JULY 2010

WIND SYSTEMS

FEATURES

DEPARTMENTS

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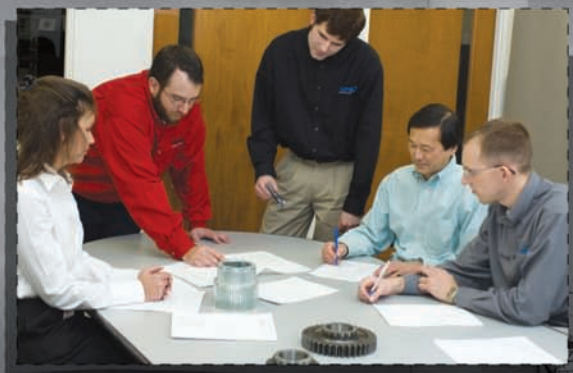

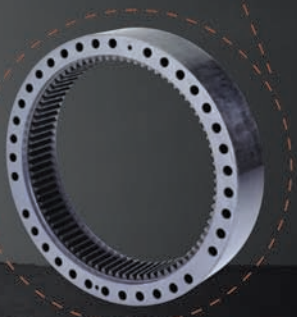

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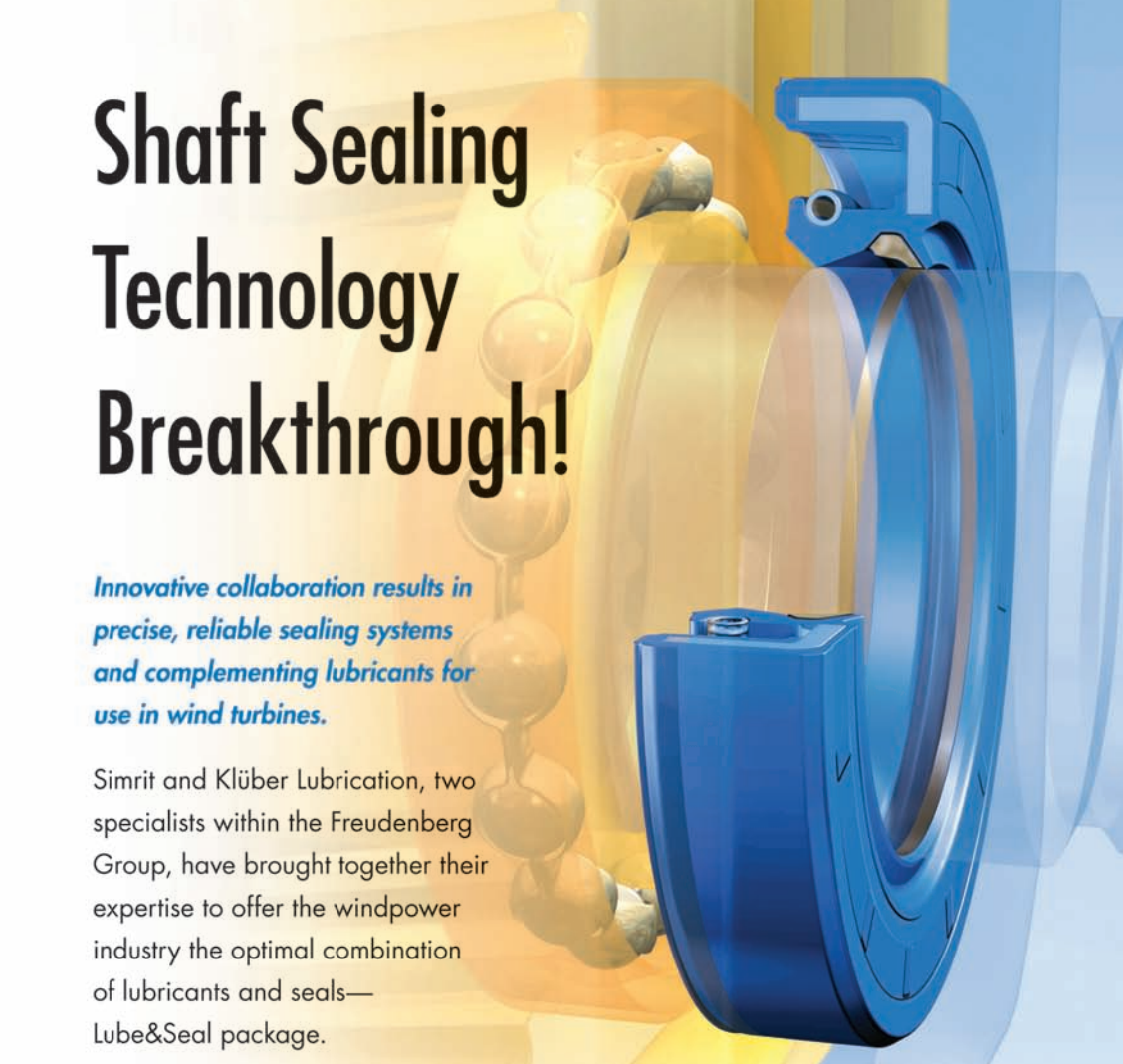
Shaft Sealing Technology Breakthrough!



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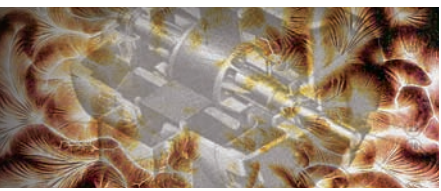
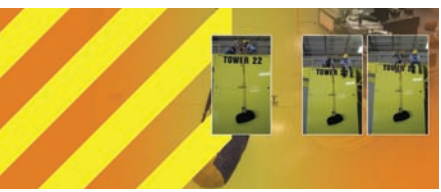
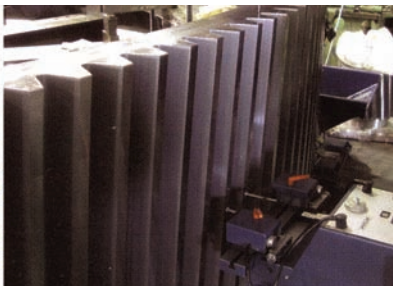
FEATURES





Gearing Up Your Business



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DEPARTMENTS

VOLUME 2 NO. 11

RESOURCES

Wind Systems magazine, published by Media Solutions, Inc., is printed entirely on Forest Stewardship Council certified Domtar Lynx paper. FSC certification ensures that this paper contains fiber from well-managed and responsibly harvested forests. The FSC logo also signals our commitment to improving the environment. *Wind Systems* paper is also Rainforest Alliance certified. Publications mail agreement no. 40624074 Return undeliverable Canadian addresses to: PO Box 503 | RPO West Beaver Creek | Richmond Hill, ON L4B 4R6

EDLETTER

As wind-energy production expands throughout the United States, it's interesting to consider how much it will benefit from the knowledge amassed by more-established companies, industries, and professions. Examples abound in this issue of the magazine, from Harvey Swift's article on how IMPACT—the Ironworker Progressive Action Cooperative Trust—and its partners are training ironworkers in tower erection techniques to Dave Bell's description of how SmartSignal is making predictive diagnostic technologies that have proven useful in the conventional power industry available to wind turbine owners and operators. In his maintenance column Merritt Brown of Rev1 Power Services discusses the development of a vibrant wind components aftermarket, also pointing out how established gear manufacturers are dealing with the restructuring of the automotive industry by entering the wind market, applying their expertise to gearbox service and repair. Not only does this mean that wind power is breathing new life into a wide variety of related industries, but also that it stands to benefit greatly from the skills and services they bring to the table themselves.

In addition to these features you'll find a wealth of great information in this issue, beginning with "Collaboration in Wind Farm Construction" by Christopher L. Floyd, P.E., of the Dashiell Corporation. Jackson Bishop of Oldcastle Precast discusses "Modular Foundations for Small Wind," and Chris Medinger of LEESON Electric outlines the benefits of premium-efficiency motors in "Maximizing Motor Efficiency." Dick Gangnon of JLM Systems describes the kidney-loop system in "Effective Lubrication Filtration," and George Sims of PMA USA has contributed "The Power of PMA Cable Protection" which demonstrates how his company's products protect cables in harsh environments. Here, too, you'll find great examples of technology transfer.

In addition to Merrit Brown's maintenance column, Eric Drooff of Hayward Baker endorses soil fracture grouting as a means of correcting foundation settlement in his construction column, and Hüseyin Kizilagac of BDP Project Logistics shares his expertise on avoiding extra supply chain costs in this installment of his column. Covering technology, Jose R. Zayas and Todd Griffith of Sandia National Laboratories write about the connection between accurate computer-based design programs and high system reliability, and Michael Brower of AWS Truepower—formerly AWS Truewind—discusses the company's rebranding campaign in this month's profile. Felix Guerzoni, product application specialist with Shell Lubricants, talks about how the close relationship between the company and clients including Gamesa, GE Energy, and Siemens Wind Power has led to an impressive array of wind-specific products.

Speaking of impressive arrays, I believe that also describes this issue's editorial lineup, and I'd like to thank everyone involved for their contribution. We look forward to featuring your own contribution in an upcoming issue! Please feel free to contact me to discuss the many editorial opportunities we can provide. All best:

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Maximum availability is on the horizon.

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LIEBHERR LAUNCHES PRODUCTION FACILITY IN MEXICO

Liebherr is building a new production facility for drive components in Mexican Monterrey, Nuevo León. The company—Liebherr Monterrey, S. de R.L. de C.V., founded in 2009—will produce large diameter bearings at this site in a wide range of diameters starting from mid 2010. These products are used in wind turbines for the pitch and yaw adjustment.

The new plant will supplement the existing production facility in Biberach an der Riss, Germany, where up to now all the components for the wind industry have been manufactured. The high quality level, based upon decades of experience, will be contained in the products manufactured at the newly founded production plant. By providing additional capacities Liebherr is preparing for the forthcoming growth anticipated for the North American wind-power market. With the new location Liebherr is going to strengthen its competitive capacity still further, and bolster its position as a strategic supplier to the wind industry.

Liebherr is the only manufacturer in the world which, as a systems supplier, can offer bearings and drive units as well as hydraulic cylinders and control technology all from its own development and production resources. In the sector of large diameter bearings for pitch and yaw adjustment in wind-power systems, single-row and double-row four-point bearings are offered that feature particularly high quality and long service life. The product range in drive systems includes multi-stage coaxial planetary gears that can be adapted to suit a customer's particular needs. Liebherr drive systems are especially famous for their reliability, compact design, and best possible weight-performance ratio. Electric motors for supplementing the gearboxes likewise come from the company's own development and manufacturing resources.

There are hardly any limits to the size of the drive components the company can provide, with a product range including parts for supply to 750 kW systems as well as large turbines with rated capacities of 7.5 MW for operation both onshore and offshore. To learn more contact Douglas Cross, sales manager, Liebherr Components North America Co., at (734) 944-6334 or douglas.cross@liebherr.com. Visit online at www.liebherr.com.

GEXPRO CONVENES ENERGY EFFICIENCY SUMMITS

Gexpro is holding "Energy Summits" across the United States to educate electrical contractors, facility managers, commercial building owners, and government buyers on how best to achieve lower energy costs with green technologies. The sessions focus on the latest advancements in energy efficiencies, new green product solutions and

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

services, and ways to benefit from the government stimulus plan (the American Recovery & Reinvestment Act), utility rebates, and state government programs. The Gexpro summits have been held so far in San Diego, upstate New York, and Atlanta, with plans for additional sessions in Dallas and Chicago.

The one-and-a-half day summits cover a wide range of topics: energy efficient lighting installations and retrofits, solar energy design and applications, ECM motors for commercial refrigeration and HVAC, and specific power quality solutions that can increase the performance, lifespan, and efficiency of all electrical products in a commercial or institutional application. Speakers come from both Gexpro and leading manufacturers, as well as other energy and environmental specialists.

Besides concentrating on product technologies and solutions, each summit includes vital information on maximizing the available benefits of the U.S. stimulus plan, explaining how the stimulus works, its funding requirements, and how Gexpro can act as a resource in helping attendees take advantage of the plan's rebates and tax incentives.

"The Energy Summit is a natural outgrowth of Gexpro's resource-rich experience in energy-efficient solutions and our dedication to comprehensive customer service in providing those solutions," says Jeff Pecoroni, director if energy solutions. "These events are designed to inform participants in practical ways to reduce energy consumption and to educate them on the economic benefits of energy-saving solutions and their relationship to new government funding opportunities. The summits are unique in that they present a forum where contractors, facility managers, and building owners can dialogue with manufacturers and electrical suppliers on the synergies of green technology and economic incentives." Learn more at www.gexpro.com.

GAMESA AND TEXAS A&M UNIVERSITY SYSTEM ANNOUNCE COLLABORATION

The Texas A&M University System and Gamesa Technology Corp. have announced an agreement with the intention to install a new generation of wind turbine at West Texas A&M University, coordinated jointly by the Energy Engineering Institute and the Alternative Energy Institute of the A&M System. The Gamesa G10X—also known as the G128—would be the largest of its kind in the country, while providing substantial advances in production output, energy efficiency and noise reduction.

A signing ceremony was held at the 2010 American Wind Energy Association WINDPOWER Conference and Exhibition, where A&M System and Gamesa officials initiated a long-term agreement in which the system, through its multiple members, will conduct ongoing research and testing for Gamesa's energy-related projects. System members include the Texas Engineering Experiment Station (Energy

Engineering Institute), Texas A&M University, West Texas A&M (Alternative Energy Institute), and the Texas Transportation Institute. The initial collaboration will involve installation of the Gamesa G10X, a 4.5-megawatt turbine that has a higher tower height and a larger rotor diameter (420 feet/128 meters) than existing land based turbines, which allows it to access better wind resources that further increase its production capability.

"Providing the innovations necessary to secure an efficient, high volume energy supply for our future is one of the most critical tasks before the world's researchers today," says Theresa Maldonado, Ph.D., P.E., associate vice chancellor for research of the A&M System and director of the E2I. "Great strides are being made in renewable energy resources, but the greatest challenge to their widespread use remains the limited capacity they currently generate. The A&M System is uniquely configured through its long history in energy research and its specialized facilities to address challenges in the wind energy industry. The Energy Engineering Institute is positioned to coordinate these R&D activities."

According to Dirk Matthys, CEO of Gamesa, "Recognized for its worldwide reputation for conducting research and finding breakthrough technology, we look forward to this collaboration with Texas A&M," he says. "This key relationship represents another milestone for Gamesa as we continue to grow and enhance our research programs to advance wind turbine technology in the U.S."

The 4.5-megawatt platform G10X is Gamesa's most ambitious program and is the industry's most powerful onshore product to date. It has a tower height more than 30 percent taller than the Statue of Liberty. With its state of the art proprietary control technology and blade design, the G10X will be able to produce a 50 percent greater generating capacity than the current technology, with both greater efficiency and at a reduced noise level. Each G10X, when connected to the grid, will add power output equivalent to the annual consumption of more than 3,000 homes. Construction will take place at the Alternative Energy Institute Regional Wind Test Center at Nance Ranch, a West Texas A&M research facility. Learn more at www.gamesacorp.com.

TRANSPORT SERVICES FROM DMI INDUSTRIES

DMI Industries, a recognized leader in wind tower manufacturing, has expanded its offerings to the wind energy industry with the addition of transport services for large-scale components. The announcement was made during the American Wind Energy Association annual conference. The new service is now available from DMI through a partnership with E.W. Wylie Corporation, a fellow Otter Tail Corporation company and experienced heavy haul provider to the industry.

"Providing greater value for our customers continues to drive our business strategy," says Stefan Nilsson, president of DMI. "Hauling large-scale components to project sites safely, timely, and cost-effectively remains a challenge for our customers. We believe this new service from DMI addresses these challenges."

In the partnership DMI takes the lead on all aspects of sales and account management for wind-related hauling of components such as tower sections, blades,

nacelles, transformers, and other large-scale components. Deliveries are executed by E.W. Wylie and their modern tractor-trailer fleet capable of loads up to 120 tons and 185 feet long. The fleet includes specialized equipment like schnables and blade trailers.

"It is a relationship that makes sense for our customers and for the industry," says Brian Gast, president of E.W. Wylie. "Both of our companies are well respected in the wind business and are supporting the efforts of the same organizations to get project sites up and running. By joining forces we are offering a single point of contact to ease the effort of getting components to the site, and giving confidence in safe and timely deliveries."

DMI is a heavy steel wind tower manufacturer with facilities located in North Dakota and Oklahoma in the United States and Ontario, Canada (see profile in the January 2010 issue of *Wind Systems* magazine, www.windsystemsmag.com). DMI offers transport services for large-scale wind energy components such as tower sections, blades, nacelles, transformers, and other components. The company also has capabilities to produce equipment for a wide variety of industries including agricultural processing, ethanol production, oil and gas extraction and processing, and water and wastewater processing. For more information, visit www.dmiindustries.com.

SKINTOP CLICK FROM LAPP USA

The new SKINTOP® CLICK represents the most innovative cable entry system in today's market. With its unique latching design, cable mounting can now be accomplished up to 70 percent faster. With no threads to cut or locknuts to screw in place, installation time is greatly reduced and is possible without ever opening an enclosure. Simply click the gland in and it is fixed, centered, strain relieved to EN 50262, and sealed to the protection class IP68.

The SKINTOP CLICK offers the same proven reliability, performance, and anti-vibration protection of the original SKINTOP cable gland, with the added benefit of the quick-click design for quick and easy mounting of the gland in any position. No special mounting tools, additional clamping rings, or locknuts are needed, resulting in greatly simplified installation. This fast and flexible cable entry system can save valuable installation time on a wide range of applications, including switch cabinets, automation systems, and plant construction. It provides the perfect solution for hard to reach dual wall enclosures and limited space applications where locknut installation is difficult. In addition, large panel jobs that previously required two installers can now be completed with just one person.

The new cable gland range also includes the SKINTOP CLICK-R with a reducing seal insert for tightening of smaller clamping ranges, as well as the flexing, SKINTOP CLICK FLEX version for additional safety against overstress and conductor breakage in applications such as hand held equipment, moving machinery, and robotics. For more information call (800) 774-3539 or visit www.lappusa.com.

NEW JUNCTION BARRIER SCHOTTKY DIODE SERIES FROM CREE

Cree, Inc., a market leader in silicon carbide power devices, announces the industry's first commercially available Z-Rec™ 1700-V Junction Barrier Schottky (JBS) diode products. Leveraging silicon carbide's unique advantages over silicon to virtually eliminate diode switching losses, these diodes are targeted at high-voltage power conversion applications in motor drive, wind energy, and traction systems. Initial products in the 1700-V series include 10-A and 25-A JBS diodes in die form, ready for integration into 1700-V power modules ranging from 50 to 600-A. The new 1700-V JBS series can increase the efficiency, reliability and longevity of power systems while also reducing the overall system size, weight and cost.

"The 1700-V diodes extend our leadership in energy-efficient power systems for data center and solar power markets to new markets such as wind energy, train, tram, and electric vehicle power converters," says Cengiz Balkas, vice president and general manager, power and RF. "Cree has the diodes of choice when high-efficiency power systems are a must. The advantages of silicon carbide are clear, and for high-voltage, high-frequency systems you can't afford not to use SiC."

"ABB has been closely involved with the development of SiC technology for many years," according to Francisco Canales,

senior principal scientist, ABB Corporate Research. "SiC diodes and switches provide an important step forward in technology that allows the increase of operation frequency, reduced size and weight while providing state of the art efficiency in applications such as motor drives and solar inverters. The 1700-V devices now being launched by Cree are an important step in the development of this technology." For more information go to www.cree.com/power.

INTERTEK OPENS TEST CENTER FOR SMALL WIND TURBINES

Intertek—a global leader in testing, inspection and certification services—has announced the opening of an open-air test site for small wind turbines. The test site in Otisco, New York, together with the company's nearby Cortland lab, is the only wind testing facility in North America that is operated by an OSHA-acknowledged NRTL (Nationally Recognized Testing Laboratory) capable of providing small wind turbine system and electrical component certifications. Third party certification—including Intertek's ETL Mark for the U.S., Canada, and Europe—demonstrates the compliance to national and international safety standards.

Government incentive programs for clean and renewable energy are a key driver in the rapidly growing international wind power market. Intertek tests wind turbines and provides data for program managers to determine product eligibility for incentive programs. As a recognized third party testing company Intertek increases sales opportunities for manufacturers by providing verification of compliance with national and international wind turbine efficiency, performance, and safety requirements.

"Intertek's new small wind test center is significant to both buyers and sellers of small wind turbines," says Brian Kramak, director of energy services. "Buyers of wind turbines have reliable third-party verification of important safety, acoustic, and performance data. Sellers of wind turbines are able to demonstrate compliance to regulatory requirements and incentive program requirements."

Intertek will test and certify small wind turbines for durability and performance according to the new AWEA 9.1 Small Wind Turbine Safety and Performance standard, and also the newly released Canadian standards such as CAN/CSA C61400-2, creating a one-stop shop for complete U.S. and Canadian wind turbine testing and certification requirements. Intertek will also test for manufacturers that wish to use other certification bodies, such as the Small Wind Certification Council (SWCC).

The facility will support testing of several small wind turbines at the same time, from the smaller micro-turbines of a few hundred watts up to the "largest" small wind turbine of 200m^2 swept blade area—about 50-60kw. Using remote access monitoring, Intertek will

generate 24/7 data to evaluate a range of real world environmental conditions, as required by the AWEA, Canadian, and international wind turbine standards. The test center complements Intertek's existing market-leading capabilities for testing and certification of electrical components and systems including generators, inverters and controls among others. Learn more at www.intertek.com/wind.

NORTH AMERICA'S FIRST FRESHWATER OFFSHORE WIND FARM ANNOUNCED

Ohio Governor Ted Strickland announced a partnership between GE and the Lake Erie Energy Development Corporation to harness the wind power of Lake Erie and develop the first freshwater offshore wind farm in North America. Strickland made the announcement at the American Wind Energy Association's annual WINDPOWER Conference in Dallas.

"Ohio's greatest potential for creating wind energy is offshore in Lake Erie, and this partnership marks a significant step forward," Strickland said. "In Ohio we have all the right assets to make offshore wind energy successful, including an innovative workforce and the manufacturing strengths that would allow us to build all the component parts for wind turbines. This partnership will not only advance offshore wind technologies, it will also advance Ohio's economy. We are eager to continue the state's strong collaboration with GE and LEEDCo as we pursue this exciting, first of its kind initiative for Lake Erie."

The partnership and project is a significant step towards accelerating the deployment of offshore wind in the Great Lakes. GE has committed to providing offshore wind turbines and maintenance services for an initial 20-megawatt wind farm. Upon its completion, targeted for late 2012, this project would be located off the shores of Lake Erie near Cleveland. This would be followed by subsequent projects with a long-term goal of 1,000 megawatts in the Ohio waters of Lake Erie by 2020. These activities will support a shared vision of making the Great Lakes a major economic engine for Northern Ohio, capitalizing on the region's skilled workforce and expertise in advanced manufacturing. The LEEDCo-GE partnership builds on the momentum of a four-year effort by The Great Lakes Energy Development Task Force and other Ohio partners to establish an offshore wind industry on Lake Erie, leveraging the region's strong manufacturing base.

In addition to collaborating on the initial 20-megawatt project, GE and LEEDCo will create a strategic plan to identify opportunities to make offshore wind energy in the Great Lakes economically viable, and also work jointly on advocacy and public policy issues to increase support for offshore wind energy. For more information go to www.ge.com/energy or www.leedco.org.

ROMAX OPENS WIND ENERGY TECHNICAL CENTER IN COLORADO

Romax Technology is opening a new technical center in Colorado in response to the growing demand for their technical consultancy services from the U.S. wind energy industry. Located in Boulder—a nationally recognized hub for wind energy technical excellence and innovation—the facility will provide a center for Romax's wind engineering excellence, enabling the delivery of key projects with local wind energy clients and partners. Adding to the company's 10 worldwide offices, and complimenting an established technical and sales team in Troy, Michigan, the facility will focus solely on the delivery of products and services for wind energy.

Recent growth in the U.S. wind industry has created strong demand for Romax's wind energy products and services, which include component and system level drivetrain design and simulation as well as manufacturing, testing, and certification support. "Over the past four years, the U.S. wind energy market has earned its position as one of the largest in the world," according to Dr. Ashley Crowther, U.S. engineering director for wind energy at Romax, "with domestic and foreign manufacturers all aspiring to meet the needs of this fast growing market."

The technical center will initially provide support to important American wind initiatives such as NREL's Gearbox Reliability Collaborative as well as assisting wind turbine and component manufacturers to supply exceptional products to the U.S. market. The first long-term technical partner to be supported by the new center is Boulder Wind Power (BWP). Identifying Romax as a key technical partner, BWP intend to design, develop, and eventually manufacture large multi-megawatt, direct drive wind turbines. Romax will lend their expertise to achieve a reduction in development time, providing BWP with design, analysis, dynamics, and instrumentation experience for the whole direct drive turbine drivetrain.

"This new facility strengthens Romax's ability to deliver local development programs and provide mission-critical technical support on drivetrain issues to the wider U.S. wind industry," says Andy Poon, director of wind energy at Romax. "In addition it will enable Romax to work more closely with research partners to advance wind turbine technology, ensuring we play a dedicated and active role within the U.S. wind industry." Visit www.romaxtech.com for more information.

SECOND-GENERATION LIDAR FROM NRG SYSTEMS AND LEOSPHERE

NRG Systems, manufacturer of wind measurement equipment, and Leosphere, a specialist in lidar for

atmospheric observations, announces the introduction of the WINDCUBE® v2, the lightest, most compact lidar remote sensor available. Used in site assessment and wind farm performance monitoring, it collects actual measurements at heights up to 200 meters, mapping the vertical wind component, wind speed, and direction, turbulence, and wind shear.

"Lidar has quickly become the must-have tool in resource assessment," says Alex Sauvage, president and CEO of Leosphere. "Over the past year our two companies have worked tirelessly to enhance the portability and durability of our lidar remote sensor, making it ideal for complex terrain, remote locations, and offshore."

Weighing 45 kg and measuring approximately 55 cm square, the WINDCUBE v2 features no internal moving parts, multiple communications options (including satellite), low power requirements (45 watts), and an all-weather enclosure. The quiet, ultra portable 200m wind profiler includes 10 programmable measurement heights, providing ready to use data.

"By collecting actual measurements of the entire swept area of the wind turbine, the WINDCUBE v2 improves data accuracy and reduces overall uncertainty of the wind farm design," says John Norton, COO for NRG Systems. "Improved certainty can make the difference between project success or failure."

The WINDCUBE v2 is an active remote sensor that operates by emitting a laser pulse through the atmosphere. Along its path the laser light is backscattered by aerosols in the air and received by an optical sensor in the lidar unit. These signals capture the shift in atmospheric particles, or the absolute wind speed in the lidar line of sight. For more information visit www.lidarwindtechnologies.com. Also go to www.leosphere.com or www.nrgsystems.com.

SECOND WIND SAILS TOWARD WIND DATA COLLECTION LANDMARK

Confirming that wind power companies are using its Triton Wind Profiler systems widely and relying on them

heavily, Second Wind announces that Triton has amassed more than 900,000 hours of global wind data and will hit the one-million-hour mark soon. "At the rate Triton units all over the world are now collecting data, we easily surpassed the one million hour mark in June," says CEO Larry Letteney. "Seeing such a large data set accumulate after just two years in the field tells us that customers are using their Tritons aggressively to gather diverse data sets to make the best decisions for locating wind turbines."

Triton is a ground-based profiling unit that employs SODAR—SOund Detection and Ranging, a variation on radar but with sound instead of radio waves—to measure wind speed, direction, and other data. Reports issued by the U.S. National Renewable Energy Laboratory and ECN Wind Energy Research Center of the Netherlands in 2010 and 2009, respectively, credit Triton with accuracy comparable to that of meteorological towers, which are the current standard for wind data collection. Triton remote sensing systems give wind power companies a mobile, ground-based complement to tower-based data collection. It broadens the range of data wind companies have for siting turbines in the most productive locations possible, profiling winds as high as 200 meters off the ground. There are 125 Triton units deployed in 15 countries across the globe.

"I think there is a great future for remote sensing," according to Andrew Garrad, president of GL Garrad Hassan, one of the world's top renewable energy consultancies. "The combination of SODAR devices and traditional anemometry is a very good one, and GL Garrad Hassan is already using remote sensing data in combination with conventional methods and data."

Triton's data collection landmark is among several important milestones Second Wind has passed recently. The company is celebrating its 30th anniversary this year. It recently sold its 10,000th Nomad wind resource data logger, which is destined for a prospective wind farm site in Texas, the nation's largest wind power producer. Nomad units are deployed on seven continents, from the Arctic to Antarctica, with each unit compiling data from as many as 20 weather sensors. Second Wind ranked on the Inc. 500 list of fastest-growing privately held companies for the past three years, and was named a finalist in the "Excellence in Renewable Energy Awards" competition for Triton, which was commercially introduced in 2008.

"The real satisfaction in being around a long time, as we have, is getting to see what you've worked for pay off in a big way," says Chief Technical Officer and Co-founder Walter Sass. "The company has learned a lot and done a lot over the last 30 years as wind power technology has developed. Now that wind power is a serious item on the national agenda, we're in a great position to take those 30 years of experience and turn them into 30 more years of success." Learn more at www.secondwind.com.

YAW POSITION SENSOR FOR WIND TURBINES FROM MICRONOR

MR200W series yaw position transducers monitor yaw position, direction, speed, and cable twist while providing proper feedback to the wind turbine's yaw directional motor drive and brake control systems. A unit can be multifunctional and integrate any combination of electromechanical limit switches, rotary encoder, resolver, or potentiometer. Anti-backlash POM (polymer) pinion gear optimizes coupling to the turbine's large yaw bull gear for long term reliability, accuracy, and repeatability.

Specially engineered for wind turbine applications, MR200W series yaw position transducers monitor position, direction, speed, and cable twist while providing the necessary feedback to the yaw directional motor drive and brake control system. These products are based on Micronor's proven modular sensor and control technology developed and refined over 40-plus years of industrial product experience. An MR200W series position transducer can be multifunctional and integrate any combination of geared limit switches, rotary encoders, resolvers, or potentiometers. For increased accuracy and repeatability the unit can be supplied with an external anti-backlash POM (polymer) pinion gear that optimizes coupling to the wind turbine's large yaw bull gear.

Micronor is a leading supplier of rugged and reliable components for industrial automation and process control industries. Motion control products include encoders, resolvers, fiber optic position sensors, rotary limit switches, geared feedback transducers, cam timers, motorized potentiometers, manual pulse generators and handheld teach pendants. Micronor was founded in 1968 and has regional headquarters in both the United States and Europe. Contact Dennis Horwitz, VP of sales and marketing, at (805) 499-0114, sales@micronor.com, or www.micronor.com.

MAINSTREAM CHOOSES ZEPHIR LIDAR FROM NATURAL POWER

One of the leading developers of renewable energy, Mainstream Renewable Power, has completed the first extensive wind assessment campaign in Latin America using Natural Power's ZephIR lidar which, based at ground level, provides remote wind measurements from 10-200 meters to aid in the development of new wind farm sites.

The deployment was in the challenging terrain of the Atacama Desert, II Region, a virtually rainless plateau covering a 600 mile strip of land on the Pacific Coast of South America. Temperatures can rise to an extreme of

Continued on page 60 >

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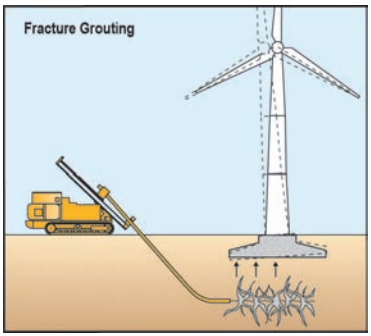
Eric Drooff
Hayward Baker, Inc.

A proven technique for correcting settlement, soil fracture grouting is a cost-efficient alternative to complete reconstruction of the foundation.

WIND TOWERS FOUNDED ON SPREAD FOOTINGS may occasionally settle as a result of incomplete soils information or inadequate subgrade preparation. When excessive total or differential settlement occurs to wind towers founded on fine-grained soils, soil fracture grouting may be the correct solution for releveling and providing long-term support. For foundation applications, soil fracture grouting is most commonly used as a remedial measure to counteract ongoing consolidation settlement in fine-grained soils, or for the pretreatment of marginally stiff, fine-grained soils that might otherwise require the use of deep foundations.

Soil fracture grouting—also known as compensation grouting, or soilfrac—is the locally confined and controlled fracturing of the ground with neat fluid grout at pressures in excess of the hydro-fracture pressure. The bearing capacity and shear resistance of the in situ soils is increased, and heave is induced to counterbalance settlement. The technique can be selectively controlled to produce deflection of varying amounts at specific locations. Soil fracture grouting has generally found a commercial niche in its application in fine-grained soils where permeation and jet grouting are not possible. Ground improvement via soil fracture grouting is based on three mechanisms:



1) The soil unit, or skeleton, is reinforced by a series of hard grout lenses which propagate out from the injection point to form a matrix of hard grout and soil;
2) The fluid grout finds and fills voids and causes some compaction in more coarse grained soil along the grout lenses;
3) The plasticity index of saturated clays decreases through the exchange of calcium ions originating from cement or other fillers.

Soil fracture grouting uses injection pipes known as Tube-a-manchette (TAM) pipes to deliver the grout. TAM pipes are typically 2-inch diameter steel pipes with injection ports every few feet along the length of the pipe. Rubber sleeves (manchettes) cover each injection port and serve as one-way valves that open during injection and collapse onto the ports after injection. The TAM pipes are installed in boreholes in a designed pattern beneath a foundation to allow injection over the entire foundation area. Depending on site access, TAM pipe inclinations can range from vertical to horizontal to create a treatment zone. Once the TAM pipes have been inserted into the borehole, the space between the TAM pipe and borehole wall (annulus) is filled with a weak but stiff grout that seals and stabilizes the borehole and holds the TAM pipe in position. A pneumatic packer is then pushed into the TAM to a specified injection point. Rubber seals at each end of the packer are hydraulically inflated to isolate the injection port. The initial pressure of the fracture grout breaks through the annulus, permitting it access to the soil. Once the hydro-fracture pressure of the soil is exceeded, fractures open up in the soil and are immediately widened by the subsequent grout.

Once the target grout zone has been reinforced and the structure has been releveled, monitoring must continue to assess long-term stability. TAM pipes can remain in the ground beneath the foundation for many years, allowing for repeated injections to further relevel and stabilize long-term movements created by secondary consolidation.

An effective quality control program requires that all stages be monitored and fully documented. Automated, real-time monitoring of structural movement is accomplished with water level systems or electro levels during injection to verify the effectiveness of the work. Grout mix, injection pressure, volume, and pump rate are also carefully designed based on the ground conditions, and monitored to help to ensure effective production work.

For more than 25 years soil fracture grouting has been used to lift and relevel foundations of structures including bridge piers, electrical equipment pads, and high- and low-rise buildings throughout Europe and North America. Wind tower construction can take advantage of this effective, cost-efficient alternative to complete reconstruction of the foundation system.

Eric Drooff is a senior vice president for Hayward Baker, Inc., the leading specialty foundation and ground improvement contractor. He can be reached at erdrooff@haywardbaker.com. Go online to 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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Merritt Brown
Rev1 Power Services, Inc.

The worldwide growth of the wind industry, in addition to the number of turbines coming off warranty, is leading to a vibrant—and valuable—aftermarket.

IN A POST-WARRANTY environment, owners and operators who seek to reduce O&M costs through parts management must begin with an understanding of the cost elements associated with wind farm operation. Ideally, inventory spares need to be close enough to ensure minimum downtime of the turbine asset. If the operator can predict which parts will be needed, as well as when and where, they can provide better service while reducing inventory costs. While parts related to operations and scheduled maintenance can be estimated, unscheduled maintenance is difficult to predict and can result in a substantial portion—some 30-60 percent—of the total O&M cost. To minimize this impact spare parts cost, availability, quality, and lead times should be administered under a proactive supply chain management program.

Not only is the wind power industry strong in the United States, it is growing around the world. Over 38,000 MW of wind power was installed worldwide in 2009, led by the U.S. and China. On a continued trend of doubling in size every three years, the impact will be felt across the global supply chain, not just domestically. The installation of new wind projects has driven up the total volume of turbines and the number of parts and spares, as well as service requirements. Concurrently, the median age of turbines is also rising, leading to increased demand for parts that are prone to wear and tear. Many factors impact a wind turbine's supply chain, such as the worldwide demand for steel and other commodities, availability of equipment large enough to manufacture and transport the large components, and fluctuating foreign exchange rates. Some OEMs based overseas have recognized the impact that transport has on the cost of their turbines, shaving off nearly 20 percent by setting up shop in the country of sale. With such names as GE, Clipper, Acciona, and Vestas already having U.S.-based manufacturing centers, recent announcements by Alstom, Fuhrlander, and A-Power continue to shape the domestic supply chain for the wind industry. Further enhancing the U.S. supply chain for large components are announcements by Polymarin Composites and Wind Water Technologies, Brevini, Moventas, and TPI that they will convert or build new factories for blade and gearbox manufacturing.

Although many of the parts used on a wind turbine are unique to the manufacturer and the model, a domestic component aftermarket is quickly taking shape. This is good news since an aftermarket environment can often benefit the turbine owner. According to AWEA's 2009 Annual Wind Energy Market Report, the largest category of new U.S. manufacturing facilities supporting the wind industry was for turbine subcomponents such as bearings, electrical components, and hydraulic systems. Between 2007 and 2009 the U.S. wind energy industry opened, announced, or expanded over 100 facilities, bringing the total of wind turbine component manufacturing facilities now operating in the U.S. to over 200. In a Kansas wind supply chain survey, 66 percent of the 227 product supply companies have planned future expansions to support the growing wind industry in the United States. Companies that once exclusively produced components for the transportation industry, for example, are turning toward wind component manufacturing as a replacement business. While the supply of gearboxes remains with only a few manufacturers, aftermarket repair companies are coming out of the woodwork. Rebuild services for gearboxes, generators, and electrical components are now commonplace for most machines.

The current economic recession was a much-needed intermission to allow the wind industry's increasing supply chain to prepare for the growth in the coming years. This time allows not only the OEM, but owners and operators to reevaluate the parts supply chain and to plan ahead and more accurately forecast the true O&M costs. Identifying critical components allows the operator to direct their failure analysis, inventory, and logistics efforts on areas that will provide the most benefit to the project. With the OEM no longer the single source of spare parts, operators can look to alternate and more-local parts suppliers.

Merritt Brown is director of business development with Rev1 Power Services and Rev1 Wind. To learn more call (866) 738-1669 or go online to www.rev1wind.com.

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Jose R. Zayas / Todd Griffith
Sandia National Laboratories

The development of accurate computer-based design programs is crucial for high system reliability through improved modeling and simulation in the design phase.

WIND MANUFACTURERS CONTINUE to pursue the design and development of larger machines with larger, lighter, and more-efficient rotors. Along with growth in machine size, the capital investment for each individual wind power plant is increasing as well. Therefore, it is of paramount importance that new designs be manufactured having no major systematic flaws as they will be fielded in large numbers in remote locations with a capital investment in the range of $1 to $2 million per megawatt. The development of accurate computer-based design programs, with support from a testing program, is crucial for high system reliability through improved modeling and simulation in the design phase.

To address the technology development needs of large blades, designers have focused on design innovations to improve performance and reduce blade weight. These innovations include use of new composite materials, novel blade geometries, and optimal material usage. With adequate computer-based design programs, evaluation of new blade designs that incorporate these and other innovations can be accurately conducted to understand their effects and maximize their benefit.

In addition to final full-scale "proof" tests required by international design standards, testing is conducted to evaluate the adequacy of the design programs as well as the credibility of the computer-based models. A specialized field of testing called "modal testing" is well suited for these tasks. Modal testing is an experimental method to measure the dynamic or vibration properties of a structure. An understanding and quantification of the vibration properties is important for turbine and blade evaluation and design.

Firstly, vibration properties are readily computed using computer-based design codes. Therefore, the accuracy of design models can be determined by comparison with physical modal test measurements. Furthermore, discrepancies in the design model can be corrected by modifying the model to accurately predict the actual, measured behavior in which the sources of discrepancy could have occurred in the assumptions when building the model, or changes from the design during manufacturing.

With sufficient agreement between the computed and measured vibration properties, a high level of confidence can be attained so that computer-based design programs can be used to simulate the actual operating conditions. Hundreds of operating conditions and scenarios must be simulated in order to certify a new turbine design. Modal tests provide the measure of the quality or validity needed to evaluate the model.

Secondly, modal testing is used to identify potentially damaging operating conditions called "structural resonances." These conditions occur when a persistent load is applied at a frequency (i.e. counts per second) that corresponds to the frequency of the structure's vibration properties. When this happens the size of the motions of the structure can be very large and can cause significant fatigue damage including a catastrophic structural failure. A well-known historical example of a structural resonance that lead to a catastrophic failure regards the Tacoma Narrow's Bridge in 1940, where the wind conditions resulted in periodic loading at a structural frequency of the bridge. Because wind turbines are rotating structures, structural resonances can be excited at the operating speed and at multiples of the operating speed. Structural resonances must be identified in the design phase so that they can either be eliminated from the design or avoided during operation.

Wind turbines are the largest rotating structures in the world. The investment costs for a large wind farm containing many nominally identical turbines is significant. Modal testing is a specialized type of testing that is needed to validate a design and a model for use in computer-based design and turbine optimization. Use of modal testing for evaluation of design codes and turbine models can reduce development costs and identify potential design flaws that can result in increased maintenance costs, loss of availability, or premature component or system failure.

Jose R. Zayas is program manager, Wind & Water Power Technologies, and Todd Griffith is senior member of the technical staff, Analytical Structural Dynamics Dept., at Sandia National Laboratories. Go online to www.sandia.gov/wind.

Hüseyin Kizilagac
BDP Project Logistics

Your supply chain is only as strong as the weakest link, so don't let uncontrollable offshore supply chain costs get you in deep water.

WIND FARM MANAGEMENT, especially offshore, is a matter of economy: generate greater amounts of energy per area, and reduce the cost per megawatt. However, as the industry continues to evolve to meet enhanced power production, it also means increased challenges and risks for project managers—unknowns that push the boundaries of being able to control the transportation and logistics process and its resulting costs. Pushing the boundaries also means pushing the limits of your logistics providers. Every reduction in the cost per MW goes right to the bottom line.

Each offshore wind power project is different. The challenges vary, including moving the all-important support structures from origin to site. Steel tube monopiles are the most common, while the larger footprint multi-pile and tripods, jackets, and steel or concrete gravity base structures are also being used on a number of projects, especially as wind turbines get larger and are being located in deeper water.

SUPPLY CHAIN MANAGEMENT

As wind farm development becomes more complex, it is important to ensure that your supply chain resources are the best. Take the transport of monopiles from production sites in, say, Germany or South Korea to the United States. On a full charter basis, the costs can be significant. An experienced logistics provider can bring transportation solutions that can reduce the costs.

The Cape Cod wind farm project in the U.S. will need 130 monopiles, for instance, which requires a large number of shiploads as well as unloading and transporting to the sites. The delivery of so much heavy wind farm equipment can be a real supply chain challenge, and not only due to the size of the monopiles but also the additional cost impact.

AVOID WEAK LINKS

You know how important it is to control your project's installation, substructure, and O&M activities, but what about the transportation and logistics? Your supply chain is only as strong as the weakest link. No matter what you are transporting, selecting the right resource is important; one that has the ability to build a supply chain management solution for each offshore project, not just a "one size fits all" turnkey solution. Be wary of companies that say they have the expertise to manage complex offshore projects but do not. You must do the due diligence.

For each offshore project a supply chain management process should be developed during the initial planning process, not in the later stages. Some project logistics resources confront issues as they occur. Instead you should insist on a fixed contract to ensure that the resources deliver what was asked for. You need a company that has no limitations in its ability to manage every stage of your supply chain. Well-managed supply chains depend on planning, process, and execution; end-to-end accountability, especially at critical points. A clear plan of deliverables and contingency actions means you leave nothing to chance. It is about a full range of services, including detailed studies, transportation procurement—including chartering special transport equipment—storage, shipping, and delivery to final destination.

FLEXIBILITY IS KEY

Time is a major cost factor, and the biggest unknown. Weather and significant wave heights are likely to be major contributors to costs and plant downtime, and what happens when cargo is delivered to the harbor and offloaded but the weather is so bad that nothing can be done? This means extra costs that may not be covered in the contract.

Waiting for improved weather results in ship detentions, which are very expensive. Your provider must be able to predetermine if cargo can be handled even in difficult and challenging weather conditions.

The logistics provider should have experience at the global level, with strong local networks and relationships that can cut through red tape. A resource that can guarantee ship availability and navigate the maze of Customs clearance processes to ensuring time-critical deliveries. Those global resources are important, especially when you consider that material is often being shipped from multiple destinations.

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PROFILE

AWS TRUEPOWER

By Russ Willcutt

Already known for its expertise in wind-farm site assessment, online weather mapping, and next-day forecasting, this company broadens its market focus.

AS IS THE CASE with many successful companies, the early years are spent following lucrative opportunities that present themselves along the way. Without pausing to develop a strategic plan, however, that forward momentum can sometimes lag, with the company never quite realizing its full potential. That won't be happening with AWS Truepower, which recently changed its name from AWS Truewind as a reflection of its roadmap into the future.

"When the company was established in 1983 it was known as Associated Weather Services, and soon after that AWS Scientific. It focused mainly on air quality and designing and conducting analyses of wind and solar projects," according to Michael Brower, chief technology officer. "My background is in physics, and while I was working as an independent consultant in the late nineties I began developing ideas for improving wind-resource modeling. I discussed them with Bruce Bailey, AWS Scientific's president, and we decided to bring in an atmospheric scientist, John Zack, and form a partnership called Truewind Solutions. We ended up mapping wind resources for the entire United States and several other parts of the world, and the maps were much better than anything else that was available at the time, so we decided to capitalize on that success by merging the two entities into AWS Truewind.

"The current rebranding actually signifies a return to the company's roots, in a way, since it had always intended to be involved in all aspects of renewable energy," he continues. "We want to take the suite of products and services we've developed for wind and tailor them to benefit related markets."

Those services are quite expansive, including resource assessment, energy assessment, project consulting, independent engineering and due diligence, operational assessment, and forecasting and grid management, all of which are available with the necessary modifications to both the wind and solar sectors. The company works with professionals involved in project development, investment and finance, grid management and integration, plant operations, and government planning. The products it has developed for wind include openWind®—wind farm design software offered in both a free community version and advanced "enterprise" version for engineers and scientists to use—along with eWind®, a wind forecasting service, SHARP, a plant operations assessment software, and windNavigator®, the online siting and assessment service that delivers proprietary high-resolution wind data and reports to help subscribers analyze business opportunities.

This service in particular marked a departure for the company. "Developing windNavigator was really our entry into the area of information services," Brower explains. "Until recently most of our business, except for wind forecasting, was on a traditional consulting model. We decided that it was time to expand into selling map and data products on a subscription basis. We approached this opportunity in a very deliberate way, and it's been tremendously successful for us. We're planning to begin extending our services globally, in fact."

Although most of the company's clients are currently found in North America, its international portfolio is expanding rapidly. Two years ago it established a joint venture in Barcelona, Spain, for instance, and its success has led to similar activities in Latin America and even India, with similar positive results. Wherever the location, AWS Truepower's wind and solar clients—which may expand into areas such as wave and hydro technologies in the coming years—will benefit from the detailed data the company compiles.

"One of our strengths is that a great deal of the site assessment information comes from a common source, and the same goes for forecasting," Brower says. "So we're able to efficiently provide solar forecasts because the same set of weather forecasting models drive both solar and wind forecasts."

The company's data also contributes to overcoming the challenges associated with the large-scale deployment of both solar and wind power on electric facility operations. "Take the Eastern Interconnect, for instance, which is a large area of the U.S. where there's a lot of wind and solar development taking place," he explains. "The questions being asked include how this influx of energy from renewable sources will affect system operators and the different power plants they manage. What's going to happen with the power flow to the transmission grid, and what new transmission lines will be needed? The solar and wind data that we provide through our modeling services is central to finding the answers to these questions."

Although Brower points out that wind remains the company's main line of business, he and his colleagues look forward to providing integrated solutions to a wide range of site developers. "It was time to take a close look at where we come from and what we've learned along the way, because that's the only way you can determine where you'd like to go in the future," he says. "And for us that involves rebranding ourselves as a full service, knowledge-based sustainable energy company."

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EFFECTIVE LUBRICATION FILTRATION

Clean lubricants are critical to allowing your gearbox to live up to its maximum service life, and the filtration method described by JLM Systems will help you to achieve that goal.

By Dick Gangnon

Dick Gangnon is with JLM Systems, Ltd. Call (888) 736-8645, e-mail info@oilmiser.com, or go to www.oilmiser.com.

ON ROTATING LUBRICATED MACHINERY oil cleanliness, oil sampling, and oil analysis are generally recognized as the cornerstones for what's known as "reliability centered maintenance." For this reason most manufacturers of powertrain components and industrial gearboxes specify oil cleanliness levels in their warranty, but few make provisions for implementing the necessary maintenance procedures. That's why you need to know about kidney-loop filtration.

For installations that work 24/7, the best choice for extending the service life of a critical gearbox is a kidney-loop filtration unit; the oil dialysis machines for lubricated machinery. Most discussions on this system will focus on the filtration unit, and not on the gearbox it services. A more meaningful discussion will start with the gearbox and lubricating oil, ending with the filtration system that best meets the requirements of the job.

THE GEARBOX

For most gearboxes mechanical reliability starts with an air breather that vents the inside air space to the outer atmosphere. Without a clean and well-functioning air breather daily temperature fluctuations can generate a pressure rise or a vacuum inside the gearbox. Both are a leading cause of premature seal failure, and too often the original air breather is not up to the job.

Generally the vent port is also used for the oil fill port, and it is the only access port on top of the gearbox. In addition to this top port there will be one or more bottom drain plugs, and possibly a side port

with a sight glass to check the oil level for the safe and continuous operation of the gearbox.

A kidney-loop filtration system is totally independent of the designed lubrication system for the gearbox. It can be turned on or off, or it can run continuously without compromising the lubrication requirements of the gearbox. When turned on the kidney-loop system must insure that the oil removed from the gearbox for polishing is returned at precisely the same rate. To add the benefits of this filtration system to any gearbox there are three prerequisites: a high-quality air breather to protect the air space above the oil; an oil outlet at the bottom of the gearbox for the suction hose to the filtration unit; and an oil inlet on top of the gearbox for the return hose from the filtration unit.

Fig. 1: The gearbox breather.

Fig. 2: An oil inlet on top of the gearbox for the return hose from the filtration unit.

OIL VISCOSITY AND LUBRICATING OILS

A youngster may not have heard of Sir Isaac Newton or viscosity, but he understands fluid mechanics when he chooses the big straw over the skinny one every time. Viscosity is a measure of fluid friction, and it is resistance to flow within a controlled space at a given temperature. A kidney-loop procedure will be most effective when the lubricating oil is in full circulation, at normal operating temperature, at its lowest viscosity, and with the gearbox operating at full load.

Working back from the gearbox, the first consideration for an efficient kidney-loop filtration system is the connecting hoses and fittings. The next challenge is using the fewest connections, with limited twists and turns and the shortest hoses. But the biggest challenge is getting the filter cart as close to the gearbox as possible while keeping safety for the service technician, the machinery, and the environment front and center.

Filtration and filter media technology have improved immensely since inline oil filters were first introduced decades ago. At the time it was well understood that a machine would run longer on dirty oil than it would on no oil. Filter heads were fitted with a bypass mechanism to maintain an uninterrupted flow of lubricating oil even when the filter element was plugged with contamination. Today the filter heads used on most filter carts are essentially unchanged.

True kidney-loop filtration is independent of the machine's normal lubrication system. The logic of this type of system says that a filter in bypass is no longer part of the solution, it's part of the problem since unfiltered oil is being circulated back to the gearbox.

FILTER CARTS

There will always be a debate over the type and number of filters used on a filter cart. The most common

Kidney-Loop Filtration: A Quick Checklist

- ❑ Make it easy to do a better job. Pre-install hose connection points and oil sampling valves on all gearboxes, standardizing maintenance procedures throughout the facility.
- ❑ Locate the kidney-loop connection points on the machine, where it is safe and convenient for the service technician.
- ❑ Keep the suction line as short as possible, and use the fewest number of fittings.
- ❑ Get the filter cart as close to the machine as possible. Accessibility is the key to maintenance procedures that get done on schedule.
- ❑ Color code machinery. Clearly identify the type and grade of lubricating oil for each machine.
- ❑ Avoid cross blending of lubricating oils. Dedicate a filtration unit to each lube oil grade specification.
- ❑ Confirm the accuracy of the condition indicator and the pump bypass pressure. The dirt holding capacity of an oil filter increases with a higher differential pressure.
- ❑ An oil filter is less stressed and more effective when the oil flow is ripple free and the flow rate is low.
- ❑ True kidney-loop filtration is independent of the machines designed lubrication system. It can be turned on and off on demand.
- ❑ A filter bypass valve begins to bypass unfiltered oil at a cracking pressure, generally well below the rated bypass pressure.
- ❑ Circulating unfiltered oil runs contrary to the ultimate purpose of kidney-loop filtration.
- ❑ Use the type of pump that is best suited to the fluid being pumped.
- ❑ Choose a filter unit that is equipped with a pump that incorporates a built in and adjustable relief valve.
- ❑ A single non bypass filter takes the uncertainty and the guess work out of a filter change out.
- ❑ A single filter element reduces the amount waste oil for disposal.
- ❑ Choose a filter cart where you can select "filter" or "no filter" on the job. Waste oil does not have to pass through the main filter.
- ❑ A secondary output flow path can accommodate an auxiliary duplex filter on the operating floor, significantly increasing productivity.
- ❑ For the highest viscosity lube oils consider an electric motor with a lower rpm like 1150 rpm instead of 1750 rpm.

Fig. 3: A typical filter cart.

filter carts use two 5-inch diameter spin-on oil filters. The first oil filter is called the prefilter, and the second is called the final filter. Each filter head will have a filter condition indicator and a bypass mechanism, usually rated for 25 psi. When the bypass valve begins to open in the prefilter, unfiltered oil passes through to the final filter. At this point the filter cart is effectively a single-filter unit.

The gearboxes that keep a facility up and running are not in the maintenance shop. They are on a crowded operating floor, on an overhead catwalk, at the end of ship loading boom, or 200 feet straight up in a wind turbine. The filter cart has to be pushed, pulled, or dragged to wherever the gearbox is located.

Changing out an oil filter is a messy business and best done in the maintenance shop, not on the operating floor. Back in the maintenance shop the real question is more than the time and cost of changing out just the prefilter or both filters; change only one and there is the risk of cross blending oil grade specifications if the filter cart is used on other applications. And then there is always the cost of the waste and disposal of a gallon or more of lubricating oil.

THE KIDNEY-LOOP FILTRATION UNIT

For lubricating oils with a wide range grade specifications and viscosities, pump selection becomes an important consideration. The heart of a kidney-loop filtration system is the pump, and the heart of a pump is the rotating group.

A fluid can only flow downhill, or move to fill a vacuum. The pump's rotating group is turned by an electric motor to create a partial vacuum on the suction side of the pump. The vacuum draws lube oil out of the gearbox through the suction hose to the inlet port of the pump, where it fills the cavities of the rotating group. The rotating group carries the oil over to the pressure side of the pump, forcing it through the filter and the return hose back into the gearbox. The performance and efficiency of the pump is determined by the amount of oil that reaches the pump and completely fills each cavity in the rotating group. With the viscosity of the oil specified by the gearbox manufacturer, the four external factors that influence the performance and efficiency of the pump are: the inside diameter of the suction hose; the length of suction hose and number of connections; the type and configuration of the pump's rotating group; and the speed of the pump's rotating group.

The most common pump is the gear pump. It works well with hydraulic oil and lighter lubricating oils. By design, it has a limited range for lube oils. The small cavities created by the internal spur gears, the close tolerances required for higher pressure, the knife-edge gear tooth form, and the fixed outer gear housing all combine to severely limit its suitability for the higher-viscosity oils.

The rotating group of a gerotor pump—sometimes called a crescent pump—is better suited for higher-viscosity lube oils. The motor-driven internal gerotor drives the external rotating gerotor to create larger and fewer cavities with rounded corners. This rolling action of the two gerotors creates cavities that open and close more smoothly. This significantly reduces the shearing of the lube oil in the pump, reducing noise, aeration and cavitation, and delivering a ripple-free oil flow. This puts less stress on the filter media, increasing the dirt-holding capabilities of the filter media. Turning the rotating group at a lower rpm improves all aspects of the pump's performance, particularly at the higher end of the viscosity curve.

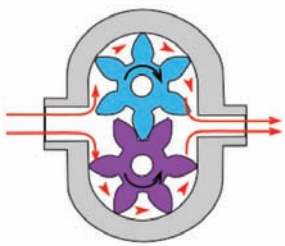


Fig. 4: The gear pump.

Fig. 5: It's important to have an adjustable relief valve built into the pump housing.

The most important feature, however, is having an adjustable relief valve built into the pump housing. This eliminates the need for a bypass valve in the filter head and insures that only polished oil can be returned to the gearbox. When the relief valve is set at 60-80 psi it significantly increases the dirt-holding capacity for an oil filter that would otherwise bypass at 25 psi.

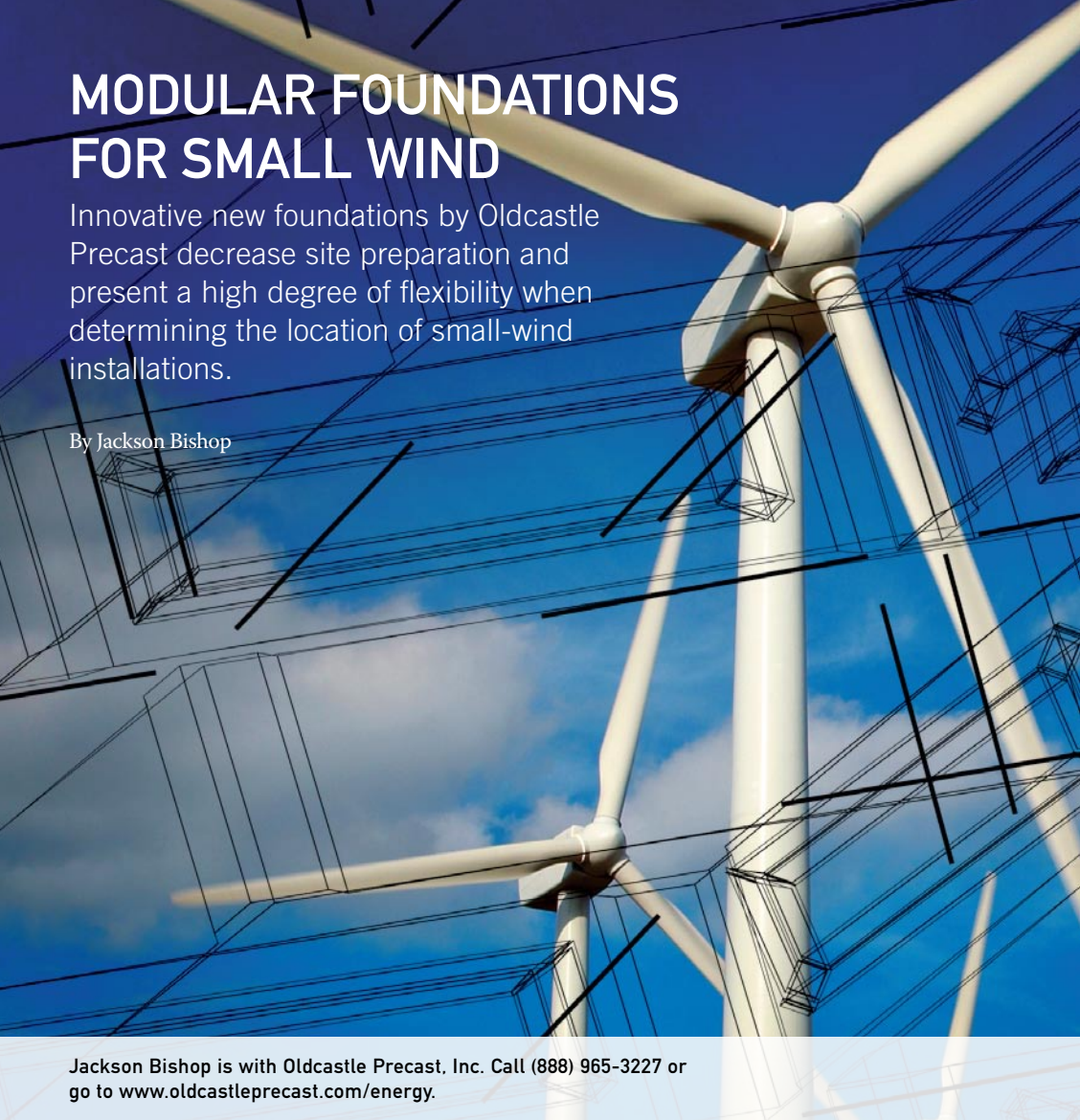
WORKPLACE PRODUCTIVITY

For the service technician, maximizing productivity is essential. One feature of a kidney-loop filtration system that can pay huge dividends is a secondary output flow path. Some gearboxes will have to be drained and the oil transferred to secondary containment, allocated to different applications, or disposed of. By selecting the secondary flow path the used oil can be drained off without fouling the main oil filter. The second outlet can also be fitted with a backup oil filter on the operating floor to continue with kidney-loop filtration without the need to retune the filter cart to the maintenance shop for servicing.

MODULAR FOUNDATIONS FOR SMALL WIND

Innovative new foundations by Oldcastle Precast decrease site preparation and present a high degree of flexibility when determining the location of small-wind installations.

By Jackson Bishop



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THE IDEA OF HARNESSING THE POWER of the wind continues to grow in popularity, presenting a viable source of clean, emissions-free power and leading to an increase in the number of installed wind power projects each year. As a result, quality installation locations with sufficient wind power are getting harder to come by.

According to the AWEA Small Wind Turbine Global Market Study for 2010, "Despite an economic downturn, the U.S. market for small wind turbines—those with rated capacities of 100 kilowatts (kW)1 and less—grew 15 percent in 2009 with 20.3 megawatts (MW) of new capacity and $82.4 million in sales. This growth equates to nearly 10,000 new units and pushes the total installed capacity in the U.S. to 100 MW.2."

Whether you are planning a shopping mall or a wind farm, one of the most important factors to take into consideration is the location. With a growing number of companies cashing in on subsidies and tax incentives, there is a greater demand for quality wind project installation sites. There are several factors to consider when deciding on a location for a small wind turbine including local design wind speeds, soil conditions, geographic location, the size, shape, and distance of surrounding objects within 500 feet, site excavation/preparation needed, accessibility of the site, and the overall distance that generated power will be transmitted. Each of these factors can play a critical role in determining the feasibility of a location supporting a wind turbine. For example:

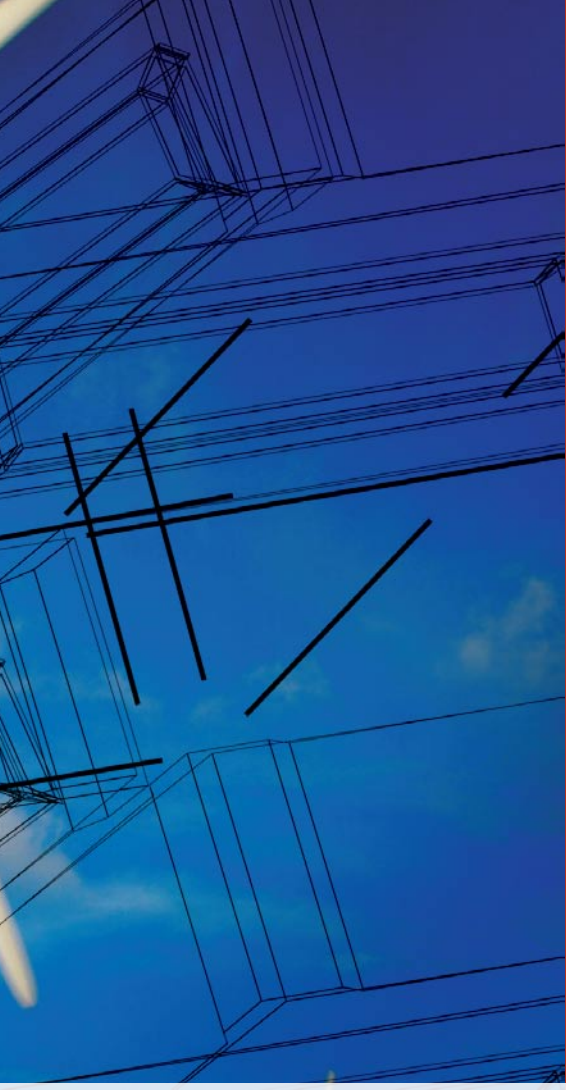


Fig. 1: Cell Blocks beneath an installed tower.

- The size and shape of surrounding objects may prevent sufficient wind from reaching the turbine, thereby reducing productivity and thus the ROI on the project;
- Some potential sites may be very difficult for concrete mixer trucks to access to pour the foundation;
- Some potential sites may have a ground surface that is impenetrable such as environmentally sensitive sites or mountainous, rocky regions where ground excavation is not practical.

While some of these factors can be reason enough to look somewhere else for a suitable location, some locations are worth the effort involved in getting the turbine installed in the right place. In some wind shear sites the wind speed can increase by 20 percent, and the power output by 34 percent for every 10 meters in elevation. The right location can make all the difference.

Small and community wind turbine systems can be supported by a variety of different foundation types depending on the soil, turbine height, and regional wind loads. Some of these support methods include driven piles, concrete piers, single piece poured in-place foundations, single piece precast foundations, and modular precast foundations.

Of these foundation methods, the one foundation system that has been getting the attention of designers and developers of wind turbine installations is the precast modular foundation. This is happening for several reasons, primarily because they are non-ground penetrating and can simply be placed in location with minimal site preparation. This makes them perfectly suited for use in locations where ground penetration is either not allowed—such as landfill or environmentally sensitive applications—or impractical due to hard to penetrate ground conditions.

Besides the previously mentioned subsidies and tax incentives the EPA has announced that they are behind the push for renewable energy projects on environmentally sensitive sites, such as landfills or Superfund sites. The following statement was issued by the White House in 2009: "President Obama and Congress are pushing to identify thousands of contaminated landfills and abandoned mines that could be repurposed to house wind farms, solar arrays, and geothermal power plants."

The Environmental Protection Agency (EPA) made this statement the same year: "The EPA is encouraging renewable energy development on current and formerly contaminated land and mining sites. The EPA has identified thousands of properties that could potentially host solar, wind, or biomass energy production facilities. The EPA used information on properties from several land cleanup programs, including abandoned mine lands and lands under EPA's Super-

Fig. 2: Positioning Cell Blocks requires little equipment or manpower.

Fig. 3: Cell Blocks can support towers, substations, and other structures.

fund, Brownfields, and Resource Conservation and Recovery Act programs."

Environmentally sensitive sites such as landfills and contaminated Superfund sites are ideal candidates for renewable energy because they are considered already disturbed lands and thereby relieve the pressure associated with developing on undisturbed or uncontaminated lands. However, many of these sites do not permit or allow ground penetration for obvious reasons. Once you get past the three feet of top cap soil you reach the contaminated soil below. This is one of the main benefits to using precast modular foundations on these types of sites: they never penetrate the soil. Additional areas where precast modular foundations are finding success include installations going in over bedrock—where penetration is difficult, if not impossible—installations with high water tables, and installations with adverse soil conditions such as corrosive soils or soils with poor passive earth-pressure characteristics. In addition to not penetrating the ground, precast modular foundation systems offer a variety of other benefits such as:

- Can be installed in remote locations where mixer trucks typically are unable to reach;
- Reduced site excavation/ preparation needed;
- Speed of delivery and installation;
- Eliminates the need for cast in place concrete and all associated issues including forming, pouring, and dry time which can dictate the pace of the installation process;
- Accommodates most site locations and conditions;
- Design performance is based on turbine asset weight, which is known precisely (on the contrary, driven piles rely on assumed passive soil pressures and other assumptions).

To meet the growing demand for precast modular foundations, a new and innovative foundation system has been developed for small and community wind turbines that will allow the harnessing of wind power on sites like landfills and contaminated Superfund sites, as well as those found in remote locations once thought unreachable.

Cell Block™ modular foundation systems—developed by Cell Blocks, Inc,. and Oldcastle Precast, Inc., for small and community wind turbines—are a precast post tensioned block system that can be assembled in a variety of configurations on site with minimal site preparation. They are designed to meet stringent manufacturing specifications for quality control and mix consistency. Cell Block modular foundation systems offer several key benefits not found in the other turbine foundation methods. One such benefit is scalability, which means the foundation can be enlarged or added onto in order to accommodate additional assets such as control buildings or shelters without interrupting the use of the turbine system. Another key benefit is that it can easily be delivered and installed with-

Fig. 4: Remote locations pose no problems.

in the same day without requiring the labor, prolonged site prep, forming, and dry time associated with other methods such as poured in place.

Cell Block modular foundation systems can also be decommissioned and reused in a different location. The post-tensioned method of connection allows the blocks to be disconnected from each other and relocated or repurposed in the event that the wind turbines they support are moved or decommissioned. This results in a tremendous environmental advantage over poured in place concrete foundations, which either require a labor-intensive effort to break up and remove the buried concrete or, more likely, leaving the concrete in place long after the turbines have been removed.

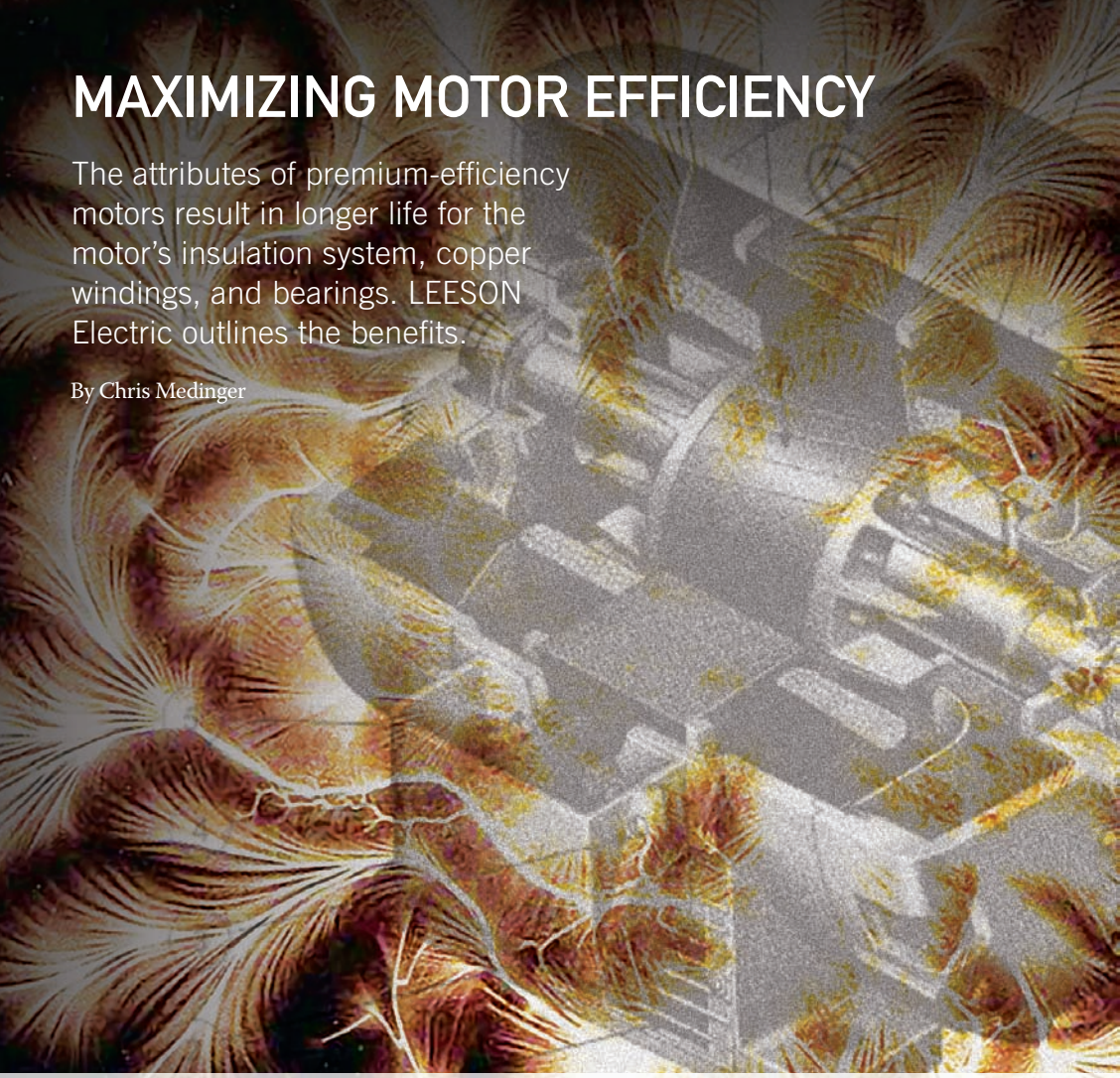
Each Cell Block modular foundation system is designed and engineered specifically for the location of the installation. The size, quantity, and configuration of the blocks are engineered based on a number of critical considerations including soil bearing pressures, regional wind design speeds, factored loads, uplift potential, buoyancy loads, and stress loads on all materials, as well as many other factors that must be considered during the design and engineering process.

Cell Block modular foundation systems offer an innovative alternative to driven piles, concrete piers, and single piece poured in place foundations. Designers and developers of wind turbine foundations are no longer constrained by the limits and labor intensive efforts that are often associated with attempting to put wind turbines in environmentally sensitive or remote locations. Having precast modular foundations as an option for supporting their wind turbines give the designers and developers more freedom to do what they do best—to go wherever the wind blows.

MAXIMIZING MOTOR EFFICIENCY

The attributes of premium-efficiency motors result in longer life for the motor's insulation system, copper windings, and bearings. LEESON Electric outlines the benefits.

By Chris Medinger



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AS READERS OF THIS MAGAZINE undoubtedly know, renewable sources such as wind and solar currently supply less than 10 percent of the energy consumed in the United States. But what if the production of this renewable resource was more efficient, enabling companies to see improved results in the bottom line and help drive the usage of wind energy?

Increasing efficiency in the conversion, delivery, and utilization of energy is an essential part of a comprehensive national energy policy. It would only make sense that alternative energy resources such as wind turbines utilize highly efficient generators or motors to create the power to the grids. The Energy Independence and Securities Act goes into effect in less than one year and specifically addresses raising the efficiency levels of industrial electric motors. A few startling statistics:

- An electric motor consumes approximately 65 percent of generated electrical energy;
- The cost of operating an electric motor can run up to 25 times the motor's purchase cost per year;
- Only about 5 percent of electrical motors have a variable speed drive to control the motor speed depending on the demand [1].

And if those numbers aren't reason enough to look at the motor in your wind turbines federal, state, county, and local governments are offering rebates and incentives to end users to help offset

the cost difference between a premium efficient motor and an EPAct efficient motor. How can a wind-turbine OEM generate more power from the wind using already well-developed equipment and more efficiently convert wind to power?

All energy sources require conversion of energy to electrical power. Obviously, the higher the efficiency of conversion, the more energy we can use productively [2]. This is where a more efficient motor can make a difference. Unfortunately, price is often the barrier. What is not realized, however, is that a motor's initial purchase price represents only 2 percent of its total lifetime costs. And while premium efficiency motors can save a lot of money, regrettably the purchase is often based initially on price rather than considering operating costs.

PREMIUM VS. STANDARD MOTORS

According to the U.S. Department of Energy, electric motors consume a large percentage of the electricity used in American industry. On average, approximately 63 percent of industrial electricity is consumed by electric motors, and it can reach 75 percent or more in certain industries. Also, motors can consume five to 12 times their initial purchase cost in energy per year. If you consider that a 25-horsepower motor running 24/7 can consume up to $15,000 in energy per year, and a 100-horsepower motor can consume up to $56,000 in energy per year, even small reductions in energy consumption per motor could result in substantial savings. Additionally, in the case of motors up to approximately 50 horsepower, the savings difference between using a standard efficient vs. a premium efficient motor could pay for the premium motor in one year. Every year after that would be money in your pocket.

So what is the difference between a standard motor and a premium efficient motor? Because of the superior designs and better materials used, premium efficiency motors tend to run at lower operating temperatures resulting in longer life for the motor's insulation system, copper windings, and bearings. Another advantage is that by generating less waste and less heat in the space around the motor ventilation requirements are reduced, resulting in additional energy savings.

The difference between a standard and a premium efficiency motor's cost can be paid off in a few months. Premium efficiency motors will always save money vs. lower efficiency units, and the savings go on for as long as the motor is in operation. In many cases this could be 25-30 years. And, not only do energy efficient motors help reduce maintenance time and costs, but they can significantly increase energy produced from wind turbines, which is a winning combination.

RESEARCH IN ACTION

Researchers at Indiana's Purdue University recently developed a technique that uses sensors and computational software to consistently monitor forces exerted on wind turbine blades, a step toward improving efficiency by adjusting for rapidly changing wind conditions. "Wind energy is playing an increasing role in providing electrical power, according to Doug Adams, a professor of mechanical engineering, director of Purdue's Center for Systems Integrity, and co-lead on this research project. "The United States is now the largest harvester of wind energy in the world," he says. "The question is, what can be done to wind turbines to make them even more efficient, more cost effective, and more reliable?" [3]

A wind turbine's major components include rotor blades, a gearbox, and generator. The aim is to operate the generator and the turbine in the most efficient way, especially since the wind towers can be 200 feet tall or more, making it very expensive to service and repair damaged components [4].

When Clemson University was awarded $45 million under the American Recovery and Reinvestment Act for a wind energy test facility, U.S. Department of Energy Secretary Steven Chu said, "Wind power holds tremendous potential to help create new jobs and reduce carbon pollution. We are at the beginning of a new Industrial Revolution when it comes to clean energy."

Introduced more than 100 years ago, electric motors resulted in enormous efficiency improvements and energy use, and revolutionized the very nature of work. Today, innovative motor engineering and manufacturing are playing an important role in increasing the productivity of the nation's energy systems, positioning themselves at the cusp of this new Industrial Revolution.

ECONOMIC STIMULATION

Your involvement in wind energy means you are probably aware that in 2008 the U.S. Department of Energy (DOE) published a report that examines the technical feasibility of using wind energy to generate 20 percent of the nation's electricity demand by 2030. Titled "20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply," the report examines the costs, major impacts, and challenges associated with producing 20 percent wind energy or 300 GW of wind generating capacity by 2030. Let's take a look at what a few states are mandating to comply with the DOE and increase their economic growth.

Michigan: Michigan's Renewable Portfolio Standard mandates that 10 percent of Detroit Edison's power generation be sourced from renewables such as wind and solar by 2015. Since this mandate was enacted, more than two-dozen companies have started or diversified into manufacturing wind turbine components. To support this Governor Jennifer Granholm proposed investing more than $100 million over the next three years to increase demand, expand production, and encourage research and development of new technologies in Michigan. One example is Global Wind Systems, which will be opening a new wind turbine assembly plant in Novi. The plant expects to hire 250 skilled trades people in May, with an additional 150 or more expected within two years, to assemble 1.5 MW wind turbines. Although many of the components will have to be initially sourced from Europe, the goal is to shift that to in-state suppliers.

Ohio: In a unanimous vote, the Ohio legislature passed a new bill

Fig. 1: Premium efficient motors meet or exceed NEMA premium efficiency standards, inverter rated 1 through 200 HP with a three-year warranty.

Fig. 2: High efficient gear reducers with input HP ratings up to 130 HP, and the design maximizes system performance 6.2:1 to 3400:1 ratios in triple and quintuple reduction offerings. Precision-cut gearing offers quiet operation.

two years ago requiring 12.5 percent of Ohio's energy to be generated from renewable sources like wind and solar. At that time Ohio became the 26th state to adopt renewable energy portfolio standards (RPS), tough new laws that are creating one of the most dramatic shifts in the delivery of energy to American consumers ever [5]. The American Wind Energy Association estimates Ohio's new RPS law on its own will result in at least $10 billion of new wind energy project investments [6]. The DOE estimates Ohio's electric generation capacity at 33,877 megawatts. Ohio's total online wind generation capacity is only 7.4 megawatts [7]; this is a miniscule 0.02 percent. There is obviously tremendous potential for growth in this state.

THE BOTTOM LINE

Conserving energy is a great idea, but companies want to see results in the bottom line: How much money can be saved by improving efficiency? High efficiency premium motors save more than $1 million per turbine for wind farm developers and wind turbine OEMs over the life of a turbine. Their unique design offers high performance at low wind speed. As mentioned, premium motors are significantly more efficient than conventional motors and they incur lower operating costs, again positively affecting the bottom line.

In these challenging economic times it is particularly important that wind farm developers and wind turbine OEMs achieve maximum ROI through new innovation, minimizing costs, and harnessing wind energy at efficient and reliable levels. Utilizing and investing in premium motors is one factor that will help achieve this.

Wind power is currently the world's fastest growing energy technology, reaching $40 billion, and the market continues to grow. As engineers create ever-more efficient models, it makes economic and environmental sense that the engine be as efficient and robust as the turbine. We are in the midst of a global recession and a decades-long slump in American manufacturing. However, as President Obama said in a speech last year at a wind energy manufacturing facility in Newton, Iowa, "The nation that leads the world in creating new sources of clean energy will be the nation that leads the 21st century global economy."

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THE POWER OF PMA CABLE PROTECTION

Wind-farm sites are becoming more remote with each passing year, and tower and turbine components must be able to withstand harsh elements—especially the cables that connect them.

By George M. Sims

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AT SEA THERE IS SIGNIFICANTLY MORE WIND than on land. That means the installation is constantly in motion so that torsion in cables, vibration, and points of abrasion can occur. The cables must be protected, naturally, so the cable protection products from PMA are employed. In system construction there is successively less space available for electrical components. Cramped cable ducts, junction boxes full to the bursting point, and extensive EMC protection elements (e.g. EMC shielding) can cause cables and wiring to experience abrasion or chaffing on the edges of electrical components, cabinets, etc., above all when vibration and permanent movement are involved. Cable protection is therefore necessary.

POLYAMIDE CABLE PROTECTION

The PMA conduit PCS was specially developed for external applications exposed to high mechanical stress. The conduit is very flexible, allowing it to be formed around sharp angles and curves. Additionally, metal conduits must be sawn to length, whereas the polyamide conduits can in next to no time be trimmed to the correct length with a pair of scissors or a pocket knife. It is manufactured from specially modified PA12 raw material supplemented by additives to improve the already excellent weathering resistance of the PA12 material. This provides a life expectancy in predominantly static applications such as those in excess of 25 years. PCS also has very good low

temperature characteristics, which is very important because the system is exposed to the elements in summer and winter. Polyamide is hygroscopic, absorbing and giving up water to the surrounding air depending upon the humidity. With PA12 this effect is less pronounced, ensuring that even with low humidity the material retains very good impact resistance.

In order to produce the right product for the right application it takes a state of the art production facility that carries out intensive R&D activities using the latest production technologies. Intensive research and development also consist of intensive product testing, which includes dynamic reverse bending, impact strength, compression strength, system pull-out strength, peak load, self-extinguishing flammability resistance, thermal aging, and cold bending, etc. Not only is the test important, so are the test methods themselves.

Test methods consist of Reversed Bending Test with Swinging Movements. This standard is based on a cyclic reversed bending test (pivoting) of conduits under various conditions (temperature). The conduits are dynamically loaded and evaluated at the upper and lower application temperature limits. The test is performed based on IEC EN 61386. The minimum requirement corresponds to the specifications of IEC EN 61386. For PMA, the test is not considered completed for final evaluation until cracking or fracture. The number of cycles to fracture determines the fatigue strength of the conduit.

The next test is Reversed Bending Test. This standard describes a cyclic reversed bending test with additional tensile loading (lifting) on flexible conduits under standard ambient conditions (23°C/73°F @ 50 percent relative humidity). The conduit is loaded until fracture. The number of cycles to fracture determines the fatigue strength of the conduit. In addition to the lifting reversed bending test there is a Rotation or Oval Reversed Bending Test. This standard describes a cyclic bending test (rotation in an oval pattern) on flexible conduits under standard ambient conditions (23°/73°F @ 50 percent relative humidity). The conduit is tested until failure. The number of cycles to fracture determines the fatigue strength of the conduit.

The next test is Peak Load Test. This standard describes the peak load test on conduits under standard ambient conditions (23°C/73°F @ 50 percent relative humidity). The conduit is deformed by a defined amount between two plates. The restoring force established over a specific time by relaxation of the conduit describes the crushing pressure or compression strength.

A Pull-Out Test defines the system pull-out test on conduits and connectors under standard ambient conditions (23°C/73°F @ 50 percent relative humidity). The conduits are mounted with the appropriate system connectors. The pull-out strength of the system is determined in a tensile test.

Next is the Impact Test. This standard describes the impact strength test on conduits at various temperatures. The conduit sample is placed on a steel plate and centered under an impact head with a defined profile. The impact head impacts the center of the conduit surface. In contrast to international specifications, deformation behavior (buckling) is determined rather than fracture behavior. The impact test has been passed if no fracture or cracking can be detected after the impact, as well as no excessive permanent deformation of the conduit

Fig. 1: PMA cable protection mounted on the deck of an offshore wind turbine can withstand intense, sustained exposure to the sun's ultraviolet rays.

in accordance with PMA specifications.

A Cold Bending Test describes one performed on conduits at low temperatures. The conduits are stored in a controlled climate cabinet at the specified test temperature. Loading is achieved by winding the conduit around a test mandrel with a defined diameter. The various products are classified based on the mandrel diameter that can be achieved.

Thermal Aging Tests are used on thermally aged conduits. The test conduits are stored in a controlled climate oven at the specified test temperature. After removal from the oven they are cooled to room temperature. Loading is achieved by winding the conduit around a test mandrel with a defined diameter.

The various products are classified based on the mandrel diameter that can be achieved.

One of the final tests is known as Self Extinguishing. This standard describes a flame test on conduits based on international specifications. The conduit is exposed to a defined flame from a standard burner. The time of ignition and flame propagation behavior—as well as time of extinguishing after removal of the flame source—are significant parameters for evaluating the flame behavior of the products.

In addition to R&D, PMA products need to conform to worldwide standards and regulations. As a pioneer in the field of cable protection, PMA has always given high priority to our own

Fig. 2: Frigid temperatures and harsh environments require cable protection to avoid equipment failure and unnecessary downtime.

Fig. 3: Isolated tower platforms must be able to provide months of unattended, maintenance-free operation.

testing facilities and have consciously introduces stringent in-house standards as described previously. This approach has enabled PMA to exercise a significant influence on the development of international standards. Standard committees with responsibility for cable protection systems regularly ask our company to provide advice or participate as an active member.

ARMED AGAINST THE ELEMENTS

A failure in the electronic monitoring system of a wind energy plant can have fatal consequences. PMA specialists for high quality cable protections systems have designed a simple but effective component, manufactured from specially formulated polyamide, which can be applied in addition to a standard lock

nut on the thread of a fitting, increasing the outlet radius and thus preventing potential abrasion damage caused by tight bending radii and vibration. The anti-abrasion lock nut is available in a divisible form for retrofit applications or as a one-piece element for applications in new designs from conception onwards.

Cable protection can generally be seen as a dispensable element. If a cable is laid without a conduit around it, it is exposed to the prevailing environmental conditions around it. Cable protection is used to protect the cables from external factors. That means that if through a particularly inauspicious collection of circumstances or some extraordinary mechanical stress damage occurs, it is "only" the cable protection that is damaged and the cable function is not affected. The cable protection may be replaced.

Through the excellent basic characteristics of the specially modified polyamide 12 material used for PCS, this conduit type is particularly suitable for use in applications that are permanently exposed to intensive sunlight (UV). Additionally, PCS possesses very good resistance to chemicals. Given that for an average installation of 100 measuring points with three components each to be installed, the time saved can add up to between 20 and 50 hours comparing the polyamide system with conventional protection using armored metal pipes.

For the installation at Alpha Ventas wind park there was no specific requirements placed upon the cable protection system from the wind energy segment regarding certification. The PCS product being used there possesses all relevant certificates for worldwide applications in the highest safety categories.

Being an installation at sea, and having the same needs and requirements as the marine industry, the use of PCS and other PMA products are approved for the shipping industry by Bureau Veritas, Det Norske Veritasl and Lloyds Register. In addition to these approvals PMA products are also approved by UL and CSA for installations in the United States and Canada.

Wind turbine systems are a network made up of motors, controls, lighting, sensors, and numerous devices located throughout the tower, nacelle, and hub. If any one of these devises fails due to damaged cables, costly repairs and service are inevitable. As Hoger Stoven says, "In wind energy installations, particularly offshore, cable protection is indispensable. The products from PMA offer everything today which is necessary for correct cable protection."

COLLABORATION IN WIND FARM CONSTRUCTION

Wind industry professionals understand the high degree of cooperation required between all the players involved in the development of a wind farm. Dashiell makes the case.

By Christopher L. Floyd, P.E.

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THE HATCHET RIDGE WIND FARM is a 101.2-megawatt (MW) wind farm owned by Pattern Energy Group, LP. It is located in Shasta County, California, near Mount Shasta on a ridge overlooking the town of Burney and is the first large-scale wind farm in the area. The wind farm construction was announced in October 2009 with Renewable Energy Systems Americas, Inc., as the constructor. With anticipated generation to power nearly 44,000 California homes annually, the project is expected to finish and reach commercial operation before the end of 2010.

The project was delayed several months from its anticipated start date of March 2009 due to financial turbulence when Australian-based Babcock and Brown filed for bankruptcy and had to be reorganized. The North American development branch, which is the operating company that will run the Hatchet Ridge project, was sold off as part of the reorganization. The newly formed Pattern Energy had only been in existence for four months when they announced the construction start date for their first project; the Hatchet Ridge Wind Farm.

Pacific Gas and Electric Company (PG&E) will purchase the power, along with the renewable attributes, under a 15-year power purchase agreement. There are 44 Siemens 2.3 MW turbines, which stand on towers more than 20 stories tall that are being erected for this

project. The Siemens SWT-2.3-93 wind turbine has more than 2,000 operating turbines worldwide, and it is well regarded throughout the industry as proven technology.

In comments made to the press Mike Garland, CEO of Pattern Energy, had the following to say about the project: "We are pleased to close financing and commence construction on the Hatchet Ridge Wind Farm," he said. "This project is the result of years of dedication and collaboration with RES Americas, Siemens, PG&E, local government, project property owners, and the community. We are very appreciative for the local support we received that helped make this project a reality."

Andrew Fowler, senior vice president of construction for RES Americas, said that "California is one of the top states in generating wind power capacity, and we are excited to continue to bring clean, renewable energy to the region and working with the local businesses in completing the project. Renewable energy brings economic benefits to the community and provides a secure and sustainable future for all."

Pattern Energy Group LP describes itself as an independent, fully integrated energy company that develops, constructs, owns, and operates renewable energy and transmission assets across the United States, Canada, and Latin America. With a long history in wind energy the group's highly experienced team of scientists, engineers, construction experts, and legal and financial professionals has developed, financed, and placed into operation more than 2,000 MW of wind power in 11 states, including the 283.2 MW Gulf Wind project in Texas; a premier wind farm utilizing a ground-breaking wildlife monitoring system. Pattern's development pipeline exceeds 4,000 MW of renewable energy projects, including the 101.2 MW Hatchet Ridge wind project in Northern California and the 138 MW St. Joseph wind project in Manitoba, Canada, that is currently under construction.

RES is one of the fastest growing renewable energy companies in the world, and it has been at the forefront of the wind industry since it was founded in 1982. It has been active in North America since 1997, and during this time it has either developed or constructed more than 10 percent of the installed capacity in the United States. As RES continues to grow it is beginning to apply its capabilities and experience in wind energy to solar energy and other emerging renewable systems. RES currently has 3,836 megawatts of operational renewable power, with 410 megawatts under construction.

Dashiell Corporation worked extensively with RES Americas in the months leading up to the official start date on the negotiation of the collector substation and the utility interconnect switchyard. Dashiell initially bid the project in early March 2009 and was given their first limited notice to proceed on the project in early June, 2009. As the financial turbulence discussed above progressed, Dashiell and RES were finally able to reach a full contract in October, 2009. At this time Dashiell was awarded the Hatchet Ridge 230kV/34.5kV collector substation and the Carberry 230kV switchyard on an engineering, procurement, and construction (EPC) basis.

The Hatchet Ridge Collector substation consists of one 230kV, 2000A gas circuit breaker; one 230kV/34.5kV, 75/100/125 MVA power transformer; five 38kV, 1200A vacuum circuit

Fig. 1: Mount Shasta, site of the Hatchet Ridge Wind Farm in Northern California.

breakers; and two 34.5kV, 10 MVAR capacitor banks. The substation has four incoming 34.5kV underground circuits from the wind farm and one outgoing 230kV overhead transmission line to the Carberry switching station. The Carberry switchyard consists of five 230kV gas circuit breakers and three incoming 230kV overhead transmission lines. One of the incoming transmission lines is from the Hatchet Ridge Wind Farm collector substation while the other two lines tie the new switching station into the PG&E power grid. Dashiell's ability to design and construct these facilities to utility specifications proved valuable, as the Carberry switchyard will be owned and operated by PG&E once it is energized.

One of the many advantages that Dashiell can provide to these large scale wind farm projects is the coordination efforts that are required between the owner (Pattern Energy), the general contractor (RES), and the utility (PG&E) so that both the collector substation and the utility interconnect substation are built successfully and on time to meet the needs of the project. Dashiell has dealt with many utilities throughout the United States.

With this wind farm being located near Mount Shasta, at high elevations in the Cascade Mountain range in Northern California, inclement weather has proven to be a major hurdle. The PG&E tie-in date for the Carberry switching station is this summer. With the high amount of snowfall that accumulates in the area late into the spring, the construction schedule has had numerous delays and has resulted in an accelerated construction schedule to meet project deadlines. Due to Dashiell's substantial experience and resources in the substation construction industry, the Carberry switching station is still on target to meet its tie-in service date, and it is anticipated that the Hatchet Ridge Collector Substation will be ready for energization within that same time frame.

Some of the larger substation material items that go into wind farm projects are the primary voltage breakers, control houses, transformers, and steel structures, and each item requires its own foundation pad. These foundation pads are the first step in the substation construction efforts. After all of the concrete foundations have been laid and cured, the erection process can begin. This starts with setting the larger scale

Fig. 2: The Hatchet Ridge Wind Farm, under construction.

Fig. 3: The control building is mounted at Hatchet Ridge.

material items on their individual concrete foundation pad. A crane is set up and utilized to lift these heavy items off of the shipment crates and place them onto the poured concrete foundations. The control house at the Hatchet Ridge substation is approximately 50 feet in length. Figure 3 shows some of how this building eventually gets set.

The transformers associated with these wind farm projects are generally quite big, both in terms of size as well as capacity. For the industrial projects that involve new substations you'll typically see a 40 or 50 MVA max transformer. For this particular project the transformer has a base MVA rating of 75 and a full load MVA rating of 125—and this is a 101.2 MW wind farm. We see some wind farms that have 250 MW capacity. Also keep in mind that as the wind farm grows in capacity size, it starts to make more sense to utilize more than one transformer. But generally speaking, the transformers that are included with these wind farm collector substations are very large.

Throughout the many phases of this project it has been obvious that without the hard work and coordination of Pattern Entergy, RES Americas, PG&E, and Dashiell working together during difficult financial times and bouts of extreme weather conditions, completion would not have been possible. In addition to providing clean, renewable energy for Californians, Hatchet Ridge has created approximately 100-200 construction jobs during the construction activities and will create as many as eight permanent jobs during operations. Pattern has also stated that they expect "an economic ripple effect in the area from the purchases of goods and services for the wind farm and the increased business for service industries." In addition, "Hatchet Ridge will invest $5 million in the local community over the life of the project through the Shasta County General Fund, the Burney Regional Community Fund that will be administered by the Shasta Regional Community Foundation, and the Burney-Fall River Education Foundation, as well as pay substantial local taxes." The benefits of this successful project are clear, and they are many.

Fig. 4: The Carberry switchyard in springtime.

Fig. 5: A shot of the Carberry switchyard under snow in deep winter.

PREDICTIVE DIAGNOSTICS FOR INCREASED PRODUCTIVITY

Predictive diagnostic software detects departures from normal wind turbine operation, allowing action to be taken before turbine performance is compromised. SmartSignal explains.

By Dave Bell

Dave Bell is vice president of application engineering at the SmartSignal Corporation. Visit online at www.smartsignal.com.

THE CHAOTIC VARIABILITY IN WIND SPEED, direction, shear, and turbulence makes monitoring and analyzing modern wind turbines a challenge. Wind operators must squeeze out every watt they can when the wind is blowing. To do so, wind projects must be reliable and maintained with minimum cost. With variable winds, high costs, and slim margins, everything has to work right to make sure that wind is an attractive alternative power and a sound economic investment. So if a turbine is to work 20 years or more before retiring, it had better be properly designed and maintained.

TRADITIONAL PROCEDURES

Most wind turbines are maintained by a combination of traditional schedule-based preventive maintenance and threshold-based alarm systems. A problem with scheduled maintenance is that the standard six-month interval between inspections may be too long to detect an emerging problem. And fixed-threshold alerts, typically set by OEMs, activate too late to support proactive maintenance. That's because the alerts are intended to protect equipment from catastrophic damage and can't take into account a wide range of normal wind-turbine operating conditions and unit-to-unit manufacturing variances. As a result, typical fixed-threshold-alert systems do not detect problems until after a failure occurs.

Likewise, traditional condition-monitoring and predictive maintenance tools such as vibra-

tion analysis, oil analysis, and thermography are limited because of the difficulty in accessing the typical wind-turbine nacelle, the variable nature of the machine, and the time limitations and analytic capabilities of the technicians using them.

Ideally, equipment maintenance should only be performed when something needs fixing. Most preventive maintenance works on the idea of regularly inspecting or servicing equipment to address potential failures before they progress. However, given the huge variations in operating profile and environment, it's easy to see that the regular, fixed inspection interval of traditional preventive maintenance may not catch critical emerging problems in the wind environment.

The conventional power industry, however, leads the industrial world in predicting impending equipment problems before they occur. And it is doing so using a technology directly applicable to the wind industry. In fact, several wind companies already use this technology to get early warnings, avoid surprises, and improve control of their operations. They reduce risk exposed by existing condition-monitoring tools and leverage SCADA data to remotely detect emerging problems by using SmartSignal predictive diagnostics.

Briefly, SmartSignal precisely identifies impending problems by detecting subtle changes in equipment operation. It finds problems earlier than OEMs' alerting systems or other condition monitoring approaches, and well within traditional alarm limits.

SMARTSIGNAL ADVANTAGES

Recognizing that wind is unpredictable in predictable ways, SmartSignal predictive diagnostic software works by analyzing SCADA data once every five to 10 minutes. It compares real-time data to software models of equipment when operating in good condition and compensates for normal variations due to load and ambient conditions. Further, SmartSignal uses software models customized for individual pieces of equipment to provide the earliest possible warning of emerging problems. SmartSignal readily integrates with an existing data infrastructure, and it's quick and easy to deploy, maintain, and use.

This method needs no new sensors, and analysts need not review masses of SCADA data. Instead the software analyzes data and alerts analysts only when it detects an exception, providing ample time to plan and respond. And by using algorithms to identify pattern changes, the analysis is highly accurate.

For wind applications the software uses models customized for each individual turbine, which compensate for fluctuations in wind speed, direction, and ambient conditions. In real time the software compares data collected in the nacelle to the models—literally tens of thousands of data points every five to 10 minutes across a fleet—and notifies maintenance and engineering of impending problems. Owners then focus on fixing problems early, before catastrophic damage occurs.

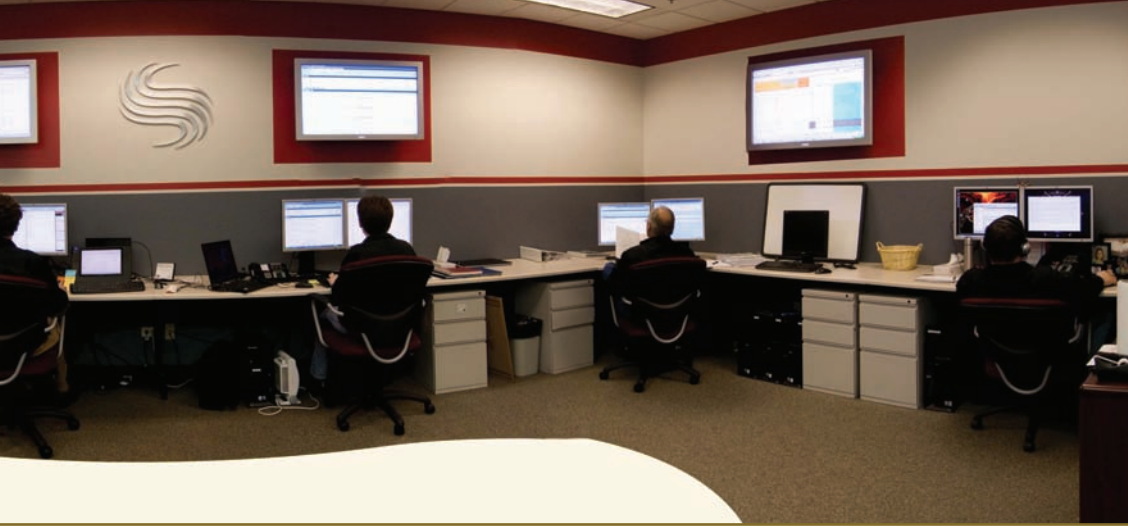
Take a gearbox, for example. During the initial system configuration a gearbox model would be "trained" using representative data provided from a data historian such as OSI PI (a data historian is a database for storing time-series data from instrumentation). Typically, one year of data would be used to train the model. In live operation data from relevant sensors on the gearbox such as for vibration and temperatures, along with operational state information such as power output and ambient temperature, would be compared to the model. The model would then provide an "estimate" of what each value should be, based on how it was

Fig. 1: SmartSignal's Availability and Performance Center, where engineers monitor dozens of customers and provide them with early detection, diagnostics, and prioritizations of impending equipment and process problems.

trained from the historical data. If the actual value statistically differed from the model estimate, the system would generate an alert. Technicians would review the sensors in alert and develop a preliminary diagnosis of the problem. A next step would typically be further on-machine investigation or use of other techniques, such as oil sampling. Note that SmartSignal even provides a full-service solution, in which its own engineers monitor customer wind farms from SmartSignal's in-house Availability and Performance Center (see fig. 1).

COMPETITIVE EDGE

A recent Wind Energy Operations & Maintenance



Report cited that approximately 79 percent of wind turbines in operation are still under warranty. That will soon change, leaving many owner-operators vulnerable to equipment failure. Gearbox reliability consistently falls short of OEM projections. Designed for a 20-year life, many gearboxes are failing after six to eight years of operation. O&M costs for wind power are exceptionally high in the United States, and often double or triple budgeted projections.

Given the high capital intensity of the wind-power business reliable, long-term operation of the equipment is critical for generating positive returns and continued industry growth. It won't take many major equipment failures before the long-term profitability of a farm is lost. As assets age, performing major work only when needed will be critical to maintaining economic viability.

Remote monitoring and condition-based maintenance approaches will be required to maintain financial returns because wind turbines are hard to access and don't receive the same "walk-around" monitoring typical of industrial plants. Although wind has unique characteristics, wind turbines are just another kind of machine and successful operators will take advantage of best practices from other industries to outstrip their competition.

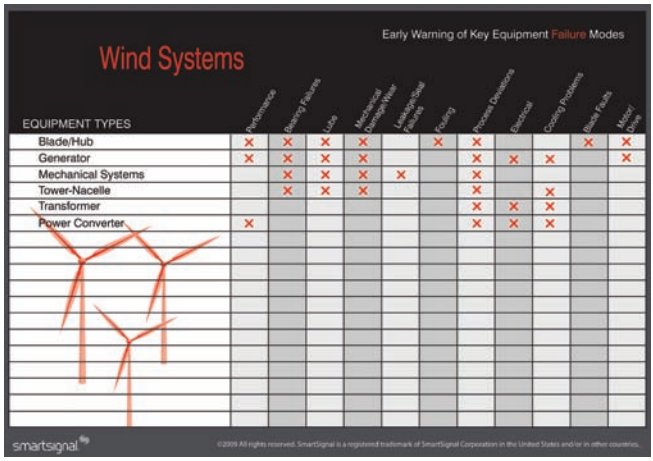


Fig. 2: SmartSignal identifies major process and equipment failures on critical rotating and non-rotating equipment across all OEMs.

Efficient wind-farm management presents distinct monitoring challenges. Schedule-based maintenance and other traditional techniques have been ineffective in the dynamic environment of wind generation. Ambient conditions vary widely, and wind turbines don't offer a constant load but rather cycle up and down, presenting a unique wind regimen and set of data points. Each turbine has 60 or more analog sensors, with data reporting every few seconds. SmartSignal analyzes in real time all the data that is collected by a programmable logic controller in the nacelle—literally tens of thousands of data points daily on a typical wind farm—and detects and notifies wind farms of impending problems, allowing owners to focus on fixing problems early and efficiently.

SmartSignal helps improve turbine reliability and availability and reduce maintenance costs across a wind farm or an entire fleet by helping to prioritize tower inspections and optimize crane usage. It avoids surprises of equipment failure, while maximizing resources and reducing risks. The chart in fig. 2 illustrates wind farm components protected by SmartSignal and the faults identified. These assets span both rotating and non-rotating equipment, including transformers, across major OEMs.

TOWER TRAINING FOR IRONWORKERS

In a relatively young market such as wind power, established professions like ironworking have decades of expertise to share.

By Harvey C. Swift

Harvey C. Swift is IMPACT assistant director of education and training.
Call (800) 545-4921, e-mail hswift@impact-net.org, or visit www.impact-net.org.

THE IRONWORKER PROGRESSIVE Action Cooperative Trust (IMPACT) is a non-profit, labor-management organization devoted to improving the ironworking industry. One of the ways that the IMPACT trustees deliver on this mission is by always looking for new and innovative ways of making ironworkers and the contractors they work for more competitive. There is no better method of doing this than through workforce training.

Ironworkers and the contractors they work for have been erecting wind turbines for many years. To meet the needs of the industry, the International Association of Bridge, Structural, Ornamental and Reinforcing Iron Workers has always maintained a wind turbine training strategy, ensuring that ironworkers had the needed knowledge and skills to safely and efficiently erect wind turbines. That strategy, still in place, includes the following training components:

- Information on wind turbine erection in the "Structural Steel Erection" training package;
- Information in the "Structural Steel Erection" training package focusing on bolt torqueing and tensioning (although not focusing specifically on wind turbines);
- "Rigging for Ironworkers" training package to teach heavy rigging procedures;
- "Cranes" training package to teach to the use of cranes (including signaling).

Fig. 1: Instructor performing a simulated over the hub rescue.

This training strategy has provided ironworkers with not only wind turbine erection market share, but also the necessary knowledge and skills to safely and efficiently erect wind turbines for decades.

In 2008 and 2009 there were a lot of wind turbines being erected in the United States. Most projections were that the upward trend of the construction of wind farms would continue, and most likely increase, into the foreseeable future. Because of this increased amount of work, and the anticipated further increase, according to input from many of IMPACT's signatory contractors there was a growing need for ironworkers to have third party, nationally recognized training certifications in several areas. These areas include wind turbine tower climbing and rescue, as well as bolt torque and tension training.

In June of 2009 two things happened that shaped wind turbine training for ironworkers. First a team traveled to Oklahoma to evaluate a wind turbine training program, and second the Department of Labor (DOL) released several grant solicitations as part of the American Reinvestment and Recovery Act of 2009 (ARRA). A team representing the Ironworkers International—referred to as "Ironworkers" from this point forward—IMPACT, and several local unions visited the Wind Turbine Technician Training program at the Francis Tuttle Technology Center (FTTC) in Oklahoma City. Team members included: Tad Kicielinski, general vice president; Mike Gravette, Texas and Mid-South States District Council; Ron Smitherman, business manager for Local 263 in Dallas; Randy Palumbo, apprenticeship coordinator from Local 48 in Oklahoma City; Rick Sullivan, IMPACT director of education and training; and myself.

FTTC is a non-profit, accredited technology training center in the state of Oklahoma and a member of the American Wind Energy Association's (AWEA) education committee, as well as a member of the Wind Energy Training Consortium (WETC). The WETC is a group of training institutions that is recognized by AWEA as promoting the skill training essential for wind turbine technicians.

The wind turbine technician training program

Fig. 2: An instructor demonstrating torque-tension skills.

Fig. 3: A student performing torque-tension practice session.

in place at FTTC was found by the team to address all three areas of interest to the Ironworkers, with a very strong hands-on focus. The FTTC program had industry partnerships with HY-TORC, Snap-on Industrial, and Capital Safety (DBI/SALA) so that program completers receive certificates from these three nationally recognized organizations. FTTC was also willing to partner with IMPACT and train ironworkers on demand.

The Ironworkers team made a recommendation to the IMPACT trustees that a partnership be developed with FTTC in order to rapidly meet the demands of this growing sector of the ironworking industry. The trustees then formed a training partnership with FTTC to train ironworkers and deliver only the segments of the wind turbine technician course that were pertinent to the erection and heavy maintenance of wind turbines. These courses are comprised of training in two major areas of the wind turbine industry: tower climbing and rescue, as well as bolt torque and tension.

The tower climbing and rescue training portion of the course covers the different forms of fall protection, rescue and evacuation techniques, types of equipment, and the proper use, care, and maintenance of the type of safety and rescue equipment used in the wind energy workplace. Upon successful completion of this component of the course participants receive a nationally recognized certification from Capital Safety.

The bolt torque and tension certification component of the

Fig. 4: An instructor performing a simulated over the side rescue.

course will certify participants in all aspects of bolt torque and tension. Topics include basic fasteners and safety, and mechanical, electronic, and hydraulic torque. This portion of the course uses a tremendous amount of hands-on learning, application, and three certifications from industry leaders Snap-on Industrial and HYTORC.

The goal of these courses is to rapidly train ironworkers to get them onto wind turbine erection sites; it is not a "train the trainer" course. These courses cover 36 hours of related classroom and hands-on instruction, and the course spans four days. Because the course is delivered in a highly accelerated manner, only journeymen ironworkers with a minimum of three years field experience who already have the OSHA 10, Subpart R, and First Aid/CPR/AED training will be eligible to register in one of these courses.

IMPACT and FTTC jointly arrange for one wind turbine course to be held each calendar quarter at FTTC's Portland campus; one of FTTC's three campuses in the Oklahoma City metro area, this campus is the site for FTTC's wind turbine technician training. Ironworkers are signed up for and registered for these courses through the IMPACT office at the request of either a local union or a signatory contractor. However, if a local union or a signatory contractor has anywhere between six and 10 ironworkers who need this training in order

Fig. 5: Tower climbing training, at top and bottom.

to work on a wind turbine erection or maintenance project, IMPACT will work with FTTC to arrange for a "private" course to be conducted within 45 days of the request.

Once participants complete the training and are issued the certifications—since these are third-party certificates, some may take three to four weeks to come back from the industry vendor—the IMPACT office receives an elec-

Fig.6: A group portrait of "the Crew."

tronic copy of the certifications. The Apprenticeship and Training Department then updates the Apprentice Tracking System (ATS) to show the certifications that the ironworker received and places an electronic file of the certificate on the ATS, as well. Since the ATS is a Web-based secure system, this allows any local union to verify that an ironworker has these certifications and can meet the needs of the contractors.

When the DOL announced large grants under the ARRA, there were several meetings at the Ironworkers International to discuss whether or not it would pursue any of the available grant money. It was decided that International, through IMPACT and the National Training Fund, would submit a grant proposal. It was understood that the competition would be tough and the amount of awardees limited, but they were confident that they could develop a competitive proposal. After reading the announcement in the Federal Register in detail, it was easy to see that a national entity was required to work with at least two but no more than five of its local affiliates in order to implement training.

The National Training Fund and IMPACT decided to write a grant that would allow the Ironworkers to take the IMPACT wind turbine partnership training (developed with FTTC and described above) and replicate it at five existing local training centers.

In order to identify these five local training centers, IMPACT looked at the projections for wind farms for the coming two years (also the term of the grant). The five regions of the country projected to have the most wind turbine erection work were identified, and the district council presidents of those regions then identified which training center in that region was best suited to be involved in the grant. The five local training centers chosen to participate in the grant were the training centers for the following Ironworkers local unions: Buffalo, New York; Salt Lake City, Utah; Dallas/Ft. Worth, Texas; Los Angeles, California; and Joliet, Illinois. Some of the other stipulations in the DOL grant solicitation required that each of the local training centers do the following:

- Work with contractors involved in wind turbine erection and to have those contractors supply a letter of support;
- Partner with the state and/or local Workforce Investment Boards (WIB) and get a letter of support;
- Establish or have a relationship with the "one-stops" in the local area.

The Ironworkers grant proposal was written during the summer and then submitted to the DOL in September of 2009. In January of 2010 the DOL announced the grant awards and the Ironworkers was one of the successful organizations. The wind turbine training will be delivered at the five local training centers by instructors who received specific instruction at the FTTC from certified industry partner trainers. The National Training Fund will then equip each of the local training centers with their industry partners' tools and equipment so that those trainers can begin to conduct wind turbine training for Ironworkers. Each training center will also receive a mobile training trailer to be pulled either directly to wind farm sites or other local training centers to conduct this certification training. By taking the training "on the road," not only will a wider geographical region be serviced with DOL grant funds, but more ironworkers can receive training. This will ensure that each training center will be able to provide at least 102, including the two instructors trained at FTTC, trained ironworkers with industry recognized certificates by the end of the grant, for a total of at least 510 trained and certified ironworkers under the DOL grant funded training.

The two wind turbine training developments forged under the supervision of the IMPACT trustees and with the partnership of the Francis Tuttle Technology Center and the Department of Labor are examples of what can happen when both labor and management work together towards a common goal. These two progressive training programs are providing ironworkers with certifications that will enable employers to secure projects and put more people to work.

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< Continued from page 16

over 40 °C during the day and drop to -10 °C after sunset. It is these thermal effects that are of interest to Mainstream due to the effect on wind shear in the area, provoked through Katabatic winds at night, while the hot desert ground during the day leads to convectional forced vertical wind components and turbulence. Traditional anemometry such as tall masts and cup anemometers, providing wind data up to 80m above ground, were not appropriate as the sole measurements in this case due to their limited height. Mainstream looked at a range of remote sensing technologies before selecting Natural Power's ZephIR lidar.

"We were very interested in exploring the impact of these thermal effects on wind shear but were unable to use tall met masts to see the effects above hub height," according to Shane Martin, senior wind analyst at Mainstream. "Natural Power's team in Valparaiso were able to assist us in providing a ZephIR lidar for the campaign and the system was on site within a matter of days, measuring wind characteristics from ground level through to turbine tip height, and above. The campaign was completed successfully and the ZephIR lidar allowed Mainstream to gather all quantitative data necessary for the evaluation of the project."

Natural Power established its Chile office based in Valparaíso during 2009, serving the South American market. Projects to date have ranged from advanced resource analysis to construction services for a range of international clients, including this latest lidar campaign for Mainstream. "It was a very positive experience to work closely with the Mainstream team on this project," says Alexander von Pescatore, head of development in Chile. "Our ZephIR lidar system operated with 100-percent system availability and 100-percent data availability in some challenging terrain and environmental conditions. There are many more sites in

South America which will benefit from the use of ZephIR over more traditional anemometry due to site conditions and thermal effects."

Natural Power is a leading renewable energy consultancy that specializes in progressing sites onshore and offshore for clients, from proof of concept through project development, construction, asset management, and onward to repowering or decommissioning. Natural Power have worked on more than 15,000 MW of wind, wave, and tidal sites across Europe, the U.S., and Canada, while also providing 360° due diligence on a range of portfolios and projects. The company delivers both technical and management services, as well as industry-leading products from offices across the UK, France, Chile, Canada, and the U.S. Send e-mail to sayhello@naturalpower.com or visit online at www.naturalpower.com/zephir.

KLÜBER INTRODUCES SPECIALTY LUBRICANTS FOR WIND

Klüber Lubrication, a worldwide manufacturer of specialty lubricants, recently showcased two specialty lubricants for the wind power industry at WINDPOWER 2010 in Dallas. The lubricants are Klüberplex® BEM 41-141 and Klüberplex® AG 11-462.

Klüberplex BEM 41-141 is high-performance grease with a special blend of base oil and additives to cover the different lubrication requirements of the individual bearing applications within wind power stations. The beige grease is ideal for pitch and yaw bearings (high stresses, oscillations, vibrations), main bearings (low rpm, high stresses, vibrations), and generator bearings (high rpm and temperatures). A simple switch to one lubricant for all bearings will reduce maintenance costs and simplify lubrication routines.

The second outstanding product is a priming and operational lubricant for open gears. Klüberplex AG 11-462 is white gear grease that provides excellent adhesion as well as superior protection against high loads and corrosion. The adhesive grease effectively lubricates the control gears for pitch and yaw systems while reducing the risk of migration inside the nacelle and onto the tower.

Klüber Lubrication, a worldwide manufacturer of specialty lubricants, has long been on the cutting edge of lubricant technology. For more than 75 years it has been committed to providing tribological solutions for its customers by manufacturing and supplying specialty lubricants for extreme applications. Its lubricants succeed where conventional lubricants fail. With representation around the globe, and a product portfolio of more than 2,000 standard lubricants, Klüber's products and services are available wherever and whenever they are needed. Learn more at www.klubersolutions.com/wind.

SECOND-GENERATION LIDAR FROM NRG SYSTEMS AND LEOSPHERE

NRG Systems, manufacturer of wind measurement equipment, and Leosphere, a specialist in lidar for atmospheric observations, announces the introduction of the WINDCUBE® v2, the lightest, most compact lidar remote sensor available. Used in site assessment and wind farm performance monitoring, it collects actual measurements at heights up to 200 meters, mapping the vertical wind component, wind speed, and direction, turbulence, and wind shear.

"Lidar has quickly become the must-have tool in resource assessment," says Alex Sauvage, president and CEO of Leosphere. "Over the past year our two companies have worked tirelessly to enhance the portability and durability of our lidar remote sensor, making it ideal for complex terrain, remote locations, and offshore."

Weighing 45 kg and measuring approximately 55 cm square, the WINDCUBE v2 features no internal moving parts, multiple communications options (including satellite), low power requirements (45 watts), and an all-weather enclosure. The quiet, ultra portable 200m wind profiler includes 10 programmable measurement heights, providing ready to use data.

"By collecting actual measurements of the entire swept area of the wind turbine, the WINDCUBE v2 improves data accuracy and reduces overall uncertainty of the wind farm design," says John Norton, COO for NRG Systems. "Improved certainty can make the difference between project success or failure."

The WINDCUBE v2 is an active remote sensor that operates by emitting a laser pulse through the atmosphere. Along its path the laser light is backscattered by aerosols in the air and received by an optical sensor in the lidar unit. These signals capture the shift in atmospheric particles, or the absolute wind speed in the lidar line of sight. For more information visit www.lidarwindtechnologies.com. Also go to www.leosphere.com or www.nrgsystems.com.

ADINDEX

Felix Guerzoni
Product Application Specialist/Shell Lubricants

I UNDERSTAND THAT YOU HAVE A GREAT DEAL OF INTERACTION WITH MANUFACTURERS, END USERS, AND OTHERS IN DEVELOPING YOUR LINE OF LUBRICANTS FOR THE WIND INDUSTRY.

It's definitely a teamwork approach. We have product development experts at the Westhollow Technology Center in Houston and also at the Shell Technology Centre Thornton in the United Kingdom. We have what we call OEM liaison contacts who work with manufacturers here in the Americas as well as in Europe and Asia, and then a team of product application specialists such as myself who service those same regions. Our role is to obtain information from the field about how our products are performing, and also to better understand the specific needs of our end users. We work very closely with the OEM liaison team, meeting with gearbox manufacturers, bearing suppliers, and filter manufacturers to understand the issues they're currently facing as far as manufacturing their components and also their reliability out in the field. We do the same thing with wind turbine manufacturers, discussing their current and future needs as we develop the next generation of custom lubricants for the wind industry.

IN WHAT WAYS DO YOU APPLY THEIR INPUT TO YOUR R&D ACTIVITIES?

During the development of Omala HD gear oil, as an example, we sought input from companies such as Gamesa, GE Energy, Siemens Wind Power, SKF, Winergy, and Vestas Wind Systems to determine their needs so we could provide the list of requirements to meet their specifications. That performance envelope addresses everything from the temperature of the operating environment to compatibility of the oil with the filters, paints, and various elastomers within the system. That same attention to detail has been applied to the development of all our lubricants for wind applications, which in addition to Omala HD 320 synthetic gearbox oil includes Tellus Artic 32 hydraulic fluid for extremely cold environments and Rhodina BBZ to protect blade bearings against fretting corrosion, moisture contamination, and false brineling. We also offer Tivela S 150 and 320 synthetic gear oil for yaw and pitch drives, Albida EMS 2 electric motor bearing synthetic grease, Stamina HDS main bearing grease, and Malleus GL and OGH grease for open gears. So you can see that we've put a great deal of time and effort into developing highly specific products for all the major contact points within a wind turbine, and we've also formulated these lubricants with a performance profile broad enough to be suitable for the vast majority of wind applications, no matter where they're found. We are also involved with various national and international industry bodies so that we'll have the opportunity to provide input into the development of standards and specifications.

WITH THE EXPECTED GROWTH OF THE WIND INDUSTRY BOTH HERE IN NORTH AMERICA AND AROUND THE WORLD, WHAT ROLE CAN WE EXPECT SHELL LUBRICANTS TO PLAY?

We are a key player in the wind turbine industry and can be a truly value-adding partner to customers throughout the entire wind turbine value chain. This includes not only component manufacture and initial fill, but also transportation of components by sea, land, or rail, and in construction and erection of the turbines through to operation and maintaining by service companies. We will continue working with manufacturers, wind farm operators, service suppliers, and many others to make sure that we understand their requirements and are meeting their needs for current as well as future designs. As the wind industry continues to grow and evolve there will be many opportunities for improvement, such as in the area of lubricant condition monitoring, which can be handled both online and offline. There will also be more wind turbine and component manufacturers from emerging markets such as China and India to factor in, and we'll be there to assist their entry and integration into a mature existing market. Since we're already working with suppliers on every continent, including these emerging markets, we're in a position to share the knowledge and expertise we've amassed over the years with our customers. In addition, we will continue to be mindful of the careful balance that must be maintained between providing the highest quality products possible and maintaining a realistic price point, so that the end user is assured of receiving a healthy return on their investment. It's our job to keep our finger on the pulse of this industry to ensure that our products will continue to meet all of our customers' needs, if not surpass them.

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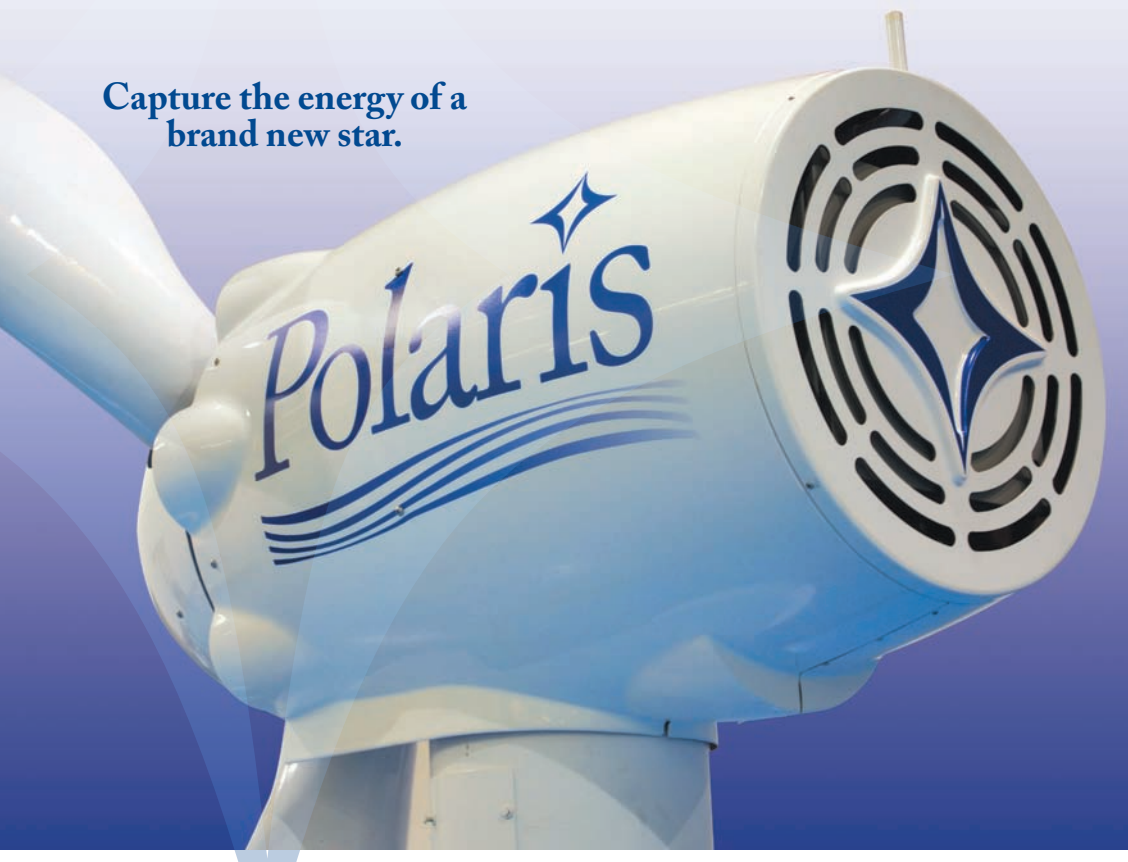

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