can be monitored by the operator and inspectors on site, and also remotely through connection to a designated FTP site. This monitoring equipment can help identify any issues during the pile installation process.

Augered piles have been used successfully on many types of structures including high-rise buildings, nuclear power plants, solar power plants, and refineries. Due to their ability to economically develop high compression and tension capacities they are ideally suited for use on wind tower applications. ✎

Mike Smith, PE, is a project manager with HJ Foundation, a subsidiary of Hayward Baker Inc, the leading specialty foundation and ground improvement contractor. Go online to www.hjfoundation.com and www.haywardbaker.com.



SITE IMPROVEMENT FOR NEW FOUNDATIONS AND FOUNDATION REHABILITATION

Photos, top to bottom:

Biglow Canyon Wind Farm, Oregon
Hayward Baker performed Dynamic Compaction for seismic and liquefaction mitigation for new wind turbine pad footings.

Wind Farm, Wyoming
Hayward Baker performed Dynamic Compaction for ground improvement and installed Driven Piles (*shown*) and Micropiles for construction of new foundations.

Trent Mesa, West Texas
Micropiles, installed in rock and designed for high cycle fatigue loading, stabilized 30 existing wind tower foundations.



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By their very nature, most large-scale wind farms are fairly remote, making theft and vandalism a very real concern. Here are some ways to deter the damage.

SECURITY OF A WIND PROJECT is a task that typically goes hand in hand with maintaining the assets and assuring high availability for the project owner. Unfortunately, some aspects of project performance can be cut short by the intentional efforts of others, specifically thieves and vandals. They can directly impact the success of a project during and after construction and will effectively diminish the potential profitability of a project, as repairs and replacements must be made.

THEFT AND VANDALISM

While vandalism is probably the biggest security concern for wind turbine owners, copper theft has become a strong second. Copper prices have started to return to their previous decade-high levels of 2008, and with this increased value offer a higher incentive for would-be thieves wishing to gain access and remove power cabling from remote and unattended wind turbines. As one of the most important industrial metals, even recyclable or recycled copper prices have increased, giving rise to new state and federal laws to combat copper theft from businesses across the country. The costs of theft and vandalism on a project are difficult to predict as they are often random events, but projects that fall victim to such losses can face significant downtime and expense. Nearly one third of the cost to make repairs after a copper cable theft is related to the replacement cost of the stolen cable itself.

Even if you have never experienced a theft or act of vandalism, no project is necessarily immune to this type of loss. Projects complacent in their security efforts are often the ones targeted by criminals, and sometimes these events can shut the project down. Federal laws already provide ample language to deter trespassing and attempted damage to energy facilities, including wind projects. In the interest of national security, the U.S. Patriot Act of 2001 amended Title 18, United States Code Section 1366, to include attempted destruction of an energy facility. Since that time it became a federal offense, including severe fines and imprisonment, to damage or attempt to damage the property of an energy facility in the U.S. The amount of damage

can be as little as \$5,000, or if an attempted offense could have caused a significant interruption or impairment of an energy facility. Laws such as these give state law enforcement additional support to local trespassing laws, such as California's Penal Code Section 602 (k) where even unenclosed or unfenced areas are covered if there is intent to destroy any property within the boundary. Most states also now have laws that establish distinctions for copper and metal thefts as either misdemeanors or felonies, and lay out minimum and maximum fines and penalties. As of August, 2010, legislation to reduce copper theft has been introduced in every state and passed into law in all but five.

Probably the best way to help control wind project theft and vandalism is to develop a thorough and sensible security plan before the start of construction, and to pass the procedures on to the post-construction O&M team. Use of proper lighting, alarm systems, fencing, and deployment of security patrol services are as important during construction as they are during commercial operations. The act of consistent and routine inventory of field spares should be made the responsibility of an assigned employee, ensuring that high-value materials are properly recorded when brought on site and also when they are used.

PROACTIVE PLANNING

In high-theft areas, patrols and other forms of proactive security may be necessary. Due to the remoteness of wind projects, passive systems can be employed in most instances. For an unattended project application of door "trip switches" or perimeter alarms can be tied into the systems' SCADA network, allowing remote centers to call local law enforcement or security teams. Since thieves will be less inclined to attempt a theft if they cannot readily enter and exit the site, mechanical security locking devices such as McGard bolts can help. Also, local law enforcement should be encouraged to patrol the area at night, and local residents can act as another form of security. With a proactive plan and diligent observation it is possible to keep a small nuisance from becoming a major problem. ↵

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.

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As the leader of the clean energy portfolio, the wind industry must continue to improve the available technologies and pave the way for markets such as offshore development.

THE CURRENT GROWTH of wind energy in the U.S. has been enabled by a significant number of viable land-based installations that today represents over 36 GW of installed capacity, translating to approximately 2 percent of our energy consumption. Although developers will continue to pursue economically feasible land-based sites to install projects, concerns or limitations in our transmission system, NIMBY, and limited land in most coastal states are all reasons why a strong interest has been spurred in exploiting our coastlines for offshore wind installations. There are many attractive reasons why offshore wind installations should be pursued on the Gulf coast, the Atlantic or Pacific coast, and/or the Great Lakes. The U.S. has an excellent offshore wind resource, and approximately 78 percent of our total energy consumption is consumed by the 28 states with a coastline. Currently there are no installed offshore projects in the U.S., but there are 13 projects being proposed, totaling to 2.4 GW.

Several European countries have already leveraged their coastlines for offshore projects; there are currently 39 installed offshore projects totaling over 2 GWs. Although the modern wind industry has many decades of experience the offshore wind industry is quite young, and several of the initial projects have experienced several technical premature reliability challenges since their installation. Fundamentally, offshore machines are quite similar to the land-based systems that we've become accustomed to, but both are driven by economic and environmental differences. Offshore machines must be equipped with systems and an operational architecture that provide accessibility and enable them to survive the challenges of the offshore environment.

From a resource perspective, it is well understood that wind over the water is often more consistent and less turbulent than on land. This typically translates to higher capacity factors and more-predictable electrical output. Coincidentally, the design of the machine from the foundation to the rotor must take these differences into account, as well as the impact of the hydrodynamic loading induced by the ocean, in order to design a machine that is efficient, reliable, and cost-effective. All current offshore installations in Europe today have been installed in fairly shallow waters (<30m), which has provided the opportunity to leverage well-known foundation designs (primarily monopole) from

other industries. Unfortunately, if the U.S. wants to capitalize on its vast offshore resource, research and development must be performed for deeper water depths where jacketed or floating structures will be needed.

There are many advantages as to why offshore projects should be pursued in the U.S. Outside of a key advantage of proximity to large load centers, offshore machines can be significantly larger than the typical land-based machines being installed today (1-2.5 MW) since the limitations in both infrastructure and transportation can be mitigated by having coastal manufacturing and barging the components to the installation sites. Typical offshore machines today range from 2-5 MW, but larger turbines are being designed and tested. There are several challenges associated with offshore wind, as well. In comparison to the land-based machines, the cost balance of an offshore project is not the same, as the turbine represents a much smaller percentage of the total cost (~25 percent). Cost associated with the support structure, the electrical infrastructure, and operations and maintenance (O&M) are significantly higher for offshore projects; hence why current offshore projects come in at a higher cost. To outweigh these challenges, future designs must be smarter and able to operate and report upcoming failures and service requirements prior to a catastrophic system failure. As an example, new machines could incorporate a sensor network that increases the fidelity in operation and condition health monitoring. Given that the turbine cost does not dominate the total cost of the installation as the land-based system does, innovation in this area is critical and a cost-effective way to enable reliable offshore turbines.

As we foresee a future for the wind industry where there will be offshore and land-based machines available and installed globally, it is important to acknowledge that technology innovation will continue to play a key role in making wind systems more reliable and cost-effective. As the leader of the clean energy portfolio, the wind industry must continue to find ways to improve the technology and pave the road for other upcoming technologies. It is hard to predict what the future energy picture will look like, but there is a high probability that if this industry continues to innovate, grow, and lead, it will have a key role in our energy future. ↘

Jose R. Zayas is the senior manager of Wind & Water Power Technologies at Sandia National Laboratories. Go online to www.sandia.gov/wind.

Meeting potential wind power goals in the U.S. will not only require increased turbine production, but also transportation and logistics equipment... and the expertise to match.

INDUSTRY DATA SHOWS THAT THE DEMAND for wind-generated power in the United States is growing, driven by a Department of Energy goal to increase domestic electricity production from wind power by 20 percent over the next 20 years.

After China, the U.S. is the second-fastest growing wind market, and despite the recession it continued to expand in 2009. According to the American Wind Energy Association (AWEA), although Germany is the world leader in terms of installed wind power with over 22,000 MW, it has only a fraction of the wind energy potential of North Dakota. AWEA reports that the top states for wind energy potential—as measured by annual energy potential in the billions of kWhs and factoring in environmental and land use exclusions for wind class of 3 and higher—are: North Dakota (1,210); Texas (1,190); Kansas (1,070); South Dakota (1,030); and Montana (1,020). Nebraska, Wyoming, Oklahoma, Minnesota, and Iowa round out the top 10.

As the U.S. wind power market prepares for increased production, it is also the time for developers to adjust to evolving market requirements. Meeting even a fraction of the potential wind power goals will not only require increased turbine volume production, but also a deep pool of transportation and logistics equipment, and the expertise to match.

In particular, there are a number of hurdles to consider as you coordinate delivery of those components to wind farm installations in the United States. Regardless of whether rail or barges are used, at some point trucks are going to become a key factor.

While equipment shortages for 2010 have not occurred at the levels predicted earlier this year, it is just a postponement of the inevitable. The recession dampened project investment and increased postponements. Now wind farm projects are coming back. Thanks to demand, trucking companies are looking at large increases in project opportunities; perhaps as much as double or triple pre-recession volume. But the numbers of trucks and experienced drivers required are not available. Many trucking companies, especially smaller firms, were unable to weather the recession—over 4,000 went out of business, in fact—and larger companies needed fewer drivers. A number of those drivers looked for alternative employment, resulting in a smaller pool, which is now creating a shortage. Plus, compliance with the new Comprehensive Safety Analysis 2010 will undoubtedly force a number of trucks and even

more drivers off the roads. Less capacity usually means higher freight rates.

One of the major challenges for the intermodal transportation of larger wind equipment components is the wind itself. Components are bigger, heavier, and therefore more challenging for the truck industry. Wind pressure on heavy loads requires experienced drivers who are specially trained to transport wind power components. As the average age of truck drivers increases, younger recruits must be found to fill the gap. Will they have sufficient experience?

Equipment supply is also outstripping demand. Trucking companies that survived the recession and want to buy trailers to meet the increasing demand often cannot because many trucks and trailers that were used in transporting wind equipment are not available since they are still tied up in bankruptcy proceedings. Access to equipment that fits your specific needs is important. The right trailers, especially for blades, must be available. Some companies have designed self-load and self-unload trailers that help cut costs associated with crane rentals.

Then there is the whole logistics process required for road transportation. “Uncomplicating” a complicated process of moving oversize heavy wind components is another challenge. Two of the primary issues that came out of a recent survey by AWEA’s Transportation & Logistics Working Group for road transportation of wind components were planning and permits.

There is no substitute for detailed advance planning as early in the transportation development process as possible. This is especially important when you consider the range of issues to manage: route and access surveys; coordination with other transportation modes; ancillary equipment; traffic conditions; height and weight limits; permits; and constant communications with local government staff, not to mention weather. Planning also means working around physical obstacles such as access roads to be constructed and bridges to be built, etc. Each state often has its own regulations that govern weight, maximum load, and superload permits. It is important to know the details of every state’s requirements at the outset of your transportation plans. Last but by no means least, as with any successful project picking the right partner resources is not only critical but probably the most important decision of all. ↴

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PROFILE

FARO TECHNOLOGIES, INC.

By Russ Willcutt



Rooted in academia, and powered by the entrepreneurial spirit of its founders, this company has developed CMM technologies that are the industry standard.

WHEN SIMON RAAB AND GREG FRASER met some 30 years ago while working toward their doctorates in biomedical engineering at McGill University, they bonded immediately, referring to themselves as “techno-junkies.” Deciding to pool their collective energy, they launched Res-Tech in 1981, which was changed to FARO Technologies two years later when they began developing technology and software to support advanced surgical and diagnostic methods.

“In the early years they spent nearly as much time attending trade shows, visiting hospitals, and meeting with potential customers as they did working on new designs,” according to Gary Telling, the company’s director of product management and business development. “But that close relationship with the end users became a cornerstone of the company’s philosophy, leading to products and technologies that actually make sense in the real world, not just on paper or in concept.”

FARO introduced its first articulated-arm measurement device in 1984, also securing patents for several pieces of equipment used in neurosurgery in the following years. By the early nineties the two colleagues had realized that their measurement arm had applications beyond the surgical theater, and that it would be ideal for introducing a coordinate measurement machine (CMM) into the manufacturing environment.

“While there were measurement machines available at that time, they weren’t portable and were housed in labs that were separate from where the manufacturing was actually taking place,” according to Pete Edmonds, vice president of sales. “What was needed was a three-dimensional CMM that could be introduced into the production line to provide in-process measurements, rather than waiting to do so once the part was finished. The hardware had to be flexible and durable, and the software intuitive and simple to use.”

With many of the company’s medical patents having been sold to Medtronic, entering the industrial arena became FARO’s primary activity for the next few years, leading to expansion into the European market in 1996 and an IPO the following year. A particular milestone was reached with the acquisition of CATS, a software design company, in 1998. “From a strategic standpoint this allowed FARO to

concentrate on equipment while CATS focused on software development,” Telling says. “This resulted in a package that allowed manufacturers to make measurements in real time and compare them to the original CAD drawings, detecting problems earlier in the process, which led to significant savings in terms of fewer scrapped parts.”

The years since have seen the advent of a suite of products in addition to the FaroArm including the FARO Gage portable CMM—as well as the GagePlus and PowerGage—the Laser ScanArm and Scanner, the Laser Tracker ION, and the 3D Imager. The company also offers its well-known CAM2 measurement and reporting software, for CMM-to-CAD comparisons. Apart from measuring virtually any type of component or part, Edmonds says his wind customers have found additional uses.

“I have one who’s a blade manufacturer, and he actually uses the Laser Scanner to measure the interior of these 80-meter blades in order to fabricate the foam core that goes inside, and it’s also perfect for measuring long sections like towers and the big parts that are used in wind turbines,” he says. “And the 3D Imager can be used to digitize blade surface profiles. So whether it comes to inspecting the molds for hub covers or checking individual parts during manufacture, we’re well-positioned to provide our customers with the exact type of measuring technology they require in support of their total quality management program.”

These days FARO is involved in a wide variety of industries—aerospace, automotive, heavy equipment, machine tools, metal fabrication, mining, medical systems, architecture, and civil engineering, just to name a few—with offices throughout the United States, Europe, and Asia. That its technologies have become industry standards are made evident by the caliber of its customers, which include Boeing, Airbus, General Motors, Johnson Controls, Caterpillar, and Honda. Fueling this growth is the same sense of curiosity and innovation that brought the company into being in the first place.

“I can definitely say that the entrepreneurial spirit that Greg and Simon brought to this enterprise continue to guide our efforts to this day,” Telling says. “Innovation is part of our DNA, in fact.”

THE CRITICAL NATURE OF CABLE DESIGN

Cable design and performance is as important as other wind farm components, providing power transmission and distribution. Dow Wire & Cable makes the connection.

By Ram Ramachandran



Ram Ramachandran is global director for end-use marketing at Dow Wire & Cable. Go online to www.dow.com/wire.

WITH WIND ENERGY in North America continuing to grow at an astounding rate, and knowing that legislated requirements are already in force for some states—and right around the corner for others—it is more important than ever to build wind energy power systems that will last. This requires several essential elements, not the least of which is reliable onshore (underground) and offshore (submarine) power cable, along with dependable cable performance standards.

From wind developers, to independent power providers (IPPs), to utilities, system reliability is critical and component performance is king. Wind towers and turbines get much of the attention because they are what

everyone sees. Granted, tower height, placement, and turbine design are all important to efficiently capture the wind. However, equally as important is what you don't see; the cables that get power from the base of the tower to the transformer, then to the grid and on to the consumer. Cable design and performance is as important as other wind farm components, and it is absolutely imperative in the ability to provide power transmission and distribution that wind farm owners, utilities, and consumers can count on throughout the life of the entire system.

NOT ALL MATERIALS ARE CREATED EQUAL
Wind power is intermittent, therefore system



reliability is crucial. Unplanned cable repairs could be costly in terms of both downtime and maintenance expense. With that in mind, an essential part of that long-term reliability scenario is direct-buried and submarine cable made with quality raw materials and tested to perform according to industry specifications. Let's start with materials.

There are a number of materials that can be used to construct power cable components: cross-linked polyethylene (XLPE), ethylene propylene rubber (EPR), and polyvinyl chloride (PVC), just to name a few. Cable manufacturers are looking for materials that best meet their needs for ease of processing while producing the performance attributes ex-

pected by the end user. In addition, cables are subject to many mechanical and environmental stresses during their lifespan. Flexibility, stress-crack resistance, and shield strippability are all factors to be considered for ease in cable installation. Corrosion kills cables and interrupts power supply. Therefore extreme heat, cold, and water intrusion resistance are paramount. So it becomes more important than ever for cable manufacturers, utilities, wind developers, and others in the value chain to become informed about how various materials perform in power cable applications.

XLPE emerged in the 1970s as the preferred insulation type for medium-voltage (MV) underground (UG) power cables due to its quality, cost competitiveness, and reduced long-term operating costs. However, those early cables were beset with construction and performance issues, limiting the lifespan of some of those cables. This led to the development of "water tree-retardant" XLPE, or TR-XLPE insulation, for underground power distribution cables that have now become the standard bearer. Dow Wire & Cable introduced its DOW ENDURANCE™ MV 4202 TR-XLPE in 1983. Studies show that 27 years later, buried cable made with this material exhibits little to no wear and has an expected lifespan of over 40 years.

As an example, shown in fig. 3, cables made with DOW ENDURANCE TR-XLPE exhibit excellent field operation over time. In addition, TR-XLPE cables have very low dielectric losses compared to EPR cables. In fact, recently updated Rural Utilities Service (U.S. Department of Agriculture) specifications for primary UG power cable (bulletin 1728F-U1) state "plain XLPE has been removed as acceptable insulation and TR-XLPE insulation has replaced it due to the significantly improved reliability." This longevity and reliability is as important for wind energy power systems as it is for traditional power infrastructure. Wind farms are designed to last for many years and the collection cables must not only last, but must be reliable for the lifespan of the wind farm.

A recent conversation with a Dow customer—cable manufacturer, Southwire—corroborates this. They have provided 35KV power cables for wind farm installations from the Northeast to California, Minnesota to Texas, and many states in between. Common features for typical wind farm cable from Southwire include:

- Aluminum conductors that range in size from 1/0 AWG to 1250 MCM and are "moisture-blocked;"
- TR-XLPE insulation;
- Customized neutral configurations;
- LLDPE jackets that provide good abrasion resistance in UG applications.

“In a nutshell, wind farms have high-cost assets that at times put intense operational burden on the installed cable system,” says Ron Burchfield, director of renewable energy, Southwire Energy Division. “You need to install cables that have been proven to stand up to that challenge. We are convinced that quality manufacturing practices along with quality raw materials are necessary to produce reliable, long-lasting power cable.”

TESTING, VALIDATION, AND PERFORMANCE STANDARDS

Many raw materials suppliers and cable makers serve the wind energy market. Not all of these players are created equal either. Research and development at the very front end of the supply chain is very important. When it comes to raw materials, cable makers, developers, IPPs and utilities alike should ask about

the kind of technology, clean manufacturing, and packaging techniques, testing, and validation that goes into raw material production. Similarly, end users should insist on specifying cable that has gone through rigorous testing and meets at least the current minimum performance standards set by utilities. Trusting investment dollars to anything less can be risky business.

There are many testing institutes and other organizations that work with companies like Dow Wire & Cable and Southwire to ensure that raw materials as well as the cables produced with those materials, meet recognized national standards. These testing institutes and organizations include National Electric Energy Testing Research and Applications Center (NEETRAC), standards development agencies such as the Association of Edison Illuminating Companies (AEIC), and Insulated Cable Engineers Association (ICEA). In addition, cable makers like Southwire are producing cables that consistently exceed stringent long-term testing standards such as AWTT and ACLT. These long-term testing methodologies demonstrate a proven track record for ensuring long life and reliable cable performance.

No exclusive standards currently exist for cable performance in the wind energy market. So, again, it is important for end users to insist on cables that meet, or preferably exceed, the current power in-

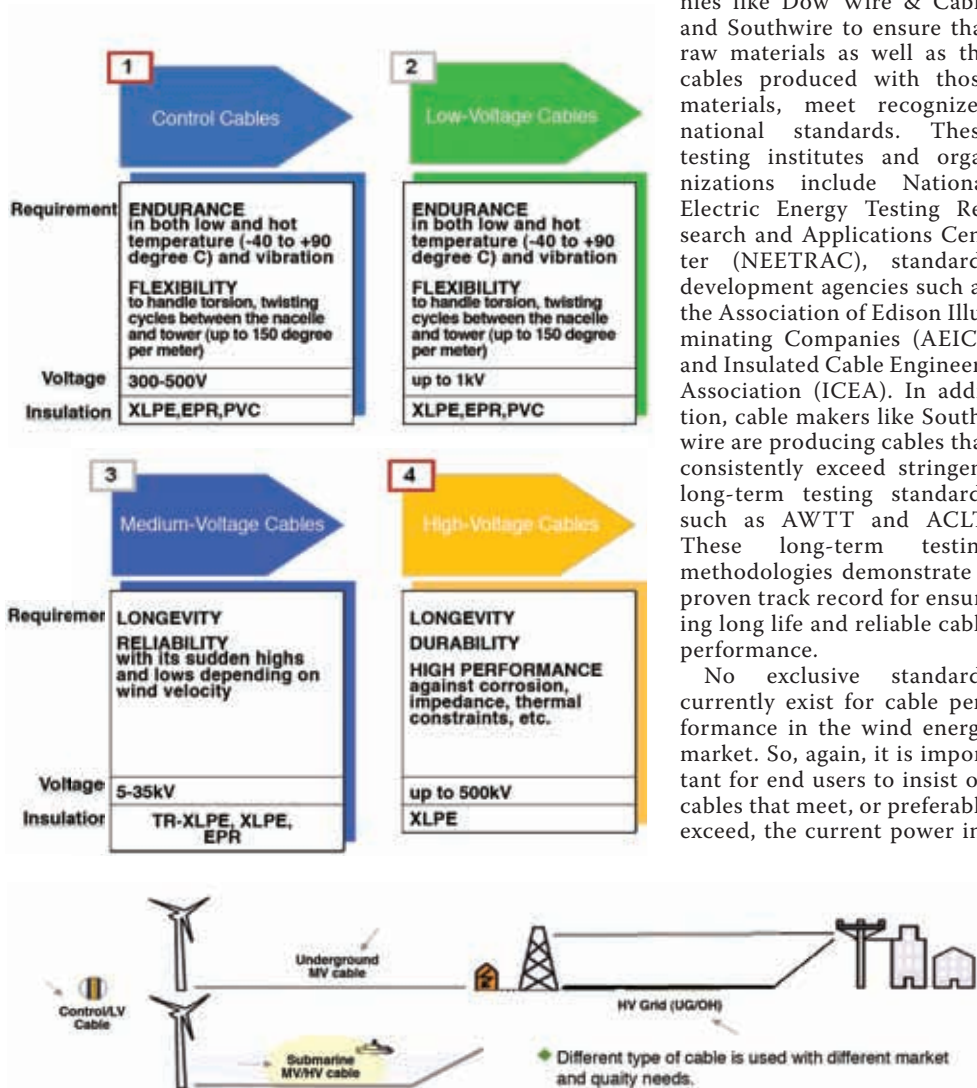


Fig. 1: Cables used at a wind farm.



Fig. 2: Dow Wire & Cable's technology centers are continually evaluating, anticipating, and responding to environmental demands and industry trends. As new ideas become reality they are put through rigorous in-house testing including computer modelling, physical testing, and burn and smoke tests, as well as electrical and analytical testing.

dustry minimum standards. Think of it this way: cables form a very small percentage of the total power system cost, and polymeric materials represent an even smaller percentage. Therefore, it is imperative that the renewable energy industry take a broad view to focus on the needed system reliability that rests, to a large extent, on excellent

materials, quality cable manufacturing processes and elevated performance standards.

COLLABORATION IS ESSENTIAL

As with anything worth pursuing, it takes a community of like-minded people to achieve success. The concept of wind power is not new. However, to go from the power needed to turn a millstone to the power needed to light up and connect communities in an efficient and cost-effective manner is quite another story. Collaboration is absolutely essential. Groups like AWEA and GWEC are certainly helping as they provide a gathering place and information portals for all stakeholders. But we need

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collaboration in the trenches as well—between investors, developers, IPPs, utilities, equipment, cable, and material suppliers, for example—to realize the energy goals that are or soon will be legislated.

To illustrate the point, cable makers require raw materials that are consistent from batch to batch and demonstrate ease of processing, manufacturing efficiency, and the ability to deliver on the attributes needed for a reliable end product. Utilities require a long-life, reliable power supply at a reasonable cost to them and to the consumer. However, the cable purchasing decision is often made based on cost, without understanding the correlation between what the utility needs in terms of long-term reliability and what a quality cable manufacturer can deliver. All cables are not created equal. At the end of the day, to ensure long-term

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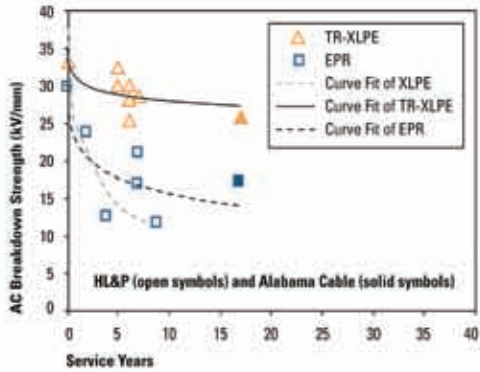


Fig. 3: TR-XLPE cables retain very high dielectric strength vs. other materials.

system reliability, cable purchase and installation decisions need to be based on more than just price.

To that end, companies like Dow Wire & Cable and their valued customers like Southwire are working together not only to validate and adopt superior products for cable construction, but to enhance market awareness about the value of building power systems with the right components, used in the best way to ensure the optimum result for the entire value chain. ↘

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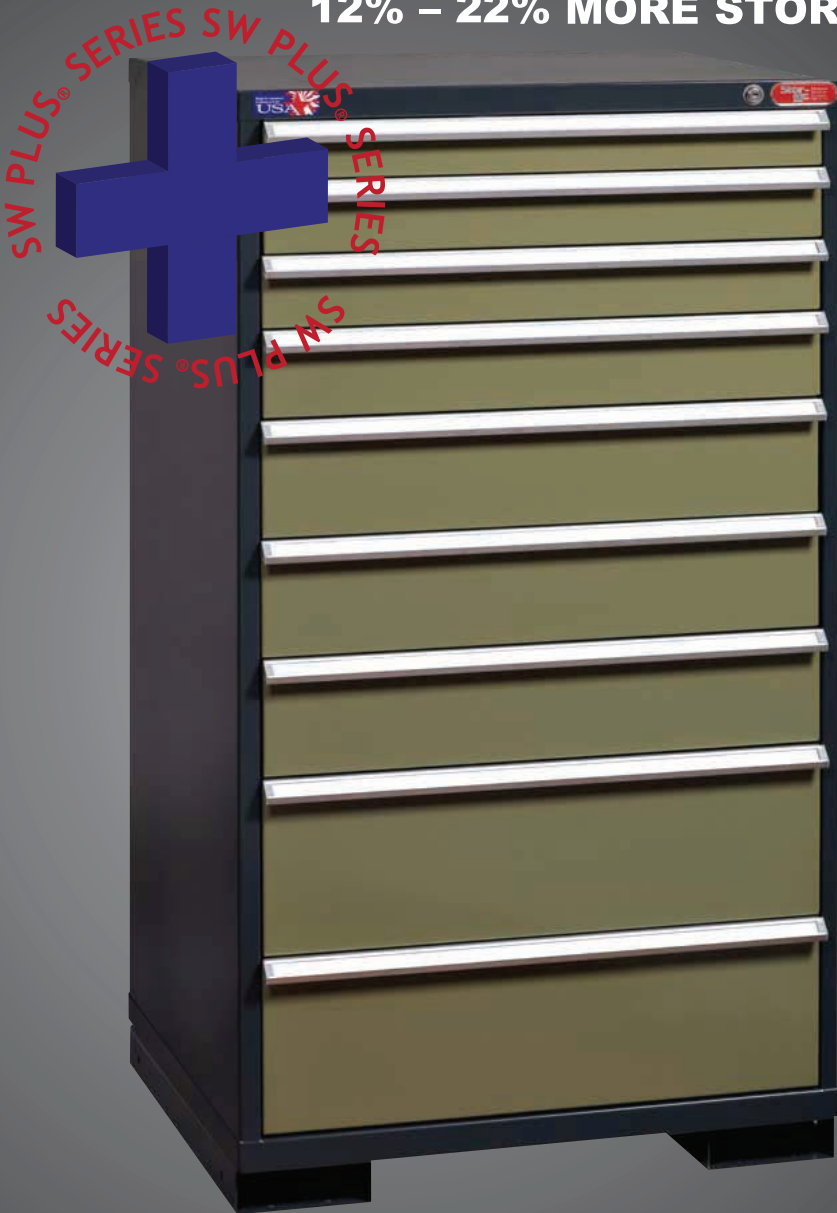
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BEST PRACTICES FOR ELECTRICAL STARTUPS

During wind farm construction, electrical systems testing and startup are critical to the project's success. AETI provides a helpful checklist to follow.

By Rick Thompson



Rick Thompson is vice president of power services for American Electric Technologies, Inc. Learn more at www.aeti.com

WIND FARM PROJECTS ARE A GROWING business segment for many electrical construction contractors. Although wind farms have been constructed for several years, owner/operators, engineering designers, and contractors continue to learn more effective and accurate methods for designing and implementing the farm's electrical systems—systems that offer high integrity, reliability, and efficiency.

FACTORS IN ELECTRICAL CONSTRUCTION

All construction projects are driven by a comprehensive schedule that includes procurement, engineering, site preparation, foundation installation, erection, buildings, equipment installation, electrical cable pulls,

termination, testing, and startup. But there are four primary factors that affect wind farm construction schedules. These include:

Engineering design issues discovered during construction: A close working relationship between project engineering designers and the construction contractor is necessary for effective problem resolution. Additionally, such relationships promote timely, accurate documentation and enables teams to work and get on and off site as quickly and safely as possible.

Site access limitations (fig. 2). Many wind farms are built on private sites, government reserves, or in locations isolated from large communities. Some are also built at high elevations. A well-established site entry plan,



Fig. 1: 180MW Tatanka Wind Farm in North Dakota, owned by Acciona.

The site is remote. As a result, local skilled labor is often used and supervised by the contractor. This can impede continuity and experience, however, hindering construction efficiency and production. It is a challenge to manage or predict, but is best minimized by maximizing the contractor's employee participation.

STRATEGIES FOR STARTUP SUCCESS

During wind farm construction, the one schedule segment that is relatively short in duration but perhaps the most important for the project's success is the electrical systems testing and startup. This begins with each wind turbine going through extensive Factory Acceptance Testing (FAT) by the manufacturer. After transport from the factory to the project location and field assembly, however, the turbine must also go through a thorough Site Acceptance Testing (SAT). The turbine SAT is often performed by the manufacturer's representative or by a testing group under their guidance (fig. 4).

The remaining electrical apparatus, components, cabling, switchgear, metering, protection, communications, and controls for the farm are thoroughly tested and reviewed by specialized, well-trained, and highly skilled technicians. Every aspect of the electrical system, from the turbine to the substation connecting the wind farm to the grid, must be tested for proper design and operation by skilled power technicians.

More qualified service companies have power technicians with experience in electrical power testing included in every aspect of a wind farm, from the turbine to the grid. A thorough understanding of wind farm electrical design, experience with power system components, and the ability to interface with contractors, designers, and utility systems are all important to successfully starting up and connecting a wind farm to the grid.

Nevertheless, every new project brings new challenges to the startup team. For example, new electrical equipment is found in a new turbine that has come onto the market; a farm's electrical system needs to be upgraded to meet OSHA and FPHA codes, or a power distribution and control schematic that has never been seen by the team is deployed to a new farm. Each of these can be quite challenging for even the most experienced technician.

Since protection, controls, metering, monitoring, and communication systems technology is constantly evolving, a technician's skills must also evolve to meet the new testing requirements for these devices. Many of the newer

right of way permit, and an understanding of the time and costs needed to deliver equipment and materials to these sites is important to the farm's rapid startup.

Covering large geographical areas. This requires construction and maintenance of many miles of roadways with conditions and accessibility that can quickly be adversely affected by traffic and weather. A well-designed road system with adequate design for load bearing and washout still requires constant maintenance and repair, and startup in the midst of very dry conditions requires frequent road watering to manage dust intrusion into systems. Both scenarios slow work progress and drive up costs (fig. 3).



Fig. 2: Site access gate for the Tatanka Wind Farm in North Dakota.

testing tools are computer based devices, so a qualified power technician must also have proficient computer skills to effectively use these tools. Technicians must also have a mathematical aptitude since substantial mathematics and a solid understanding of three-phase power systems is needed.

UNIFYING MULTIPLE ELECTRICAL COMPONENTS

There are many types of electrical equipment and components from the grid back to the turbines. All of this equipment must be thoroughly tested for insulation integrity and functionality, and the use of set points must often be applied to properly insulate, control, meter, and protect each unique system. These include:

- Power cables
- Distribution transformers
- Inverters/Converters
- Capacitors/Reactors
- Switchgear
- Extra high, high, medium, and low voltage breakers
- Metering
- Relaying
- SCADA

- Communications systems
- Power transformers
- Instrument transformers
- Battery systems

In the electrical construction and startup of a wind farm, the devices and conductors are installed and tested first. After the conductors are terminated, AC and DC control systems are temporarily energized so that the protection, control, metering, and instrument transformer systems can be verified and tested for proper design and operation. Power technicians often work with construction engineering to tweak the equipment design as issues are discovered during testing. If mistakes are made by a wireman during conductor termination, the power technician will discover them during checkout and work with the wireman to make corrections. This step must be thorough to help minimize safety risks and ensure system integrity (fig. 5).

Next, all systems are protected by complex relaying devices. These relays often require the installation of programmable logic files, each of which is a set logic based on rules written as a computer-controlling program. Through the use of computer-based testing devices and sophisticated testing software, an experienced



Fig. 3: Construction project installing a 900KW wind turbine converter.

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Fig. 4: Distribution setup transformer at base of a 1.5MW Acciona turbine.



power technician will verify the protection and metering systems and then assist construction engineering with any needed changes. This step must be carefully executed, as minor mistakes in setting the files can often appear as a wiring error or an equipment flaw later and could result in taking the commissioning process down the wrong path for hours, and sometimes days. Installing the correct files and validating that they were set up correctly is critical, as it can preserve valuable startup time.

ENERGIZING THE SYSTEM

After all devices and systems are tested and all problems found and corrected, technical teams work with the operations group to start up and energize the entire system. The startup energization procedure must be a sound plan that requires personnel safety and system protection. Energization most often starts at the point of connection to the grid, and then it is stepped back along the way toward open connections along the collection grid up to each turbine. The turbines are then started up and synchronized with the utility system. There are no shortcuts in this process. One has to establish zones of correctly working equipment and cabling backward from the point of grid connection to cost-effectively energize a site, otherwise commissioning untested zones with tested zones will result in lost time and money as teams backtrack to make corrections.

Each energization step requires the power technician

Fig. 5: AETI power service technician testing a 345KV GCB, Nevada Utility substation.

to perform a number of verification tests such as system voltage phasing, voltage rotation, voltage and current vector relationships measured at the protective relaying, and metering equipment. Some service companies believe one test is good enough, but if there is a problem there usually is not enough information to quickly identify and address it. In comparison, it may take more time to conduct multiple tests and document the results in at the outset, but it will to help shorten problem-resolution times in the future.

Finally, a project is not complete until all drawings have been redlined and modified to reflect all field changes, all testing documentation is completed and organized, and the customer has been presented with the upgrade to the farm's electrical system. Upgrades represent any change to a farm's design, regardless of how minor. This is extremely important, as many service companies do not invest the time to instruct owners about the new condition of the farm, which is necessary for further farm upgrades—again, avoiding future operations and maintenance issues.

ATTENTION TO DETAIL

American Electric Technologies, Inc. (AETI), has been providing electrical services for more

than 30 years and has service technicians with an average of more than 20 years of experience each. Leveraging its experience in industrial and marine traditional energy for wind farm electrical services, AETI has developed a unique framework for successfully addressing the issues of today's wind farm electrical system testing, commissioning, and startup energization.

Known as AIRDAP, this framework stands for "Attention to all details, Identification of any issue, Rapid resolution of issues as they appear, Documentation of any changes to the electrical system, Avoidance of leaving any problem behind, and Presentation of all information to the operator. As discussed, the successful startup of the wind farm's electrical systems requires significant attention to every detail to ensure safety while driving down time and cost.

As the startup progresses from the grid toward the turbines, every issue identified must be resolved before proceeding to further contain costs. And to avoid leaving issues on the farm that will hinder future progress, documentation and presentation of all findings to the operator is critical, ensuring wind farm integrity, reliability, and containment of operations costs in the long term. ↘



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LIGHTNING DETECTION FOR TURBINE PROTECTION

Whether you are planning a wind farm and assessing turbine risks or operating an existing one, make sure you have all business-critical weather data at your disposal. Vaisala explains.

By Nikki Hembury



Nikki Hembury is thunderstorm systems and data product manager at Vaisala. Visit online at www.vaisala.com.

AS TALL OBJECTS IN A FIELD, wind turbines make ideal targets for lightning strikes. Even more so as the application continues to grow as a serious source of new electricity generation: the total wind power capacity now operating in the United States is over 35,600 MW, which corresponds to the power usage of 9.7 million homes, according to the American Wind Energy Association (AWEA).

As in any trade, system downtime and repairs must be minimized. This is where information about critical weather parameters becomes an important part of decision making. Wind, temperature, icing, lightning—relevant weather data can prove to be a vital asset for wind farm operators and other power compa-

nies alike. Ignoring these parameters can be a costly exercise. For example, the U.S. National Lightning Safety Institute states that at one wind farm in the southwest lightning damage alone exceeded \$50,000 in the first year of operation, and at another 85 percent of the downtime experienced was lightning-related.

Wind turbines are designed with grounding systems to isolate the lightning current from sensitive electronic and mechanical components to ensure safety. Industry standards require wind turbines to withstand 98 percent of natural lightning strikes. Unfortunately, no lightning protection system is completely effective, so Vaisala lightning data is used by turbine manufacturers to validate that damage



Fig. 1: Any tall structures, such as power poles or wind towers, are natural targets for lightning.

was truly caused by lightning before replacing blades under the terms of the warranty. Vaisala's STRIKEnet® Internet service allows turbine manufacturers and wind farm owners to enter the geo-coordinates of the damaged turbine and search an extensive archive of cloud-to-ground lightning strikes for up to a 72 hour time window, generating an automated report of the lightning strikes in the vicinity. Depending on the terms of the agreement, turbine manufacturers or wind farm insurers will be responsible for repairing the damage. Additionally, Vaisala's high quality real time and archive lightning data from the National Lightning Detection Network (NLDN®) is used by the Vaisala FALLS® application for

extensive forensic analysis of faults and identifying lightning strokes which have caused outages or damage to transmission lines.

Lightning is also a challenge to traditional energy and power industries. High-current lightning strikes are a significant threat to the dependability of electric power transmission, because they can cause severe damage to power lines. Being able to detect and locate these events means savings in both time and money as the fault locations can be found more quickly, and electricity can be re-routed to a different path. Recent findings in Japan show an encouraging future trend in lightning detection for power companies and demonstrate the value of accurate and timely weather data in decision-making.

SIGNIFICANT R&D ACHIEVEMENTS

Lightning locating systems provide valuable information to a wide variety of applications. The demand for both data quality and the range of cloud-to-ground lightning parameters is highest for forensic applications within the electric utility industry. For years the research and operational communities within this industry in Japan have pointed out a limitation of these systems in the detection and location of damaging (high-current and large charge transfer) lightning flashes during the winter months. Most of these flashes appear to be upward-connecting discharges, frequently referred to as "ground-to-cloud" flashes [1].

Lightning events along the coast of the Sea of Japan during the winter months emit particularly different waveforms than the majority of other lightning events, which makes them hard to detect or classify properly. To address this

problem Vaisala has worked together with Tohoku Electric Power Company and Sankosha Corporation to develop improved lightning sensor software. Tohoku Electric supplies electricity to approximately 7.7 million customers throughout the seven prefectures of the Tohoku region. The company's electric power sales amount to over 81,101 kWh, ranking it fifth among the 10 Japanese electric power companies. Sankosha Corporation has been supplying Vaisala lightning detection systems to the electric power companies in Japan for more than 25 years. Sankosha engineers install and maintain about 100 lightning sensors operating in Japan. They work closely with Vaisala engineers and scientists to make sure that networks are operating properly and network operators take advantage of new technologies as they become available.

The result of the joint R&D effort is the latest software for the Vaisala Thunderstorm CG Enhanced Lightning Sensor LS7001, which delivers double the detection accuracy of high peak current winter lightning discharges compared to older sensors. The new sensor is able to continuously sample and process detected signals eliminating the dead time problems of previous sensor generations. Enhanced self-test and calibration capabilities permit the simulation of more complex waveforms and help achieve a significant improvement in stroke time measurements.

As a part of the cooperative research project, a six sensor network of the new sensors was deployed in the Tohoku region during the 2009/2010 winter lightning season. Data from Lightning Electromagnetic Pulse (LEMP) recording equipment operated by Tohoku Electric and information from lightning related failures in Tohoku's transmission line systems demonstrated significant improvements in lightning detection performance. This was achieved by studying electromagnetic waveforms generated by winter light-

ning and then developing new parameters for their detection. "Lightning detection information is extremely important in the operation and maintenance of our electric power transmission and distribution systems," according to Noriyasu Honma from Tohoku's Electricity Technology Section. "Improvement in our ability to detect high current winter lightning events is a critical step forward."

The project in Japan will con-

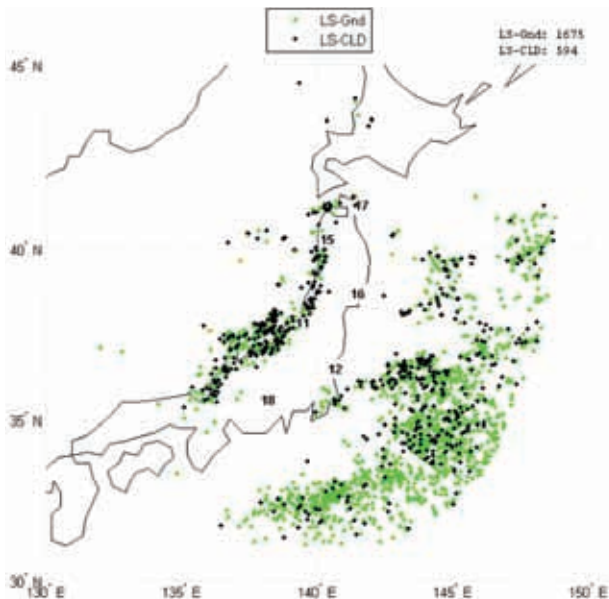


Fig. 2: Evaluation period: 1,675 strokes (green) and 594 cloud pulses (black) located by the six-sensor LS network in Tohoku region during the evaluation period.



Fig. 3: Vaisala lightning sensor located in Tohoku, Japan, showing mounting pad, mast, electronics enclosure, and antenna assembly.

tinue through the 2011 winter lightning season. The algorithm updates employed in the reprocessing will be implemented in sensor software, which will be downloadable into most existing Vaisala LS sensors, making improved detection performance available for energy and power industries around the world.

FEATURES AND BENEFITS

The LS7001 is a compact, lightweight sensor with optional indoor mounting capability that detects low frequency (LF) signals using magnetic direction finding combined with time-of-arrival technology to deliver higher detection efficiency, location accuracy, and redundancy than any other method for detecting cloud-to-ground lightning strokes. The LS7001 is a cost-effective solution for customers demanding high reliability, ease of installation, and ease of maintenance. Features and benefits include:

- Cloud-to-ground lightning detection for the most accurate lightning location and calibrated parameters;
- Cloud-to-ground lightning of greater than 95 percent network detection efficiency;
- Detects up to 30 percent of cloud lightning for early thunderstorm identification;
- Detects cloud-to-ground lightning at long ranges (>1500 kilometers);
- Calibrated parameters for cloud-to-ground lightning: time, location, amplitude, polarity;
- Third party validated 250 meter median location accuracy for cloud-to-ground lightning strokes;
- New efficient lightweight electronics module allows for ease of installation and maintenance;
- Sensor can be installed separately from antenna in remote severe weather locations;

- Compatible with predecessors Vaisala IMPACT and Vaisala LPATS sensors;
- Available in AC and DC versions.


PRECISE WEATHER KNOWLEDGE

Wind turbine manufacturers and wind farm operators require high quality environmental measurement systems to maximize performance, support safe operations, and fulfill industry standards. Intelligent environmental measurements can be used in control systems, for example, improving community acceptance of wind farms by dimming obstruction lights in clear weather and getting field service teams to safe ground before thunderstorms arrive. Turnkey atmospheric observation networks can provide that significant advantage to save millions of dollars, combining wind speed predictions with other business-critical environmental data. ↴


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TWISTING IN THE WARRANTY WINDS

Understanding and managing wind turbine warranty exposure is important pre-expiration preparation. PowerGuard Insurance Services provides pointers.

By Mike McMullen



Mike McMullen is managing principal at PowerGuard Insurance Services. Visit online at www.powerguardins.com.

AS THE WARRANTY EXPIRATION DATE on your fleet of wind turbines approaches, there are many questions to be asked and a range of risk management options you should consider. This process needs to take place well in advance of the warranty expiration date to insure that all alternatives, including new third party warranty products, have been identified and carefully evaluated. Only then can you make the best financial and risk transfer decisions regarding the future of your machines.

Possible strategies run the gamut from full limits five-year warranty extensions to completely assuming the risk on the operator's balance sheet with no warranty coverage in place. The following is an analysis of wind turbine

warranty exposures and the various strategies that can be employed to understand and manage these risks.

Typical warranty language reads as follows: The Seller warrants to the Buyer that during the Warranty Period: (i) the Equipment to be supplied hereunder shall (a) be designed and fit for the purpose of generating electric power when operated in accordance with the Seller's specific operating instructions and, in the absence thereof, in accordance with Prudent Wind Industry Practices (b) be new and free from defects in material, workmanship and title, (c) comply with the Technical Specification and (ii) all Services to be performed hereunder shall be performed in a competent,

resulted from a number of factors, including budget constraints and a lack of trained service technicians.

This statistic has larger ramifications to the wind farm operator than simply being behind a maintenance schedule. Almost all wind turbine supply agreements are very specific about both the maintenance schedule and who is to perform the work. In addition, the typical Turbine Supply Agreement (TSA) has very specific language regarding the exclusion of warranty claims if the maintenance performed and documentation of servicing of the turbines are not in accordance with the TSA.

Exclusionary language related to warranties in a typical TSA is as follows. The exposures and potential pitfalls related to service, maintenance and record keeping should be clear: The Seller does not warrant the Equipment or any repaired or replacement parts against normal wear and tear, including that due to environment or operation. The warranties and remedies set forth herein are further conditioned upon (i) the proper storage, installation, operation, and maintenance of the Equipment conformance with the operation instruction manuals (including revisions thereto) provided to Buyer by the Seller and/or its Subcontractors or Suppliers, as applicable and, (ii) the provision and maintenance throughout the Warranty Period of a T-1 line for remote monitoring as described in the Technical Specification, and (iii) repair or modification pursuant to the Seller's instructions or approval. The Buyer shall keep proper records of operation and maintenance during the Warranty Period. These records shall be kept in the form of log sheets and copies shall be submitted to the Seller upon its request.

As turbines approach the end of their warranty period, it is therefore critical to put into effect a well thought out end of warranty strategy.

INDEPENDENT TURBINE INSPECTIONS

The first step should be sourcing an independent inspection of each and every turbine that is coming off warranty. It is critical that this inspection be done before the warranty ends for several reasons.

First, the owners will want to document all possible claims and submit them, via a Reservation of Rights letter, to the original equipment manufacturer (OEM) far enough in advance so the operator can negotiate any repairs directly with the OEM. This negotiation process can be time consuming and the wind farm owner will want to allow enough lead time so any needed repairs are completed before or shortly after the end of the OEM warranty period.

The second reason the wind farm owner needs an independent inspection is for docu-

diligent manner in accordance with the requirements of this Contract and any other mutually agreed specifications (collectively, the "Warranty").

With the explosive growth of the wind turbine industry over the last five years there has been a year by year increase in the number of wind turbines coming out of their original OEM warranty. Compounding the issue of warranty expiration is the fact that more than 50 percent of the U.S. wind turbine fleet may be behind in scheduled maintenance. It has been estimated that ownership and maintenance costs can increase by as much as 250 percent over the 20-year life of the wind turbine. This lag in scheduled maintenance has



Fig. 1: Any tall structures, such as power poles or wind towers, are natural targets for lightning.

mentation purposes as to the condition of the wind turbine at the time of the warranty expiration. This documentation may be required for the wind farm's lenders and will certainly be required by the insurance companies participating in the coverage of the wind farm.

It is also important to note that once this report is completed it will document the areas of concern on each and every turbine. If for some reason these documented issues are not addressed at the end of the warranty by the OEM or repaired by the wind farm owner, any future insurance claims stemming from these issues will be denied as resulting from a "pre-existing condition."

EXTENDED WARRANTY COVERAGE

Should I purchase extended warranty coverage or not, and what are my options if so? This is the question that is now being contemplated by over 20 percent of our country's wind turbine owners as their assets become warranty liabilities.

The good news is there are now third-party extended warranty options available in the insurance market place. Historically, extended warranty options were limited and typically provided by the wind turbine manufacturer. These warranties were usually negotiated at the time of wind turbine purchase and the standard warranty "built into" the sales price of the turbine was two years

with a three year extension available for an additional per turbine, per year charge.

Over the last 20 years, the length of warranties has decreased dramatically. As manufacturers built substantial liabilities on their own balance sheets and established their operations and maintenance (O&M) divisions, warranty periods were reduced and the sale of warranty extensions became a substantial profit center.

WARRANTY OPTIONS

Balance sheet finance: As the turbine warranties expire, the wind farm operator may decide to assume responsibility for 100 percent of the costs and losses resulting from warranty related incidents. Keep in mind that the true cost of a warranty occurrence is the combination of costs associated with securing the effected turbine, obtaining and shipping the replacement part, hiring and transporting the repair equipment, providing the labor for repairs, and assuming the lost income and production tax credits, if applicable. Historically, this has been the only option available to wind farm operators since the OEM's did not offer extended warranties past the five-year period.

Rely on property insurance: Wind farm owners who choose to forgo extended warranty coverage believing their property insurance coverage will respond to a warranty claim are likely to be surprised when that claim is denied. While some property insurance policies provide a minimal amount of coverage as outlined below, a property policy will not provide the wind farm operator with complete warranty coverage. Unlike property policies that require losses to stem from a covered peril, a warranty policy does not require you to run your equipment until it breaks in order to have coverage.

Property forms do not provide warranty coverage and can be ambiguous with exclusions or limitations



Fig. 2: This fire was caused by a blown coupling.

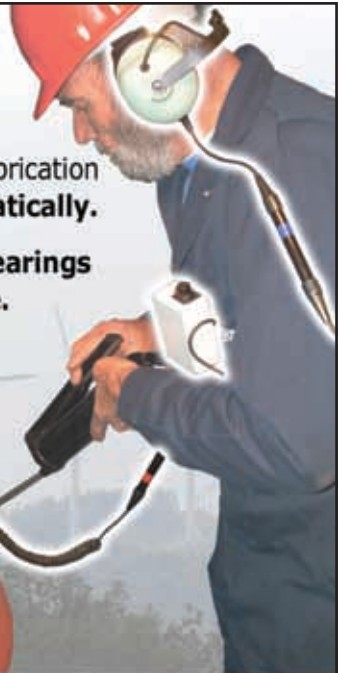
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Fig. 3: The aftermath of a turbine fire.

so losses are subject to underwriter's acceptance or are left for attorneys to litigate. There are too many gray areas that leave projects exposed and put lenders and investors at risk. Here are some of the major differences between property policy coverage and warranty policy coverage. Property forms provide coverage for the peril of mechanical and electrical breakdown if the failure is sudden and accidental and subject to exclusions and limitations. Coverage is excluded under a property policy for the following:

- Defects or faults in material, workmanship, or design: As an example, blades are cracking due to faulty materials or bolts are not fastened properly during construction and nacelle falls off tower.
- Wear and tear: Cable brackets are failing due to a repetitive movement over a long period of time and the cables are splitting and arcing.
- Gradual deterioration: Bearings are grinding over a long period of time, which causes your gearboxes to fail.
- Inherent vice: There are hidden defects in the equipment or materials that cause deterioration and/or damage.
- Latent defects: There are hidden defects in material and/or workmanship not discoverable through general inspection.
- Serial losses have limited coverage under a property policy: Development of a defect in equipment indemnity would be: first item 100 percent; second item 75 percent; third item 50

percent; fourth item 25 percent; subsequent 0 percent.

Warranties have a positive impact on insurance premiums as they indemnify the equipment system owner in the event a product defect that leads to losses. They do not take the place of a warranty policy, however, and should not be counted on to do so.

Purchase extended warranty from the OEM: Extended warranties might be available in several forms from the OEMs. Depending upon who the wind farm operators are, the quantities of turbines with expiring warranties and the locations, the warranty offering might be parts only or may include parts and labor. These warranties are sold on a per-turbine, per-year basis and cover the full value of the turbines with little to no deductible. Pricing for the OEM warranties range anywhere from \$30,000.00 per turbine per year for a 1.5MW turbine to over \$150,000.00 per turbine per year for a 3 MW machine. Using the lower pricing range, a wind farm with 100 1.5MW machines electing to purchase a five-year warranty would incur costs of \$15M. (100 Turbines x five years x \$30,000 = \$15,000,000 warranty bill).

Purchase a third party insurance warranty: Until very recently a viable, cost-effective third-party warranty option has not been available to the wind farm operator. Today's third-party warranty product is designed to wrap around the

turbine supply agreement (TSA) to continue the coverage supplied by the OEM. The third-party warranty product can be modified to cover additional risks or to modify the risks covered in the original TSA. The third-party warranty (written on A.M. Best Rated A XV paper) covers serial defect, product defect, availability, parts, and labor. Optional coverage for power curve and noise are also available and can be added to the third-party warranty by endorsement.

The third-party warranty is generally sold in "blocks" of limits that are usable for a five-year period. Unlike the OEM warranty, the third-party warranty minimum insurance limits required are calculated on a maximum probable loss (MPL) basis. This means that under reasonable conditions, taking into consideration the make, manufacturer, current condition, and loss record of the turbines, the limits required should cover the foreseeable loss.

Third-party warranties also have annual deductible structures similar to property policies. The final decision as to the amount of limits to be purchased is made by the wind farm owner and will ultimately determine the warranty price. Significantly, third-party warranty coverage can be purchased for far less than available OEM warranty options. Consider again our hypothetical wind farm with 100 1.5MW machines electing to purchase a five-year warranty:

- OEM Warranty Costs: 100 turbines x five years x \$30,000. = \$15,000,000 warranty bill;
- Third Party Warranty Costs: \$10M in limits, usable up to the limits of the policy, for a five-year period = \$3M warranty bill.

In this example, the wind farm operator would save an estimated \$12M with the purchase of a third-party warranty policy, reducing warranty costs by 80 percent. This is clearly an option that must be understood and investigated by anyone with a financial interest in wind turbines approaching the end of initial OEM warranty.

One final word of advice. Providing warranty coverage of this nature is a highly specialized discipline having many nuances. Not everyone has the experience and the knowledge to fully understand the issues and to craft the necessary strategies and solutions. No single approach will be the right one for every situation. There is no "one size fits all." Look for insurance and financial services advisors who have a strong background in the energy industry and work extensively with alternative approaches and emerging technologies. Otherwise, you may just find yourself twisting in the wind. ✪



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(PM, IIRG Bluewater Wind, Offshore Wind Power, 2-3 February 2010, Philadelphia, USA)

INCREASING UPTIME WITH REMOTE MONITORING

According to Schenck Balancing & Diagnostic Systems, the difference between replacing a part and experiencing catastrophic failure is substantial. Here's one way to save.

By Roland Kewitsch



Roland Kewitsch is with the Schenck Trebel Corporation. Go online to www.schenck-usa.com.

MUCH LIKE THE GOLD RUSH or even the space race, the goal set by the U.S. government to reach 20 percent of energy coming from wind power by 2030 has sent everyone searching for ways to get involved. A report by AWEA [1] finds that, during the decade preceding 2030, the U.S. wind industry could:

- Support roughly 500,000 jobs in the U.S., with an annual average of more than 150,000 workers directly employed by the wind industry;
- Support more than 100,000 jobs in associated industries (e.g., accountants, lawyers, steel workers, and electrical manufacturing);
- Support more than 200,000 jobs through eco-

- nomic expansion based on local spending;
- Increase annual property tax revenues to more than \$1.5 billion by 2030, and;
- Increase annual payments to rural landowners to more than \$600 million in 2030.

The biggest deterrent is that harnessing the wind is a challenge, to say the least. Installing literally tons of equipment atop a tower hundreds of feet in the air? Building a machine that can handle exposure to permanently changing loads? Climbing into the clouds to maintain the turbine in extreme weather conditions? Sure, there are those who thrive on such challenges, but new remote condition monitoring equipment and service options lower the risks



Fig. 1: About 10 percent of all turbines experience major damage each year.

bines—different sizes from 250 kW to 5 MW and more than 20 different designs, onshore as well as offshore—we know that approximately 10 percent of all turbines will experience major damage each year (fig. 1). This might seem like an insignificant number when operating only a few turbines, and you may just fall into the category of the 90 percent of “lucky” owners who do not experience damages (fig. 2). But the average wind farm in North America has between 50 and 100 turbines, and the more turbines the more relevant those statistics become. Do you want to test your luck and be unprepared to halt the use of a turbine for a repair, or would you rather catch a small glitch before it snowballs into a huge problem?

Having a tool that helps asset managers to permanently monitor the condition of major components—the main bearing, gearbox, and generator—provides the basis for the right and timely decision. This lowers the probability of a major mechanical malfunction and betters your chances for profitable margins.

The main goals of remote condition monitoring are avoiding or prolonging the replacement of costly components, reducing high maintenance costs, optimizing utilization of resources (equipment, personnel), limiting collateral damage, and reducing inventory costs and unscheduled downtime. A typical remote monitoring system will cost you approximately \$10,000.

Since the gearbox seems to be the weakest element in the drivetrain, here is an example for cost savings by implementing condition monitoring: With no condition monitoring implemented gearbox damage occurs without warning, running to approximately \$130,000 for replacement costs, and four to eight weeks of downtime. With condition monitoring in place indicators for gearbox damage is detected early, maintenance can be scheduled around the wind, it will cost approximately \$70,000 for repair/overhaul, and one or two weeks of downtime.

Another potential for cost savings involves

involved in maintaining your investment in wind power.

The two primary factors, each with a direct correlation to project profitability, are efficiency (how well a turbine performs when it's operating) and availability (the time a turbine is available for production). Turbine size is permanently growing, and downtime can potentially cost project owners significant revenue. By simply considering the costs associated with an unanticipated gearbox failure during peak hours at a 3 MW turbine that is five miles offshore, the advantage of having prevented such a failure becomes abundantly clear.

Having monitored more than 1,000 tur-

the “end of warranty inspection.” It is common practice to perform a 100-percent visual inspection of all gearboxes—100 percent with regard to the number of gearboxes is correct, but 100 percent with regard to the components of the gearboxes unfortunately is not. Many components remain uninspected. With a remote condition monitoring system in place you could focus the inspection on those gearboxes showing certain indicators for wear/damage and perform a more-thorough inspection.

Condition monitoring is not new. It is standard practice for steam turbines, gas turbines, and even hydro turbines. However, remote conditioning for wind turbines faces very unique challenges such as the very low speed of the rotor (main bearing) rotation and the permanently changing dynamic loads. “Standard” condition monitoring systems would create either tons of false alarms or no alarm at all, both of which are absolutely critical for the acceptance of a condition monitoring system.

In the early nineties Schenck and ISET (today Fraunhofer IWES) started a project sponsored by the German government to develop technology for monitoring the condition of wind turbines. The result was the product “VIBRO-IC,” the first dedicated, industrial-proven monitor for wind turbines. It was monitoring rotor unbalance, aerodynamic unbalance, misalignment, and bearing, gear, and generator condition. VIBRO-IC got an award for “best new product of the year 1998” by *Design News* magazine.

In 2003 Schenck Trebel partnered with Prasentia, a system integrator and service provider to the wind power industry, to develop remote interface capability between the condition monitoring system and the SCADA system. A cooperative pilot study of the installation began at a wind farm in Palm Springs, California, that utilized 700 kW turbines. Within a short time a potential misalignment problem between the generator and



Fig. 2: A damaged gearbox is pictured here.

the gearbox was detected by the CMS. The alignment check revealed that the misalignment was greater than the acceptable tolerance. A second observation showed high “shock pulse readings”—an indicator for bearing problems—on the NDE side of the generator. During a scheduled maintenance the lubrication system was checked and adjusted. The shock pulse readings went back to “normal” [2].

Allianz, one of the larg-

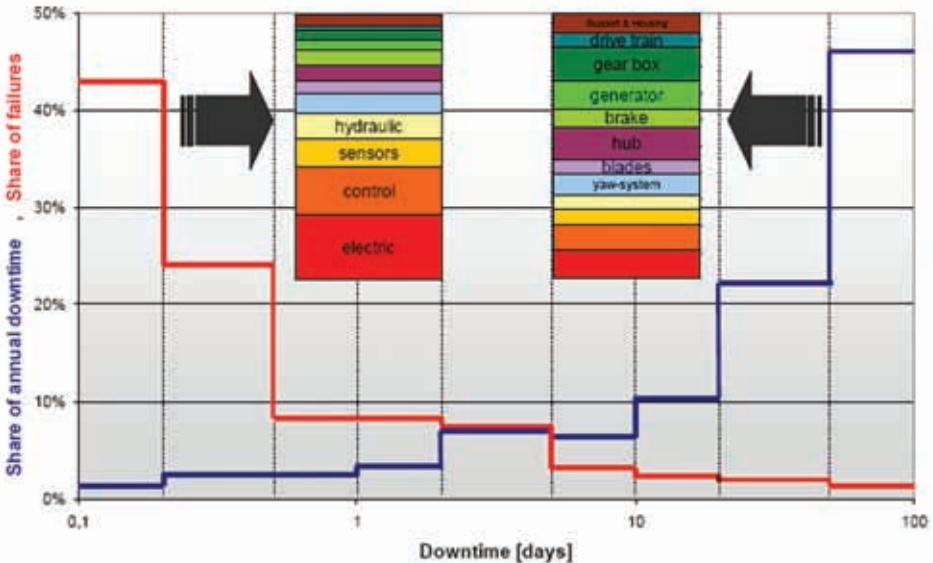


Fig. 3: Characteristics of failure occurrence (Fraunhofer IWES).

est insurance companies in Germany, conducted vast research in condition monitoring for wind turbines and summarized the results in their final report in 2003 [3]. The report describes the basic requirements for a CMS for wind turbines. It makes clear that only online systems with remote access for a “vibration expert” are acceptable for this application. The report refers to the final report from ISET from 1999.

It is essential for the acceptance of condition monitoring for wind turbines to combine a dedicated product with the experience of vibration experts. For these reasons Schenck is not offering a product to the industry, but rather the remote condition monitoring service. Both the product as well as the service are certified by GL Garrad Hassan and approved by Allianz.

Our service center (fig. 4) will monitors turbines 24/7, providing notification in case irregularities/indicators have been detected along with an explanation of measurements, trend curves, spectra, etc., and recommendations as to actions to be taken, and with what degree of urgency. To be able to provide the service we make sure that the right sensor is picked and installed properly in the right location, that the system is set up individually for your specific turbine, the communication works reliably, and the monitoring center is available at all times. Will your turbine be one of the 10 percent to experience damage, or will you be in the 90 percent who enjoy increased profitability? Remote condition monitoring could be the determining factor. ↵

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- 1) www.20percentwind.org
- 2) Schenck balancing news 0406
- 3) Allianz Centre for Technology, report nr. 03.01.068



Fig. 4: Schenck service centers monitor turbines 24/7.

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A MODEL FOR OFFSHORE INNOVATION

As offshore development begins in the United States, Scotland's position as a leader in deepwater wind farms stands as an ideal example to be studied and followed.

By Tom Lamb



Tom Lamb is head of renewable energy at Scottish Development International. Go online to www.sdi.co.uk.

THE UNITED STATES GOVERNMENT has set a goal of using wind energy to generate 20 percent of the nation's electricity demand by 2030. As the U.S. looks to generate more wind energy onshore and expand into the technically challenging offshore wind market, it will not only need to innovate, but also learn from other countries' approach to the installation, construction, and maintenance of offshore wind projects, which are moving farther and deeper than previously thought possible.

Scotland has already shown that it is a powerhouse in the renewable energy industry. The Scottish government recently announced its aim to generate 80 percent of Scotland's electricity consumption through renewable sources

by 2020, primarily through wind power. While these targets may seem ambitious, they are certainly not unrealistic; Scotland has fantastic wind energy resources—25 percent of the European total—and there are plenty of opportunities to generate additional power through both onshore and offshore wind energy.

Scotland now seeks to enhance its offshore wind sector by opening up much of its territorial waters to wind farm development. It currently has more than 90 onshore wind farms in operation or under construction, and it is leading the world in the development of deepwater offshore wind farms, having deployed two of the largest-capacity turbines ever constructed. Indeed, there are many lessons learned in Scot-



Fig. 1: Atlantis Resources Corporation, AK1000™ tidal turbine. EMEC, Orkney, Scotland.

ity. The Crown Estate—the body in the United Kingdom that dispenses the seabed rights in the country—has granted a number of leases to develop commercial scale wind farms in the waters around Scotland. Offshore, there will be 9,500 turbines installed around the UK in the next decade, of which Scotland's share will amount to around £30 billion worth of investment, and up to 28,000 jobs. Currently production of 10.5GW is planned off the coast of Scotland, with 5.7GW in territorial waters and 4.8GW in the Crown Estate's leases in the Moray Firth and the Firth of Forth. Although deepwater turbines are more expensive to install, operate, and maintain than those onshore, they provide less visual intrusion, can generate more energy, and can be developed at a much larger scale than onshore wind.

REPURPOSING RESOURCES

Scottish companies utilize proven technologies borrowed from the oil and gas industry to assemble, install, and operate the Beatrice turbines. The substructures for the wind turbines are jacket technology (lattice towers) taken straight from offshore oil and gas experiences. Much of the supply chain that now exists to serve offshore petroleum production could be configured to support offshore wind.

The Scottish-based Burntisland Fabrication built the jackets for the Beatrice project and is now supplying jackets to several near-shore wind developments in the UK and Europe. Jackets can be installed in deeper water with less visual intrusion, they require less steel—which reduces cost—and can support much larger wind turbines (5-10MW) than conventional monopiles, which have been the solution to date in shallow water near shore projects.

Burntisland Fabrication is also deploying its oil and gas industry expertise in the area of marine energy, having recently won the main £2 million contract for the next stage of the development of one of the world's most advanced tidal turbines, Hammerfest Strøm's HS1000 device, which will be installed at the Scottish government-supported European Marine Energy Centre (EMEC) in Orkney in 2011. This is part of over £4 million worth of contracts awarded to Scottish businesses by Hammerfest Strøm UK, a company jointly owned by Scottish Power Renewables and Norwegian energy companies.

EXPANDING ONSHORE

Offshore wind is a new direction for renewable developments, but Scotland is already a major market for onshore wind. Europe's largest onshore wind farm, which is already powerful

land that can be applied around the world.

GOING DEEPER

Scotland has led the way in offshore wind with the Beatrice Wind Farm Demonstrator Project. Located 12 miles off the country's east coast, the project is a world first. In 150 feet of water, Beatrice is operating at almost double the depth used anywhere else, using 5MW wind turbines; the first of this size ever installed offshore in the world.

This project has paved the way for future large-scale wind development off the shores of Scotland. The proposed follow-on full-scale development of the Beatrice Demonstrator will be a wind farm of 920MW installed capac-



Fig. 2: The Beatrice Wind Farm Demonstrator Project off the East coast of Scotland.

enough to meet the city of Glasgow's electricity needs, is set to expand by more than a third as part of a major green energy initiative by the Scottish government. The 322MW Whitelee wind farm south of Glasgow has been given permission to increase its capacity to a total of 215 turbines. Construction has already begun on the expansion and is expected to be completed by 2012, delivering 596MW, which is enough energy to power 180,000 homes. An ambitious scheme in the Shetland Isles has also recently been submitted to the Scottish Government for a 550MW wind farm. This will be a joint venture between the community-owned Shetland Trust and major utility company Scottish & Southern Energy. This will also include a 330 kilometer subsea cable back to the Scottish mainland.

Additionally, Scotland's onshore wind industry presents excellent opportunities both for companies involved in supplying components such as towers, blades, gearboxes, and hubs, and those involved in operation and maintenance. Furthermore, due to the scale of the country's onshore wind sector, many of the overseas wind turbine manufacturers have set up sales, operations, and maintenance facilities in Scotland. These companies include REpower, Siemens Wind, Nordex, Vestas, and Skycon.

COLLABORATION IS KEY

The Scottish European Green Energy Center, which opened this August, is a government and university collaboration. A £1.6-million invest-

ment in the Aberdeen facility through the European Regional Development Fund, and more than £1 million of funding from the Scottish Government over the next three years, will allow SEGEN to focus on marine energy, offshore wind, long-distance super grid development and smart distribution grids, carbon capture and storage, renewable heat, and energy efficiency.

In the private sector, Scottish and Southern Energy, PLC, and Mitsubishi Heavy Industries Ltd (working through their European subsidiary Mitsubishi Power Systems Europe Ltd) recently signed a strategic agreement to cooperate on low carbon energy developments including offshore wind farms, carbon capture, and high-efficiency power generation. The agreement builds on SSE's establishment last October of a Centre of Engineering Excellence in Renewable Energy in Glasgow and should lead to up to 100 additional highly skilled, engineering-based jobs being created. This is expected to grow to up to 1,000 jobs over five years.

Scotland's Low Carbon Investment Conference in September 2010 is another example of the country's ability to forge lasting partnerships around wind energy development. Conference attendees included Scotland's First Minister Alex Salmond along with global politicians, industry executives, and representatives from several U.S.-based renewable energy companies and investment firms. On the first day of the conference Salmond announced the country's move to increase its renewable energy target

from 50 to 80 percent supply by 2020. Several of the expansions and new wind energy proposals that will contribute to meeting this aggressive goal were on display throughout the conference.

ACADEMIC SUPPORT

The close cooperation between Scotland's universities and companies has created a united community of innovation to rival the world's biggest centers of academic excellence. In collaboration with Scottish Development International (SDI) and a government determined to attract the best in academic and business excellence, Scotland offers a huge range of free support and incentives to companies investing in the country's people and economy. Scotland's universities house a number of research and development centers and institutes, which themselves have spawned a number of companies in the wind energy arena that have already produced advanced products and services, and others are involved in the further commercialization of research projects to add to the body of work coming out of Scotland.

MARINE INNOVATION

Simultaneous to the rather aggressive development and deployment of wind energy technologies, Scotland is also deeply invested in leveraging innovative marine energy technology. The Scottish government is working proactively to promote continued development in tough economic times with initiatives such as the Saltire Prize, awarding a £10 million challenge prize for advances in marine renewable energy. Jason Morgan, an advisor to President Obama and leading expert in the use of innovation prizes, recently lauded Salmond as being "ahead of the White House" for implementing this prize to drive renewable technology



Fig. 3: Voith Hydro Wavegen, LIMPET Wave Device, Islay, Scotland.

innovation. Scotland already has other innovative incentives in place to support the development of marine energy (wave and tidal). The Crown Estate has completed a licensing round for the Pentland Firth between mainland Scotland and the islands of Orkney, which is the first commercial scale development in the world for wave and tidal energy. This 1200MW development will be operational by 2020 and will utilize technologies trialed and tested at the EMEC in Orkney.

In recent weeks Atlantis Resources Corporation has successfully deployed its AK1000™ tidal turbine, the world's largest rotor diameter tidal turbine, on its subsea berth in 35 meters of water at the EMEC. The device is one of a number of technologies currently being tested at EMEC, and it is 22.5m tall, weighs 1,300 metric tons, and has a twin set of 18m diameter rotors.

In a parallel development that will take offshore wind into a new technical dimension, Statoil—a Norwegian-based oil company—is discussing the possibility of developing the world's first floating wind farm in Scotland. The company has identified two potential sites, one off the coast of Lewis and one off of Aberdeenshire, that could be suitable for a pilot park, testing the concept of their Hywind floating turbines further.

Statoil has already constructed a full-scale prototype Hywind unit, anchored 10 kilometres offshore at Karmøy in Norway. The floating wind turbine is performing beyond expectations and has delivered power to the grid since September 2009. The next stage of the project could involve constructing between three and five Hywind units to document the commercial potential of the concept.

Scotland's unique collaborative environment, innovative spirit, wealth of natural resources, and experience in energy research and production has allowed a nation of five million to take the reigns as a pioneer in wind energy. At a time of global need for new, alternative sources of energy, this small nation has a vital role to play in leading the way for the next generation of energy research and production, and in influencing other countries to follow suit.

Note: Scottish Development International is the country's inward investment agency, providing advice and support to international companies looking to invest in Scotland. It also provides support to Scottish companies doing business across the globe. ↗



MAXIMIZING WIND ENERGY YIELD

Wind farm operators want to make sure their turbines are reaching their maximum energy-production potential. Duke Energy shares its own substantial experience.

By Greg Efthimiou

Greg Efthimiou is with Duke Energy Corporate Communications. Go online to www.duke-energy.com.

IT'S NO SECRET THAT THE OVERALL SUCCESS of a wind farm is primarily determined by the amount of power it produces, which translates into revenue generation for its owner. Yet the prevailing industry measure of a wind turbine's performance remains its availability to produce electricity if the wind is blowing. In fact, virtually all original equipment manufacturers base their wind turbine warranties in part or in whole on availability metrics. As a result, technicians at wind farms across the United States often find themselves scrambling to get turbines back online following an unexpected interruption in availability.

Sometimes these efforts do little to boost profitability, particularly if restoration occurs during

a lull in wind resources. In other instances, wind farm operators authorize "quick fixes" instead of addressing root-cause problems that may impede high performance over the long run. At Duke Energy's nine U.S. wind farms, the focus is simple: leave no stone unturned in the quest to maximize each turbine's energy yield. While availability is still measured and effectively managed, achieving higher energy yields is what helps the company wring as many electrons—and dollars—as possible from its wind power assets. Duke Energy's formula for success is based on the same strategy that helped the company become one of the largest electric power holding companies in the country.



ZERO TO 1,000 MEGAWATTS

With regulated operations in five states—the Carolinas, Indiana, Kentucky, and Ohio—and more than 100 years of experience in the electric utility sector, Duke Energy knows how to get the most from its power generation and delivery assets. The company serves approximately 4 million customers, representing a population of roughly 11 million people. Its non-regulated commercial business unit, which generates about one quarter of the company's earnings before interest and taxes, operates like an independent power producer.

In 2007 Duke Energy's commercial unit launched aggressive plans to add wind energy generation to complement a diverse exist-

ing portfolio of assets in the Midwest and Latin America. The strategy: use a few key acquisitions to propel an ambitious organic project development plan.

First came the purchase of Austin, Texas-based Tierra Energy in 2007. Along with a healthy portfolio of development projects, Duke Energy took control of three wind farms that began generating electricity in late 2008. The company then netted a 50 percent stake totaling 283 megawatts in phases one through five of the massive Sweetwater project in Texas through the acquisition of Catamount Energy, based in Rutland, Vermont. That purchase raised the total capacity of Duke Energy's wind projects under development to roughly 5,000 megawatts.

Duke Energy now has nearly 1,000 megawatts of capacity in operation at four wind farms in Wyoming, three in Texas, one in Colorado, and another in Pennsylvania. The company's continuously replenished pipeline of potential development projects currently totals approximately 5,500 megawatts.

IMPROVING PROFITABILITY

In the spring of 2009, leaders in Duke Energy's wind unit took notice of a troubling trend: the company's wind farms were earning very high marks for turbine availability, but some were missing their profitability targets. Upon closer inspection, they diagnosed three key problems.

First, some turbines were not producing the maximum-rated output as prescribed by their manufacturers, even though availability figures remained high. Second, maintenance schedules were often established with the sole intent of boosting availability rather than maximizing actual production and revenue generation. Finally, technicians were sometimes dispatched to return offline turbines to service just in time for periods of sustained low wind. "We kept hitting our availability targets," according to Jason Allen, Duke Energy Generation Services vice president of operations. "When we delved deeper, however, the question soon became 'Are we hitting the right bull's-eye?'"

Allen assigned a team to compare the power curve specified for every wind turbine in Duke Energy's fleet, totaling 650 units at the time, to actual output. The results were eye opening. Some turbines:

- Cut off before achieving their manufacturer-specified maximum rating (fig. 1);
- Backed off early due to high generator temperatures, possibly due to faulty thermocouples (fig. 2);
- Exhibited partial back-off tendencies due to high generator temperatures, possibly the result of additional load on generator bearings from yawing (fig. 3);

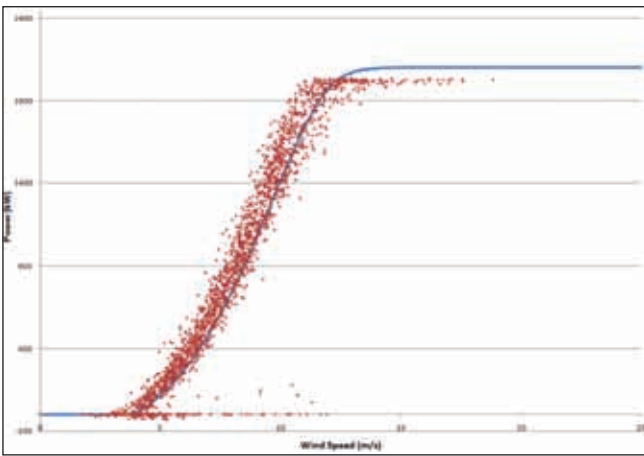


Fig. 1: Turbines can cut off before achieving their manufacturer-specified maximum rating.

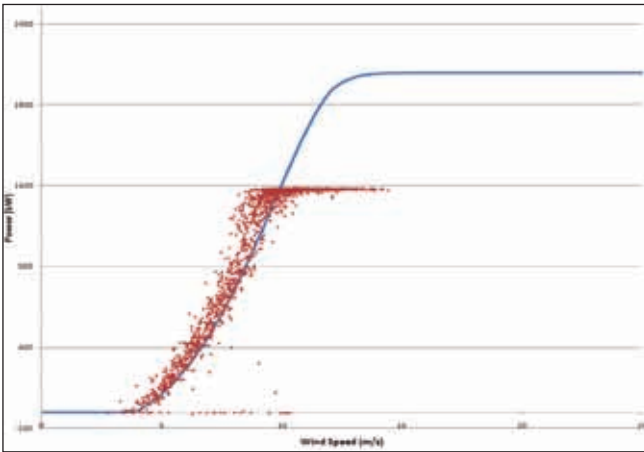


Fig. 2: Turbines backed off early due to high generator temperatures, possibly due to faulty thermocouples.

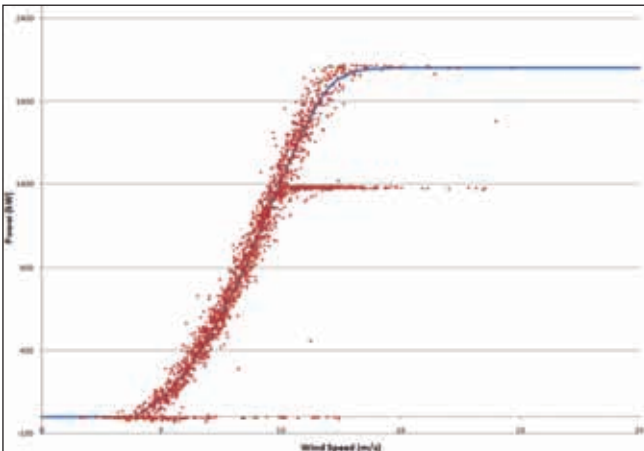


Fig. 3: Turbines exhibited partial back-off tendencies due to high generator temperatures, possibly the result of additional load on generator bearings from yawing.

- Showed “candy-cane” behavior, where turbine performance worsened as wind speed increased instead of following the vendor’s power supply curve (fig. 4);

Other turbines’ output lagged behind the manufacturer’s power curve, or sagged through the middle of the curve. The analysis team was pleased, however, to find that most turbines yielded perfectly clustered data, with output matching the vendor’s power curve precisely. In some cases turbines actually produced more power than originally guaranteed by their manufacturers. “We achieved exceptional results through condition-based monitoring and world-class maintenance, but our analysis showed that we were still leaving money on the table,” Allen says.

Power Operations Manager Tom Paff led the team charged with monitoring wind farm performance, working with site personnel to troubleshoot problems with underperforming turbines, and helping prevent the potential loss of future revenue. In one case his team identified a pitch ram misalignment on a turbine at Duke Energy’s Notrees Windpower Project in Ector and Winkler counties, Texas, that resulted in tens of thousands of kilowatts in lost electric generation each month. Had the combination of performance and condition-based monitoring not uncovered the problem, Duke Energy would have missed out on nearly \$30,000 in annual sales from that single wind turbine. The team tackled dozens of similar seemingly minor issues, resulting in higher energy yields that translate into increased revenue for each wind farm and the company.

In addition, Jason Allen directed regional and site managers to refine their approach to scheduling maintenance and dispatching crews for repair work. “Turbine availability is an important metric, but never more so than when the wind is blowing,” he says. “It’s

bad to have a turbine come back online just in time for the wind to die down. It's even worse to have a technician performing routine work on a turbine when we could be producing electricity at peak capacity due to very windy conditions."

Allen's teams at Duke Energy's nine wind farms now try to schedule basic maintenance and equipment upgrade work when wind resources are forecasted to be low. Wind forecasts also play a major role in determining when to send technicians to restore off-line turbines.

"Why wake a technician up in the middle of the night, get him out of bed, make him drive to the site, and pay him overtime just to restore a wind turbine that won't even produce much power or revenue during the day, when winds at some sites are typically lighter? As long as you're fully complying with all turbine warranty guidelines it makes more sense to dispatch work crews strategically, based on wind forecasts and the time of day."

PREDICTING MOTHER NATURE

There's an old saying in Wyoming, where Duke Energy owns and operates four wind farms: if you don't like the weather, wait 10 minutes and it'll change. Accurately predicting that change is another story. That's why Duke Energy's wind power unit—which had been contracting with third-party vendors for weather imagery, alerts, and real-time forecasts—turned to the broader corporation's meteorology team in the spring of 2009 for help.

"Our group had already developed a comprehensive suite of weather monitoring and forecasting tools to support power generation and delivery operations in both our regulated and commercial businesses," says Meteorology Director Nick Keener. "The wind group came to the conclusion that Duke Energy's in-house meteorology team could cre-

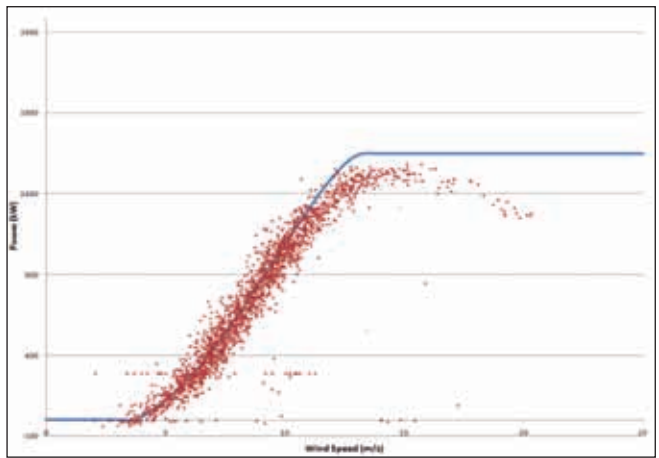


Fig. 4: Turbines showed "candy-cane" behavior, where turbine performance worsened as wind speed increased instead of following the vendor's power supply curve.



Fig. 5: Duke Energy's Campbell Hill project in Casper, Wyoming.



Fig. 6: The Happy Jack project in Cheyenne, Wyoming.



Fig. 7: The North Allegheny wind farm in Pennsylvania.



Fig. 8: Duke Energy's new Renewable Energy Monitoring Center.

ate a robust, highly customized solution, and at a fraction of the cost."

In addition to radar and satellite weather imagery, meteorology built a smart phone-networked notification system that allows site personnel to receive alerts when lightning is detected within a 60-mile radius of a wind farm and alarms when lightning is within 30 miles. "First and foremost, the software is designed to keep our employees and contractors safe," Keener says.

One challenge for Duke Energy's meteorology group involved forecasting winds at hub height, where the turbine blades connect to the nacelle. Senior Meteorologist Steve Leyton explains. "We have access to the same numerical weather prediction models as all the private vendors," he says, "However, none of the models we looked at explicitly predict wind speeds at hub height. So we had to devise our own methodology, which involved reviewing the science and developing equations to account for different wind profiles at that height."

PERFORMANCE MONITORING

The detailed, site-specific weather reports and forecasts generated by the meteorology group's end-to-end software solution are delivered in real-time format to wind farm personnel, as well as to staff members in Duke Energy's new Renewable Energy Monitoring Center (REMC).

Located in Charlotte, North Carolina, where Duke Energy is headquartered, the REMC serves as the nerve center for the company's entire renewable power fleet, including the commercial unit's growing portfolio of solar farms. Experienced operators staff the REMC 24 hours a day, every day of the year. In addition to wind forecast-

ing, the REMC enables virtually instantaneous turbine alarm response and remote resets.

Original equipment manufacturers monitor many of the wind turbines in Duke Energy's fleet, pursuant to original purchase agreements. But according to Tom Paff, turbines that "trip" and go offline can sometimes go unnoticed by the OEMs for long periods of time because they have so many units to monitor throughout the country. "Time is money, and we're saving both by learning about turbine performance issues as they occur," he says. "Around the clock performance monitoring is a key driver for higher energy yields at Duke Energy wind farms."

The REMC, powered in part by dependable wind and severe weather forecasts, has been so successful that Duke Energy is now accommodating requests by other wind farm operators to monitor their assets, as well. "It wasn't part of the original game plan," Paff explains, "but once word got around about how integral the REMC was to our success, we decided to open the doors to a select number of other renewable project operators. It's a win-win scenario, because our clients are saving money and we're achieving better economies of scale."

LOOKING AHEAD

Keith Trent, group executive and president of Duke Energy's Commercial Businesses, believes superior operational efficiency will continue to be a key differentiator in the competitive wind power industry. "It's more critical than ever to effectively manage the assets you have in operation," he says. "That's what the energy yield approach is all about—doing everything you can to make the most of what you've got." 🏹

< Continued from page 15

control systems that significantly improve the performance of sustainable power systems based on wind-generated energy. The new wind turbines leverage a sophisticated system of electronic sensors combined with software from IBM to gather input regarding wind direction, speed, temperature, and other factors to optimize performance and increase efficiency. A central control system collects and analyzes data from each turbine to remotely control individual turbine subsystems, perform diagnostics and manage wind farm power generation. Alstom and Ikerlan-IK4 are using IBM software to help develop and automate the “system of systems” that controls the turbines and their interconnected communications systems.

“Leveraging IBM software helps us apply an automated process to the design and development of Alstom Wind control systems,” says Alfonso Faubel, vice president of Alstom Wind. “This advantage definitely allows us to deliver tailored solutions that are fully adapted to new emerging standards, markets, and client needs.”

Alstom and Ikerlan-IK4 are also using the Gears Software Product Line Lifecycle Framework™, from IBM business Partner, BigLever Software™, to customize their designs to accommodate the varying climates and geographies where the wind turbines will operate. Alstom and Ikerlan-IK4 estimate that their use of IBM and Big Lever Software reduces development costs by as much as 25 percent and decreases development time by a factor of 10 for each product variation.

“The fact that the wind turbines can be customized to accommodate geographic differences and also adjust to ambient environmental changes adds a layer of complexity to an already a complex software development process,” according to Dr. Salvador Trujillo, chief product line engineer at Ikerlan-IK4. “By using IBM Rational Software for model-driven development combined with BigLever Gears for product line engineering, we can reuse software assets and manage these variations at a pace that allows us to keep up with market requirements.” To learn more visit www.ibm.com.

DREXEL UNIVERSITY COMMITS TO 100 PERCENT WIND ENERGY

In a new agreement between Drexel University and Community Energy, Inc., Drexel will purchase Renewable Energy Certificates equal to 100 percent of its energy use, making Drexel one of the top 50 purchasers of wind energy in the nation. This Renewable Energy Certificate purchase will ensure that 84,268 megawatt

hours of electricity will be matched annually with wind energy entering the electricity grid. The Renewable Energy Credits will be supplied by renewable energy marketer and developer Community Energy. This purchase will place Drexel among the top five university purchasers in the nation, according to the current Environmental Protection Agency’s Green Power Partnership rankings.

“We are proud to be a leader among colleges and universities, and to do our part for the environment,” says James Tucker, Drexel senior vice president for Student Life and Administrative Services. “Having our electricity matched with clean, renewable energy is one piece of our larger commitment to sustainability. We hope other institutions will follow our lead and make the choice as well.”

Compared to the average generation mix in the national electric grid, the environmental benefit from this purchase is equal to offsetting approximately 60,518 metric tons of carbon dioxide per year, the annual impact of which is equivalent to the carbon sequestered by 12,904 acres of trees or removing 11,571 passenger vehicles from the road, according to the Environmental Protection Agency’s greenhouse gas equivalencies calculator.

“Drexel University realized the importance of renewable energy early on and Community Energy is proud of our long partnership,” according to Jay Carlis, Community Energy’s vice president. “The decision to substantially increase the university’s wind energy purchase to 100 percent of electricity usage establishes Drexel as a national leader in supporting environmental sustainability.”

Drexel was recently honored by PennFuture, a leading Pennsylvania environmental advocacy organization, with a Green Power Award for leadership in energy efficiency, including deploying an energy monitoring system at the main campus. Additional sustainability efforts include using biodiesel fuel for shuttle buses, purchasing hybrid and battery-powered vehicles, free bike share program, implementing a multitude of energy-saving controls and lighting efficiency measures, use of ice thermal energy for cooling, and wide-ranging recycling efforts. Learn more at www.drexel.edu.

WES CONSOLIDATES OPERATIONS IN TEXAS

Wind Energy Services Company (WES) announces that the company’s base of operations has been relocated to Gainesville, Texas. Staff and equipment from the satellite operations in Sweetwater, Texas; Independence, Kansas; and Worthington, Minnesota moved to the new location.

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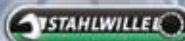


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WES is taking these necessary steps to position the company for long-term profitability in the current challenging economic environment. WES is a wholly owned entity of the Molded Fiber Glass Companies (MFG), a diversified manufacturer of composite components for wind energy equipment as well as products for the automotive, trucking, construction, and defense industries. Going forward, WES service centers will be strategically co-located with existing MFG manufacturing operations, resulting in cost reductions for facility maintenance and human resource administration.

The MFG facility in Gainesville, Texas, currently produces wind energy blades and a mix of other large composite products. The state of Texas has the highest concentration of wind energy farms in the U.S., and the proximity to this dense customer base will support the company's mission to provide industry leading, rapid response, onsite repair and maintenance services for wind blades, nacelles, and spinners.

Molded Fiber Glass Companies is a leader in the field of reinforced plastics and composites, serving diverse markets with a variety of composite material systems. The company has 16 operating entities in the United States and Mexico, strategically focused to supply high value, high quality products and manufacturing services for applications such as wind energy, automotive, heavy truck, defense, construction, material handling, and water treatment. An entity of the Molded Fiber Glass Companies, WES provides fast response, onsite FRP composite repairs and maintenance for wind energy equipment including new sites, retrofits, and inspections. The company's mobile response service teams are trained and equipped to quickly assess and make repairs from lightning strikes, shipping and installation damage, structural cracking, leading edge erosion and coating failure, blade balancing, and cosmetic/general warranty needs. Repairs can be handled prior to erection (shipping and handling damage), uptower, onsite with the blade removed, and offsite for more extensive factory repairs when necessary. WES employs 50-plus certified composite wind repair technicians who conduct approximately 90 percent of repairs onsite. Learn more at www.windenergyservicesusa.com.

MOTION SOLUTIONS FOR CLEAN ENERGY APPLICATIONS FROM THOMSON

Thomson introduces the 2010 Guide to Motion Solutions for Clean Energy Applications. The guide reviews some of the most significant considerations that design engineers should take into account to maximize the reliability,

accuracy and efficiency of their solar panel and wind energy machines, with specific information on the benefits that linear actuators, precision linear actuators, and screw jacks can bring to these challenging applications.



Motion Solutions for Clean Energy Applications

“Robust linear actuators from Thomson are an easy to apply ‘green’ alternative to hydraulic or manual actuation,” according to Rob Gallagher, marketing communications manager, global. “Design engineers will benefit from a wide range of actuator platforms with flexible design and envelope possibilities to meet the diverse requirements for solar tracking systems and the key operating components of wind power, and this guide is designed to help them quickly and easily start to navigate the options.”

Thomson industrial linear actuators are engineered to deliver robust, reliable operation in the wide ranging outdoor conditions a clean energy facility is likely experience. Their industrial linear actuator products feature proven weather protection (ranging from IP56-67) to provide maintenance free 20-year life based on one complete cycle per day. Thomson's proven power drive units can hold static loads of up to 4000lbs and provide superior resistance to back driving in high wind conditions. Temperature ratings cover significantly varied conditions, ranging from -40F to +185 F. The Thomson screw jack product line provides reliability and versatility in a variety of clean energy applications. Technically mature and with an easy-to-mount rectangular housing, they are easily extended to form wide-area jack systems with the aid of a wide range of accessories. Call (540) 633-3549, e-mail thomson@thomsonlinear.com, or go online to www.thomsonlinear.com. ↴

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You're right, and I think it's a great example of how we do business. Rather than just talking about how our existing tooling can be used in their application—which is definitely the case, in many instances—we work with our customers to learn about the market they're involved in, the processes involved, the equipment required, and then we develop tooling to meet their specific needs. We also keep those tools in stock so they can ship quickly to prevent any avoidable downtime. Tooling that we've developed specifically for the wind industry includes the new Double Octomill, which is a 16-edge face-milling insert, our Graflex boring bar system, and a complete range of drilling, boring, and reaming tools. We've also developed the Duratomic insert coating technology, which allows for extremely high cutting speeds and drastically improved tool life. We have tools that are used for gashing pitch and yaw gears, including machining the teeth, and we're working on special radius cutters for helical milling. Seco tools are used to manufacture the gearing and parts of the main frame, the hub, the main shaft, and our milling cutters are used to prep the bevel around the plate prior to welding tower sections. So our tools really are touching most of the parts in a standard wind tower and turbine.

TELL US ABOUT THE COMPANY'S ENTRY INTO THE WIND MARKET.

The Seco Group has been involved in the wind industry for many years, from a global standpoint, but Seco Tools really started focusing on the North American market about five years ago. Then in 2009 we decided to hold a series of seminars for Michigan-area automotive manufacturers who were thinking of expanding into making wind components and wanted to know what was involved. We brought together members of the local and state government, including legislators and representatives from the governor's office, and we addressed everything from where seed money to fund this venture could be obtained to what types of capital investments, such as equipment and tooling, would be required. A member of the American Wind Energy Association (AWEA) attended, along with companies such as DMI Industries, which manufactures wind towers, to provide additional insights. The event was very well received, and not only did it provide attendees with valuable information for making their plans, it helped us chart our own course in terms of really beginning to provide solutions that are specific to the wind energy market.

I WOULD THINK POTENTIAL CLIENTS ARE IMPRESSED BY SECO TOOLS' ATTENTION TO DETAILS.

That and our close relationship with the Seco Group and its R&D labs in Sweden, which has allowed us to harness knowledge gathered over many years in the more-mature European wind industry to share with our customers throughout North America. From a physical standpoint we have Seco Technical Centers located all around the world, with wind-power machining specialists available to assist OEMs and others overcome obstacles in their design and manufacturing activities. And we're constantly working to resolve "persistent customer issues," or PCIs, whether that involves supply chain efficiency or engineering outsourcing, which is something we're increasingly being asked to provide. So the Seco philosophy involves understanding a customer's applications so that we can help them overcome the challenges they encounter along the way to achieving their production goals. Because when that happens, it means that we've achieved our own goals as well. ↙

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