MAY 2010

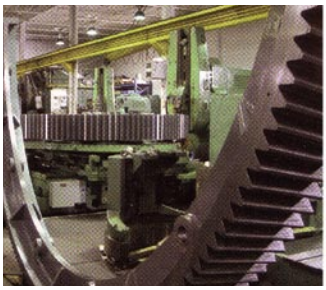
AWEA WINDPOWER SHOW ISSUE

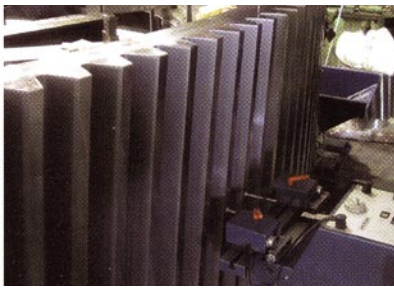
WIND SYSTEMS

FEATURES

DEPARTMENTS

Gearing Up Your Business





You speak, we listen, and together we develop solutions to your complex manufacturing challenges. With years of experience in designing and manufacturing gears, CGC also understands the importance of project management and logistics, ensuring on-time delivery of high-quality products made to meet AGMA, ISO, and DIN standards. So give us a call, and we'll give you a listen.

CAPABILITIES	CURRENT	FUTURE
Gear Cutting	8m	10m
Gear Gashing	5m	10m
Gear Grinding	1.5m	2.8m
Machine Turning	2m	4.5m

Booth# 8401

2010 WINDPOWER CONFERENCE & EXHIBITION

Carolina Gear & Components Ltd.

P.O. Box 20100 | 1615 Bishop Street North | Cambridge, Ontario | N1R 8C8

P: 519-623-8806 | F: 519-623-4886 | E: sales@cgc-group.net | W: cgc-group.net

RSC
Equipment Rental

Innovative Service That Will Blow You Away

RSC Equipment Rental has what you need for your wind power construction and maintenance projects.

At RSC Equipment Rental, we have more than well-maintained equipment. We have innovative programs and services that are sure to make your job easier.

Whenever you need equipment or tools and support services, you'll see many factors that separate us from the competition:

- > 24/7 Customer Care and After-Hours Support
- > Well-maintained equipment, backed by our rigorous preventive maintenance schedule
- > Total Control® Management System
- > Tool Management Solutions, such as Mobile Tool Room™
- > Operator and Safety Training

Visit us at *WindPower 2010*

Stop by booth #15722 and register to win one of three daily giveaways* during the conference.

Call 800.394.9400 or visit RSCrental.com/WS, anytime for reliable equipment and innovative services.

*Terms and Conditions of daily giveaway will be displayed at the RSC Equipment Rental booth during normal exhibition hours. Items will be mailed directly to winners at the close of the conference.

RSCrental.com/WS • 800.394.9400

GEARS MADE ON GLEASON MACHINES SUPPLY OVER 50% OF THE WORLD'S WIND ENERGY

PROVIDING ALL THE TECHNOLOGIES YOU NEED TO PRODUCE HIGH QUALITY LARGE GEARS FASTER, AT THE LOWEST COST

SOFT PROCESS SOLUTIONS

- ✓ Hobbing
- ✓ Shaping
- ✓ Chamfering & Deburring
- ✓ Up to 6 meters
- ✓ Tooling solutions for every process

HARD FINISHING SOLUTIONS

- ✓ New TITAN® Machines deliver up to 50% productivity gain with POWER GRIND
- ✓ Profile Grinding
- ✓ OPTI-GRIND increases productivity up to 40%
- ✓ Up to 6 meters
- ✓ Tooling solutions for every process

METROLOGY SOLUTIONS

- ✓ Analytical Gear Inspection Systems
- ✓ Up to 3 meters

WORKHOLDING & AUTOMATION SOLUTIONS

- ✓ Innovative workholding concepts for reduced set up times
- ✓ Set up tables and/or automated systems for reduced idle times

SERVICE SOLUTIONS

- ✓ Service
- ✓ Parts
- ✓ Training
- ✓ Preventive Maintenance
- ✓ Application Development

Gleason

www.gleason.com • sales@gleason.com

THE TOTALGEAR SOLUTIONS™ PROVIDER

Download our Total Solutions Brochure, Big Gears at www.gleason.com/biggears

See us at WINDPOWER 2010 Booth #15004

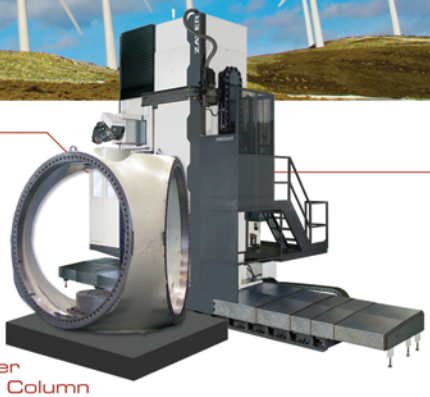
FEATURES

We do

WIND TURBINES

from **TOP** to **BOTTOM**

Geminis
Heavy Duty Lathe
Wind Turbine Rotor Shaft



Zayer
Travelling Column
Machining Center
Wind Turbine Rotor Hub

Bermaq 5-Axis
Machining Center
Wind Turbine Blades

Republic Lagun has your solutions. Versatility is key in an emerging industry. With the demand for a wide variety of complex parts, suppliers need machines that can handle different tasks. Republic Lagun offers a variety of machines perfectly suited for the wind industry. Get the versatility you need with machines from Republic Lagun and you too can stand tall.

STORM coming soon


Vertical Mills


Horizontal Mills


Lathes


Surface Grinders


Radial Drills

Republic LAGUN Machine Tool Co.

800 Sprucelake Dr. Harbor City, CA 90710

CALL US TODAY: 310.518.1100 / 800.421.2105

View all of our product lines at www.lagun.com

DEPARTMENTS

VOLUME 2 NO. 9

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

With the projected growth of the wind industry throughout North America and around the world, it is entirely fitting that WINDPOWER 2010—presented by the American Wind Energy Association (AWEA)—is being held in Texas; a state known for big ideas and limitless horizons. With exhibitors representing both developing and established markets, it's an excellent opportunity for new ideas to merge with existing expertise, to the benefit of the industry at large. In fact, that's a goal we share with AWEA in each issue of the magazine we produce.

This issue stands as proof of that commitment, with an amazing mix of articles beginning with "Increasing Productivity with Integrated Controls" by Lou Mello and Dennis Wylie of Rockwell Automation, describing how the company's Automated Integrated Architecture system improves reliability and reduces maintenance. Calvin Earp and Billy Higgs of Shermco Industries have contributed "Raising Generator Reliability," pointing out how proper maintenance can increase generator life and productivity. In "Small Wind, Big Potential" Amy Berry of Windspire Energy—formerly Mariah Power—explains how exposure to small wind paves the way for greater acceptance of big wind, and Brendan FitzPatrick, P.E., of the Geopier Foundation Company discusses their Rammed Aggregate Pier® system in "Innovative Turbine Foundation Solutions." Jeffrey Seagle of Stahlin Non-Metallic Enclosures has penned "Enclosures for Wind Energy Engineers," and Chris Pattison—a doctoral fellow in Wind Science and Engineering at Texas Tech University—makes a great case for combining wind and solar power technologies to increase site productivity in "Solar Support for Wind Energy."

In this month's technology column, Jose R. Zayas and co-author Matt Barone of Sandia National Laboratories discuss the importance of research into the aero-acoustic properties of blades, and Dennis W. Boehm of Hayward Baker advocates soil mixing as an alternative to deep foundations for challenging sites in his construction column. Merritt Brown of Rev1 Power Services spotlights areas turbine owners can address to increase reliability and service life in his maintenance column, and Hüseyin Kizilagac of BDP Project Logistics details the challenges presented by increased global wind-energy production in his logistics column. Nordic Windpower is this issue's profile—thanks to CEO Tom Carbone for sharing the company's fascinating history with me—and Jeff Anthony, AWEA's director of business development, details how the association is addressing supply chain matters as our Q&A subject.

As you can see, our pages are packed with interesting people and information, just as WINDPOWER 2010 will be. Each day we will raffle ExoFit NEX™ full-body harnesses provided by Capital Safety and Stor-Loc tool cabinets, so be sure to pay us a visit at booth #10841. All best!

Russ Willcutt, editor
Wind Systems magazine
russ@windsystemsmag.com
(800) 366-2185

WIND SYSTEMS

David C. Cooper
Publisher

Chad Morrison
Associate Publisher

EDITORIAL
Russ Willcutt
Editor

SALES
Brad Whisenant
National Sales Manager

Glenn Raglin
Regional Sales Manager

Tom McNulty
Regional Sales Manager

CIRCULATION
Teresa Cooper
Manager

Jamie Willett
Assistant

Kassie Hughey
Assistant

ART
Jeremy Allen
Art Director

Michele Hall
Graphic Designer

CONTRIBUTING WRITERS
Matt Barone
Amy Berry
Dennis W. Boehm
Merritt Brown
Calvin Earp
Brendan FitzPatrick, P.E.
Billy Higgs
Hüseyin Kizilagac
Lou Mello
Chris Pattison
Jeffrey Seagle
Dennis Wylie
Jose R. Zayas

media solutions
PUBLISHED BY MEDIA SOLUTIONS, INC.
P. O. BOX 1987 • PELHAM, AL 35124
(800) 366-2185 • (800) 380-1580 FAX

David C. Cooper
President

Chad Morrison
Vice President

Teresa Cooper
Operations

SSB Service

Achieving more. Naturally.

SSB provides the solutions and service you need to meet the highest requirements.

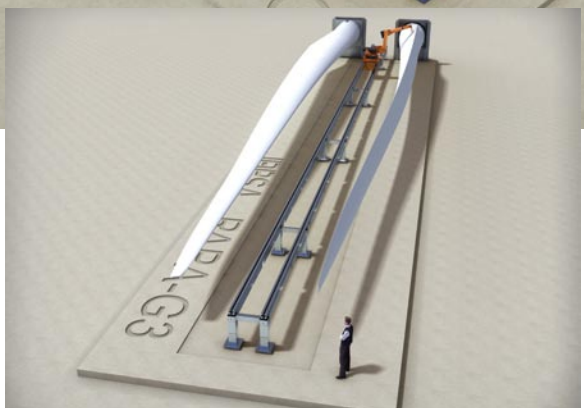
Nature shows us that a down-to-earth approach produces better results. That's why, at SSB, we focus on providing down-to-earth service when delivering our full line of WTG solutions – from remote monitoring, maintenance, repairs and spare parts service – including major components – to optimization of products and more. That dedication to service has been with us since we had only a handful of employees and it continues today with our 150+ employees worldwide. To learn more about how we can help you achieve your goals, call or visit our Web site today.

Visit us at the
WINDPOWER 2010
CONFERENCE & EXHIBITION
Dallas, Texas In May 23th – 26th
Stand no. 11659, level 1

SSB SERVICE INC.
3060 S.E. Grimes Blvd., Ste. 500, Grimes, IA 50111-5007
www.ssb-group.com | 515.986.9101
info@ssb-group.com

SSB. Experience works.

SSB



NEW BLADE FINISHING ROBOTIC SYSTEM FROM IDPSA

The third generation of the RAPA G3 multi-processing system has been developed to reduce the time of all machining and finishing work for wind blades, aerospace components, and other oversized parts. The RAPA G3 is a robotic machine tool platform designed with a double workstation supporting a wide variety of applications and processes. The platform uses a high accuracy double modular rack and pinion drive system from Parker Hannifin to create any X-axis length required. The modular rack and pinion drive system is fixed to the factory floor. A workholding platform is moved by the rack and pinion drive system, above which is fitted an anthropomorphic KUKA robot with automatic tool change.

The wind blade-finishing robotic system works over a 50x15x6 m (164x49x20 ft) standard area and it performs scanning, measuring and inspection, blade machining and finishing quickly and repeatedly, increasing productivity and quality while reducing manual labor significantly. The RAPA G3 is designed to access any wind blade surface point by the anthropomorphic KUKA robot displacement over the rack and pinion drive system and the two rotation blade axes. A high-capacity vacuum system with spindle shroud is available to capture dust and chips. A drum-type tool changer holds 12-16 tools for automatic tool changes. RAPA G3 uses a guidance system for robots, developed by IDPSA that allows guiding a robot in space, with the theoretical wind blade model as the reference. The guidance system accuracy is less of 1 mm and is controlled

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.

by a distributed control system based on a net of INTEL Core 2 Duo industrial PC with color screen, handheld pendant, and hand-wheel controls.

IDPSA is an engineering company founded in 1986 that specializes in turnkey industrial automation processes. It services the aerospace, automotive, defense, wind power, solar energy, composites, fiberglass, general machining, and heavy equipment markets. For more information contact Angel Navarro Oriol at +34 637808595 or angel.navarro@idpsa.com. Go online to www.idpsa.com.

AVANTI ENCOURAGES SAFE PROCEDURES

The wind turbine owner is responsible for ensuring that the safety equipment used by personnel working the towers is always maintained and in perfect working order. "But we get the impression that a number of turbine owners are not aware that such items as work cages/service lifts must be inspected, tested, and approved once annually to fulfil safety requirements," according to Kent Pedersen, general manager for Avanti Wind Systems in the United States.

The law says that the owner must keep a certification journal with dates of the latest inspection and which describes the inspection and testing of all safety equipment in the turbine tower in detail. The certification journal must always be present when the authorities perform a check. There is some difference in legislation from state to state in the U.S., but in general the requirements for maintenance are the same. And it will always be the owner's responsibility to ensure that safety equipment works and is regularly tested and maintained. "The owner is also responsible for ensuring that the personnel working in the towers are trained to use the safety equipment, and that their training is kept up to date," he says.

Avanti Wind Systems sells and installs service lifts and ladder systems with fall safety equipment in wind turbine towers. Avanti also runs safety courses for technicians. "All turbine owners naturally accept that the equipment in towers has to be correctly installed by authorized personnel. But a wind turbine tower is also a place of work, and in contrast to most other places of work, turbine owners often forget that safety equipment has to be regularly tested, and that must be done by authorised personnel," says Pedersen, adding that Avanti Wind Systems' warranty for lifts and ladders also requires test and inspection at least once per year by Avanti or personnel trained by Avanti. "Safety in wind turbine towers always has top priority at Avanti. That's why it's always important to us that

turbine owners know their responsibilities."

Avanti Wind Systems is a leading world-market producer of service lifts/work cages and other personal security systems for wind towers. For more information contact Pedersen at (262) 641-9101, kp@avanti-online.com, or www.avanti-online.com.

SKF SOLUTION FACTORY OPENS IN THE UNITED STATES

The first-ever SKF Solution Factory in the United States has opened in Houston to provide customers with ready access to a portfolio of services and competencies under one roof at one strategically located venue. The first-ever 25,000 square-foot facility joins a growing network of eight others around the world.

"This new facility can equip customers with value-added solutions and industry knowledge to optimize their machinery performance and maximize operating efficiencies," according to Poul Jeppesen, president and CEO of SKF USA, Inc. "The facility further provides us with an unprecedented venue to advance our dialogue with customers in a working partnership to help solve their challenges."

Among on-site competencies and services the Solution Factory houses applications engineering, spindle and ball screw repair, bearing application expertise, sealing solutions, lubrication system expertise, mechanical equipment services—including mounting, alignment, and balancing—remote condition monitoring and diagnostics, engineering consultancy services, and operator and worker training.

"All these resources under one roof allow us to deliver customized and timely product and service packages tailored for particular operations," Jeppesen adds. "We expect that this Solution Factory will quickly become a key destination for customers striving to increase overall asset efficiency, reliability, and productivity."

The newest SKF Solution Factory serves a wide range of industries in the region and beyond, including petroleum and gas, hydrocarbon processing, wind energy, and general manufacturing, among others. To learn more call (281) 925-2800 or go to www.skfusa.com.

CONSENSUS REACHED ON WIND TURBINE GUIDELINE RECOMMENDATIONS

Secretary of the Interior Ken Salazar praised the work of the 22-member Wind Turbine

NACHI AMERICA INC.
Tel:+1-888-340-8665 URL: http://www.nachiamerica.com/

NACHI ROBOTIC SYSTEMS INC.
Tel: +1-248-305-6545 URL: http://www.nachirobotics.com/

NACHI CANADA INC.
Tel:+1-800-387-9188 URL: http://www.nachicanada.com/

NACHI MEXICANA, S.A. DE C.V.
Tel: +52-55-3604-0832 URL: http://www.nachi.com.mx

Guidelines Federal Advisory Committee, which reached consensus on a set of draft recommendations aimed at minimizing the impacts of land-based wind farms on wildlife and its habitat. Salazar said he will review the recommendations and take them under advisement as he asks the service to develop guidelines for evaluating wind energy development on public and private lands.

"Wind power is one of the keys to America's clean energy future, but its development must be balanced with the long-term protection of the natural resources under our management," Salazar says. "I commend the committee for their two years of work developing these recommendations, which will help us ensure that wind energy is developed in a responsible manner."

Highlights of the committee's recommendations include a decision-making framework that guides all stages of wind energy development; reliance on the best available science when assessing renewable energy projects and their potential environmental impact; and use of landscape-scaled planning that recognizes the need to think long-term about protecting our nation's economic and natural resources.

"The Interior Department is creating a new energy frontier for America by harnessing the renewable-energy potential of America's public lands while protecting wildlife," says Michael Bean, counselor to assistant secretary for Fish and Wildlife and Parks. "The committee's recommendations will help us reach science-based decisions for future wind energy projects, while minimizing and mitigating local and regional impacts to wildlife."

The group was created in accordance with the Federal Advisory Committee Act and represents varied interests associated with wind energy development as well as wildlife management professionals. The committee does not address offshore wind energy development. The committee reports to the secretary of the interior through the director of the U.S. Fish and Wildlife Service. It functions solely as an advisory body, providing recommendations on effective measures to protect wildlife resources and coordinate the review and evaluation of facilities by state, tribal, local, and federal agencies. The draft report contains both policy recommendations and recommended voluntary guidelines for siting and operating wind energy projects in order to avoid or minimize potential impacts to wildlife and habitat. To learn more about the Interior Department's wind initiatives visit www.doi.gov/whatwedo/energy.

MARIAH POWER CHANGES NAME TO WINDSPIRE ENERGY

Mariah Power, developer of the Windspire® vertical axis wind turbine, announces a corporate name change to Windspire Energy, Inc. The name simplifies the branding of the company and its lead product, while leveraging the innovation of the Windspire wind turbine. In conjunction with the name change the company has also launched www.windspireenergy.com, a new buyer-focused Web site with information on the many available applications of Windspire wind turbines.

The Windspire is a vertical axis wind turbine designed for use in urban, suburban, and rural areas. The unique design of the rotor enables the turbine to generate energy silently while standing just 30 feet tall. Hundreds of Windspires are currently powering homes, businesses, schools, and museums across the United States. Recently the company announced the installation of 20 Windspires at the headquarters of leading software company Adobe Systems in San Jose, California (see article in this issue).

"We are focused on delivering renewable energy solutions that are elegant in their simplicity," says Walt Borland, president and CEO. "The corporate name change is just one example of how we are simplifying everything that we do, including our brand."

Designed and manufactured in the U.S., the Windspire is eligible for a 30 percent federal tax credit and many local rebates that can be as much as $4,800.00. In 11 mph average annual winds a Windspire will generate about 2,000 kWh over the course of a year. The thin profile of the Windspire allows customers to easily scale-up the number of turbines to meet higher energy needs.

Windspires are currently manufactured in Michigan and are available through a network of certified dealers who are trained to do site evaluations, installations, and to facilitate permitting and local rebate redemptions. Visit www.windspireenergy.com to learn more, or to locate a dealer near you.

PORTABLE DIGITAL TORQUE TESTER FROM SNAP-ON INDUSTRIAL

Regardless of the workplace—from a manufacturing plant to a diesel repair center, power generation site, or a wind farm—the portable Snap-on Industrial Digital Torque Tester (DTT) can do its job almost anywhere. Thanks to its light weight combined with an integral transducer and sturdy housing, the unit can be wall mounted or employed in a benchtop vise to allow the user to accurately test torque wrenches and torque screwdrivers.

The Snap-on Industrial DDT features an easy-to-use 4.7-inch

touch-pad screen to capture peak torque values during real-time testing and allows download of test data to a PC. All DTT torque testers are sold in a complete kit that includes the tester, hard carrying case, two socket driver reducer adapters, AC/DC power supply, AC adapter, and USB cable. The six DTT models range in capacity from ¼" drive, 10-100 in. oz. to ¾" drive, 60-600 ft. lbs. All models will display readings in English, Newton meters and kilogram-centimeter units of torque. Accuracy is ±0.5% of reading ±1 count CW and CCW from 10 to 100% of full scale at 25°C. Display accuracy of the unit is four digits, 9999 cycle counts. It requires six AA Alkaline batteries, or it can be run off the AC adapter.

Snap-on Industrial is a division of Snap-on Incorporated, a leading global innovator, manufacturer, and marketer of tools, diagnostics, equipment, software, and service solutions for professional users.

More information is available by calling (877) 740-1900 or visiting www.snapon.com/industrial.

INGETEAM REINFORCES U.S. PRESENCE

Ingeteam will invest in the implementation of a combined production center in the United States. The company's activity will focus primarily on the energy sector, specializing in the manufacture of wind power generators and converters, as well as solar photovoltaic converters, to meet the needs of the North American market. Ingeteam already has an office in Santa Clara, California, specializing in the sale of solar photovoltaic inverters. Likewise, another of the new affiliate's objectives is the manufacture of motors, generators, and converters for other markets in which the company is active.

Ingeteam currently has a location in Mequon, Wisconsin, carrying out wind turbine operation and maintenance activities. Through this activity it manages more than 2,200 MW distributed over 60 wind farms all over the world. It should be stressed that Ingeteam's wind power systems currently enjoy a market share between 12 and 15 percent. This share will increase in the coming years since the new factory is going to make possible the production of equipment for the equivalent of

7,500 MW each year, meeting the needs of its customers in this country. Several ranges of converter/generator products will be manufactured in the facilities, covering ranges from 1.5 to 5 MW of power for wind usage. In the medium term it is planned to endow the plant with the capacity to perform joint testing of complete equipment.

Ingeteam is a business group specializing in electrical engineering and the development of electronic technology that works in the energy, industry, marine, and railway traction sectors with the brands Ingeteam, Indar and Pine. It is made up of 28 companies spanning four continents—Asia, Europe, North America, and South America—and employing more than 3,500 people. To learn more contact Aitor Sotes at (262) 240-9850 or aitor.sotes@ingeteam.com. Go online to www.ingeteam.com.

KORINDO WIND MARKETING TOWERS IN NORTH AMERICA

Indonesia-based Korindo has announced it has begun marketing utility-scale wind towers in the United States, Canada, and Mexico under the name Korindo Wind. To date it has delivered 550 towers to customers developing North-American wind energy projects, and nearly 1,000 worldwide. With its plant less than a mile from the Port of Ciwandan, Indonesia, and the ability to deliver sections to the port closest to a project site, Korindo Wind is able to develop competitive pricing for customers around the globe. Jakarta-based Korindo, founded in Jakarta in 1969, launched Korindo Wind with the construction of a wind tower manufacturing facility in 2006.

"With the expected upturn in wind energy development in North America, it has become important to more firmly establish Korindo's wind energy division here," says Ricky Seung, president of Los Angeles-based Kousa International, exclusive agent for Korindo Wind. "Now, as the U.S. economy rebounds and more financing becomes available for wind projects, Korindo Wind is in an excellent position to form long-term partnerships with companies that develop projects or source primary components such as Korindo Wind's high quality wind towers."

Korindo Wind is an ISO 9001:2000 certified wind tower manufacturer. Its technologically advanced plant in Ciwandan, Indonesia, features a highly efficient linear production line and has an annual capacity of 800 towers, or the equivalent of 2 gigawatts installed. The company also provides Precision LogisticsSM, a comprehensive, risk-free logistics solution based

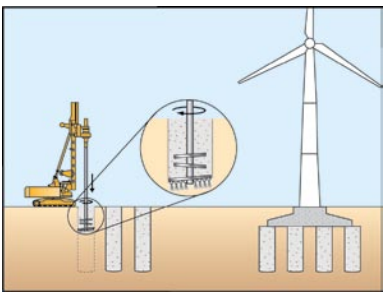
Continued on page 72 >

Dennis W. Boehm
Hayward Baker, Inc.

Soil mixing is an economical and efficient alternative to deep foundations for challenging sites, particularly for wind turbine foundation applications.

SOIL MIXING TECHNIQUES are used to mechanically blend soils in place with cementitious material to improve the soil engineering properties such as strength and compressibility. This installment discusses the soil mixing concept and technology.

Oftentimes the engineer has no influence over the location of the wind energy site and has to design the foundation around whatever geologic setting or soil types are found there. When faced with soft soils that are unsuitable for shallow foundations, the engineer often turns to deep foundation systems such as drilled shafts or driven piles. Deep foundations bypass unsuitable soils and bear into deeper strata to provide the required capacity. These foundation solutions can present challenges due to schedule constraints, cost, and constructability limitations. For many soft soil conditions, soil mixing techniques can produce columns or a stiffened mat of soil cement, often referred to as "soilcrete," to support the proposed wind tower foundation. Shallow foundations can then be constructed on top of the soilcrete columns or soilcrete mat. Because mixed soil provides enhanced bearing capacity and reduced compressibility, the use of the soil mixing technique allows for a reduction in size of the mat foundation for the tower, often reducing the overall construction cost and time.



Soilcrete created by mechanical soil mixing introduces cementitious binder material into the soil through a hollow rotating pipe that is equipped with cutting and mixing blades. The soilcrete product can take the form of individual columns of various sizes, typically in the range of 2.5 to 8 feet in diameter. Columns can be installed as individual elements, as overlapping multiple elements installed with a multi-axis mixing tool, or in the form of a mat, installed with a specialized blending tool attached to an excavator arm. Depending on the equipment, treatment depths can exceed 80 feet.

There are two types of soil mixing: wet, and dry. For wet soil mixing the cementitious binder is introduced in slurry form, whereas cementitious binder is introduced in powder form for dry soil mixing. The appropriate method is chosen based on the moisture content of the targeted soils and the application (i.e. structural foundation support or slope stabilization).

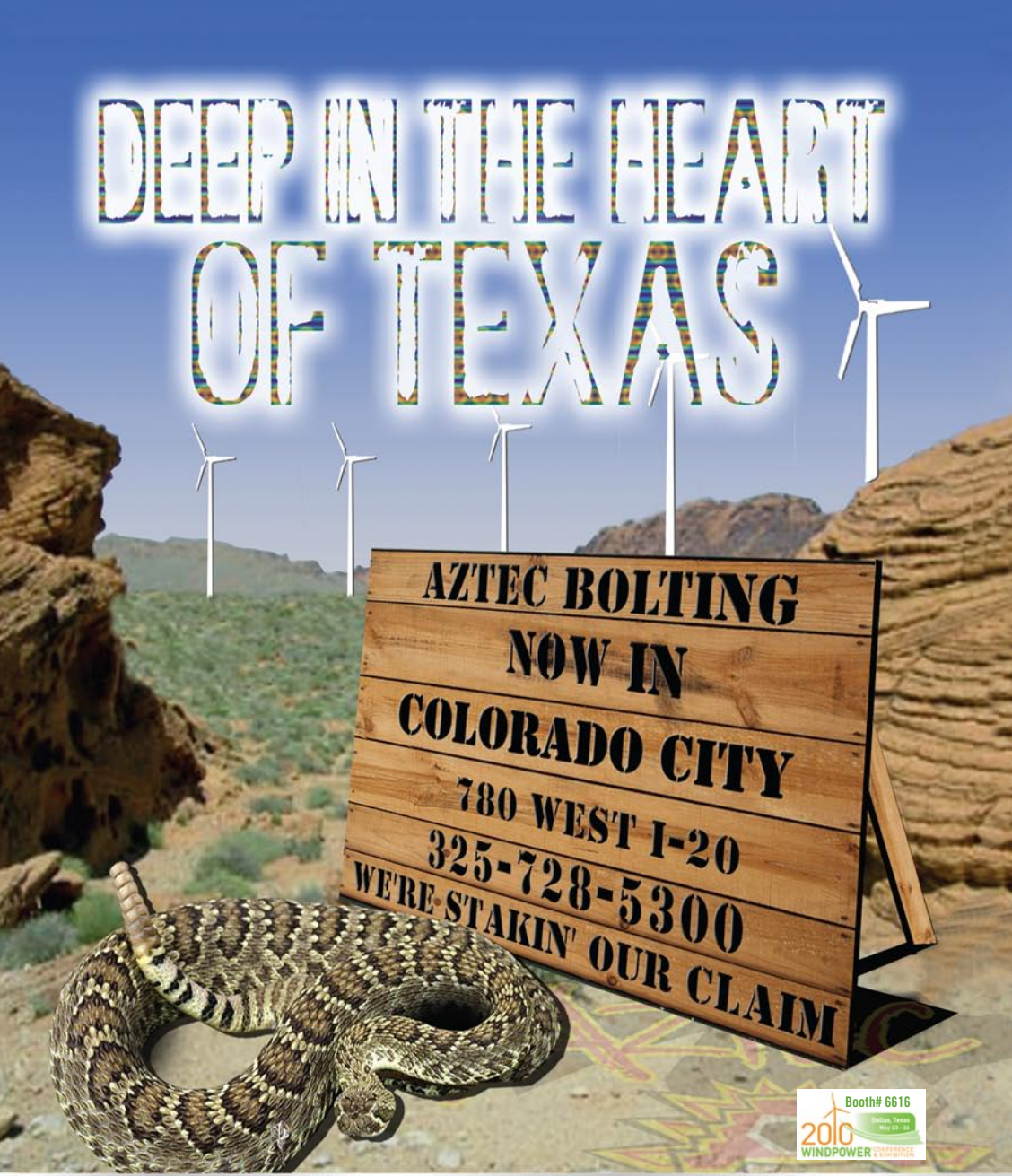
For column-style soil mixing, individual columns or a grid pattern of overlapping columns are often installed to treat 15-70 percent of the targeted soil mass. The percentage of treatment is dependent on the existing soil conditions, design loading, and performance criteria. The relationship between the treated and untreated soil is often referred to as a geocomposite ground improvement system. This composite system is also affected by the strength of the installed soilcrete elements. When a mass mixed solution is used, nearly 100 percent of the targeted problem soils are treated to ensure compliance with the performance requirements of the foundation. Depending on the existing soil types, very large loads can be handled easily after soil mixing treatment.

Soil mixing is often chosen as a pre-construction ground improvement process, before installation of the tower footing. After soilcrete construction the site is graded and the mat foundation is constructed. Depending on the design requirements the mat can be installed just below grade to take advantage of overburden surcharge for overturning resistance, or built at grade. Either construction option would be acceptable and would more than likely be driven by the project economics. Anchors can be installed into the soilcrete elements to resist overturning.

The construction aspects of the soil mixing process and the need to carefully control the blending of the soil in place demand a rigorous quality control plan. Typically, computerized equipment is used during the installation process to monitor the quality of the constructed soilcrete. Samples are taken during the construction process of the wet soilcrete and are tested in accordance with applicable standards to ensure that the minimum design unconfined compressive strength (UCS) of the soilcrete is being achieved. Continuity testing of the constructed elements from top to bottom is also performed as a post-installation check of the quality of the constructed soilcrete.

Since its introduction in the early 1950s, soil mixing has increasingly been used to improve poor soil conditions worldwide. Soil mixing is fast becoming an economical and efficient alternative to deep foundations for challenging sites, particularly for wind turbine foundation applications.

Dennis W. Boehm is a director with Hayward Baker, Inc., the leading specialty foundation and ground improvement contractor. He can be reached at dwboehm@haywardbaker.com. Go online to www.haywardbaker.com.



AZTEC

PROMPT SERVICE

4/7/365

TECH SUPPORT STAFF

"WHEN THE WORK IS" CRITICAL

LEADERS IN THE TORQUE AND TENSION INDUSTRY

ISO 9001:2008

Bolting.com 1-888-470-4903 www.bolting.com

520 Dallas Street League City, TX 77573 Ph: 281-338-2112 Fax: 281-332-1780

TORQUE TENSION CALIBRATION PRODUCTS SERVICES

Merritt Brown
Rev1 Power Services, Inc.

In order to increase reliability and service life, there are a number of areas wind turbine owners can address. Here's what you need to know.

AS THE U.S. WIND INDUSTRY begins a trend of increased post-warranty operations, owners are taking aim at turbine reliability as a critical aspect in the success of a wind project. Inarguably, poor reliability results in increased O&M costs, accompanied by a reduction in availability and increased downtime.

Modern turbines unfortunately have a relatively short operating record, and since most are still under warranty reliability data for this short time period is often difficult to acquire from the manufacturer. Some projects do indeed boast high reliability and availability in the first years of operation, mostly due to a combination of several factors including manufacturer's design, quality of manufacture and construction, servicing quality, operating environment, and wind regime.

How does an owner mitigate poor reliability, and what areas are within their control? They first rely on turbine "type certifications" to ensure the manufacturer has designed and constructed the turbine in compliance with International Electrotechnical Commission (IEC) rules.

To be certified manufacturers must design a wind turbine that will reliably produce energy for 20 years while withstanding extreme conditions. To maintain valid certification, the turbine supplier must build their units according to the specification and can't vary the components once certified. With short innovation cycles it's important to check that the turbines delivered are consistent with the certificate and with the specification.

Other factors that cause the most downtime can be addressed through a quality assurance (QA) plan that encompasses both the construction and operational phases of a project's lifecycle. Construction QA is paramount to limiting decreased reliability by ensuring the erection contractor has assembled the turbines according to the manufacturer's specifications. Common to all turbines are bolted joints; a frequent QA issue during construction. Tower bolts are a vital component of the turbine, and it's important that these bolts are installed and torqued properly.

It would be reasonable to expect that tower bolts are always handled with care, and that manufacturer storage instructions are followed to the letter. However, in a hurried effort to save work-hours in transporting parts to a turbine location, it is often found that tower bolting is delivered directly to the pad location, thus leaving them open to the elements and susceptible to corrosion. Just as over-lubrication reduces the torque value and can result in over-tightening, dirt and corrosion will affect it in the opposite way, leaving a tower bolt vulnerable to loosening and later failure.

Another important construction quality focus is on tower wiring. Repeated vibration during operation will cause cables and wires to rub against their surroundings. If not secured away from sharp edges, failure is guaranteed. While the approved construction drawing might not always represent the true field installation, good construction QA should always enforce proper industry practices.

Parts replacements make up a significant portion of the overall O&M cost of a wind project—nearly 30 percent in the first five years. Regardless of the manufacturer, this cost will increase over time. Not only are parts replacements affecting the project's cost of energy, but reliability and availability take a hit while parts are sourced and replaced.

In Pareto studies published at recent forums, submissions were made that electronics failures are the most prevalent of parts issues, followed by a variety of component failures. Many parts generally weaken over time regardless of use and will be replaced under a scheduled program.

Other components such as brake pads wear based on use and will have a replacement plan based on operating hours. Early unintended failure of these components can be expected to contribute to poor reliability of the project.

It is the project owner who must understand the influences that drive reliability, making allowance for uncontrollable circumstances such as manufacturer defects or operational errors, etc. Turbine manufacturing oversight, management of construction quality, a strong supply chain, and experienced operators that employ root cause analysis are a good formula to maintain high reliability of a wind project.

Merritt Brown is director of business development with Rev1 Power Services and Rev1 Wind. To learn more call (866) REV1NOW or go online to www.rev1wind.com.

WIND TURBINE
GEARBOX ANALYSIS PROGRAM

Maintaining your turbines at peak efficiency!

Provides in depth analysis of wind turbine gearboxes Lubricant and Gearbox Condition Analysis includes:

- Wear Rates
- Wear Particles Analysis
- Particle Counting
- Contamination Levels
- Oil Degradation
- Antioxidant Levels

Grease Analysis, Filter Analysis and Oil Quality Studies along with Internet Data Management System

Booth# 5108

2010 WINDPOWER CONFERENCE & EXHIBITION

Dallas, Texas May 23-26

Why would you need to use any other lab?

Call us today to find out how we can assist you in maintaining your turbines!

Herguth Laboratories, Inc.

800-OIL-LABS | herguth.com

Jose R. Zayas / Matt Barone
Sandia National Laboratories

Research into aero-acoustic properties will result in both the improved efficiency of wind turbines and increased siting opportunities, as the associated noise is decreased.

AS THE INDUSTRY CONTINUES to grow and develop, and with wind turbines continuing to be deployed across the nation, the likelihood of wind farms being sited near inhabited areas increases. An important constraint on wind turbine placement arises due to the consideration of wind turbine noise generated at the edges and tips of the blades, among other sources. As a key design metric, the noise generated by a turbine can determine its required setback distance from residences or buildings and depends on local community noise regulations. Noise is typically measured on a logarithmic, or decibel scale. As an example, a six decibel increase in the noise of a turbine would double the required turbine setback distance; likewise, a six decibel decrease in noise may allow the turbine to be half as far away. Wind developers seek to place turbines in locations that possess the optimal wind resource, but as installations encroach populated areas the noise constraint can prevent the optimal placement and adversely impact the economics of a wind farm.

Noise involves several distinct elements, including the source, the propagation through the atmosphere, and the perception, all of which are relevant to wind turbine acoustics and design. It is important to recognize that not all noise is the same, and that not all noise is perceived in the same way. Tones, or noise at discrete frequencies, tend to be perceived as more bothersome to humans than broadband noise, which is spread over a continuous range of frequencies. Low-frequency noise propagates through the atmosphere more efficiently than high-frequency noise, hence it can travel over large distances.

There are two primary sources of noise generated by wind turbines: mechanical noise, and aero-acoustic noise. Mechanical noise involves machinery-generated noise from the gearbox, bearings, and generator. This noise can directly radiate from the machinery components and cause vibration in the surrounding structures such as the nacelle and tower. This is often referred to as "structure-borne" noise. Mechanical noise often occurs at well-defined tones associated with the rotational frequencies of the machinery components, such as gears and individual gear teeth. Unlike aero-acoustic noise, mechanical noise sources are often easier to isolate since the source and location is well known and can lend themselves to effective mitigation through the use of insulating material in the nacelle and vibration isolation to prevent structure-borne noise.

Aero-acoustic noise is the noise created due to the motion of the rotating turbine blades relative to the surrounding air. Aero-acoustic noise is the result of several complex fluid dynamical phenomena that occur on a wind turbine blade and is usually broadband in nature, meaning that the noise signal is spread over a continuous range of frequencies. A particularly important aero-acoustic noise source is trailing edge noise, which results from the flow of air past the aft, or trailing edge of a blade. For an observer on the ground near a turbine this noise is modulated by the passage of the rotating blades, resulting in a characteristic "swoosh, swoosh" sound. Trailing edge noise imposes a rather strict design constraint on the tip speed of wind turbine rotors, limiting how fast the turbine rotor can rotate.

A key scientific challenge involves the fact that the precise relationship between the shape of a blade design and its aero-acoustic noise signature is not well understood, which makes blade designers apprehensive to large changes that could result in a higher acoustic signature. This constraint tends to limit innovation in blade design.

Key acoustic research being conducted at national laboratories, universities, and by corporate entities within the wind industry is targeted at developing the underpinning technology and analytical tools to better understand the phenomena. Once these efforts have succeeded we can expect that not only will wind turbines be able to be sited closer to populated areas without disturbing those who live there, but the overall efficiency of wind systems will increase.

Jose R. Zayas is program manager, Wind & Water Power Technologies, and Matt Barone is senior member of the technical staff of the Aerodynamics and Aeroacoustics Lead at Sandia National Laboratories. Go online to www.sandia.gov/wind.

- Durable, reliable electrical and hydraulic equipment that can withstand the harshest environments
- Remote-monitoring systems
- Cost-effective assembly solutions
- Customized equipment

EATON
Powering Business Worldwide

Need expert help with your wind installation?

Eaton's Electrical Services and Systems engineers can assist you with installation, commissioning, maintenance, retrofit upgrades and turnkey substation construction.

For more information about Eaton's solutions for wind systems, visit www.eaton.com/windpower

Booth# 11462
2010 WINDPOWER CONFERENCE & EXHIBITION
Dallas, Texas
May 23 – 26

Hüseyin Kizilagac
BDP Project Logistics

Offshore energy production is on the rise around the world, which will present logistical challenges for onshore developers as well, requiring knowledgeable partners to overcome.

OFFSHORE ENERGY PRODUCTION is gaining traction as consumption of electricity from conventional sources declines and renewable sources continue to grow. Countries and companies alike are gaining confidence in this relatively new opportunity for renewable power. Offshore wind velocity is generally higher and the wind more consistent, compared to onshore winds. That can provide greater capacity, increased energy production, and greater revenue for offshore wind farms. Plus, as turbines are built further offshore, perhaps on special floating platforms, even greater amounts of wind energy can be harnessed.

One of the first wind farms in the world is in the North Sea off the northeast coast of the UK, which also has awarded licenses to develop 32 gigawatts from a number of wind farm locations ranging from the English Channel to the North and Irish Seas. The European Wind Energy Association anticipates 70-percent growth in its offshore wind sector this year, leading to that sector providing 10 percent of the electricity in the European Union upon completion of all planned projects. China is developing its own share of the market. Asia's first offshore wind power plant recently completed the installation of 34 wind turbines in Shanghai. According to a senior energy official, China will give top priority to developing offshore wind power projects this year. Spain, home to the world's largest wind power producer, is also expanding its presence in the offshore market.

Although the United States has dragged its feet on offshore power, a recent government report by the U.S. Department of Energy pointed to latest estimates of the nation's wind energy potential as three times what the agency had estimated earlier. Not counting Hawaii and Alaska, they say production could be 37-million gigawatt hours of wind power annually, which is nearly 10 times the total power generated in the U.S. in 2009, around four million gigawatt hours. Problems for offshore power development could be just over the horizon, however, unless the right resources are in place.

As the offshore wind market grows there are already bottlenecks in the supply of transportation components. Ironically, in the UK, offshore wind is competing with offshore oil and gas for many of the same vessels and support craft, of which there are currently very few. While there are plans to build more specialized vessels, the supply-demand situation means there could be significant delays.

Just like the development and erection of onshore wind farms, the logistics and construction pieces have to fit perfectly for offshore. It is still about reliability—on-time delivery, and within budget. While larger components for offshore farms generally can be transported more easily than onshore, there are special or additional logistics expertise required for offshore projects, such as selecting the most appropriate port facilities for successful deployment, infrastructure issues, and specialized vessels for transportation, as well as loading oversize components on vessels and their safe transit to the site even in the most difficult weather conditions—the new Siemens 3.6 megawatt wind turbine towers are around 230 feet tall and have blades 192 feet long, for example.

It makes sense to work with a logistics provider that is already engaged in the wind power industry and has deep experience in the maritime and civil engineering sectors; an experienced 3PL and 4PL resource that can see and resolve logistical challenges before they become problems and has the proven capacity to deliver. That means a company with a global network that can provide a vast sourcing perspective to bring all the components from various suppliers to a final destination in a cost-efficient manner.

A project logistics company with experience in key trade lanes—such as China to Europe and the United States—is important, especially as the volume of components being shipped continues to increase. As the offshore wind power industry evolves and develops, you need an experienced logistics partner to help you overcome the inherent challenges.

Hüseyin Kizilagac is director of business development for BDP Project Logistics. Call + 49 911 965223-19, e-mail hueseyin.kizilagac@bdpprojects.com, or go to www.bdpprojects.com.

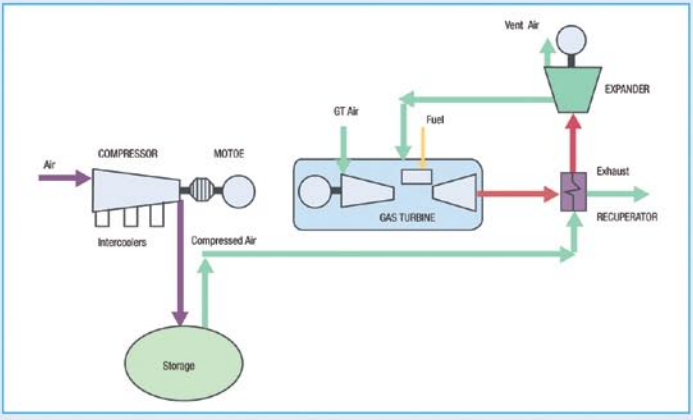
Energy Storage and Power LLC

SECOND GENERATION COMPRESSED AIR ENERGY STORAGE ("CAES2") TECHNOLOGIES ARE PATENTED BY DR. NAKHAMKIN AND LICENSED BY ES&P.

ES&P PARTICIPATES IN ALL STAGES OF CAES2 PROJECTS EXECUTION FROM CONCEPTUAL ENGINEERING AND OPTIMIZATION TO DELIVERY OF PLANTS ON TURNKEY BASIS.

SECOND GENERATION CAES2 PRIME FEATURES:

- Provides Load Management of Renewable Energy and Optimization of Smart Grid
- Totally Green Energy Storage Cycle with ~ 90% Efficiency
- Scalable from 15 MW to 430 MW
- Total energy delivered with Heat Rate Less than 3,800 Btu/kWh
- Bottoming Cycle Green Power is ~ 150-200% of CT Capacity
- Above- and Below-Ground Compressed Air Storage
- Less Expensive than Combined Cycle (CC) Power Plant



ES&P IS THE ONLY COMPANY THAT WAS INVOLVED IN ALL STAGES OF EXECUTION OF THE 110 MW CAES PROJECT- THE ONLY CAES PROJECT IN THE US.

CONTACT:

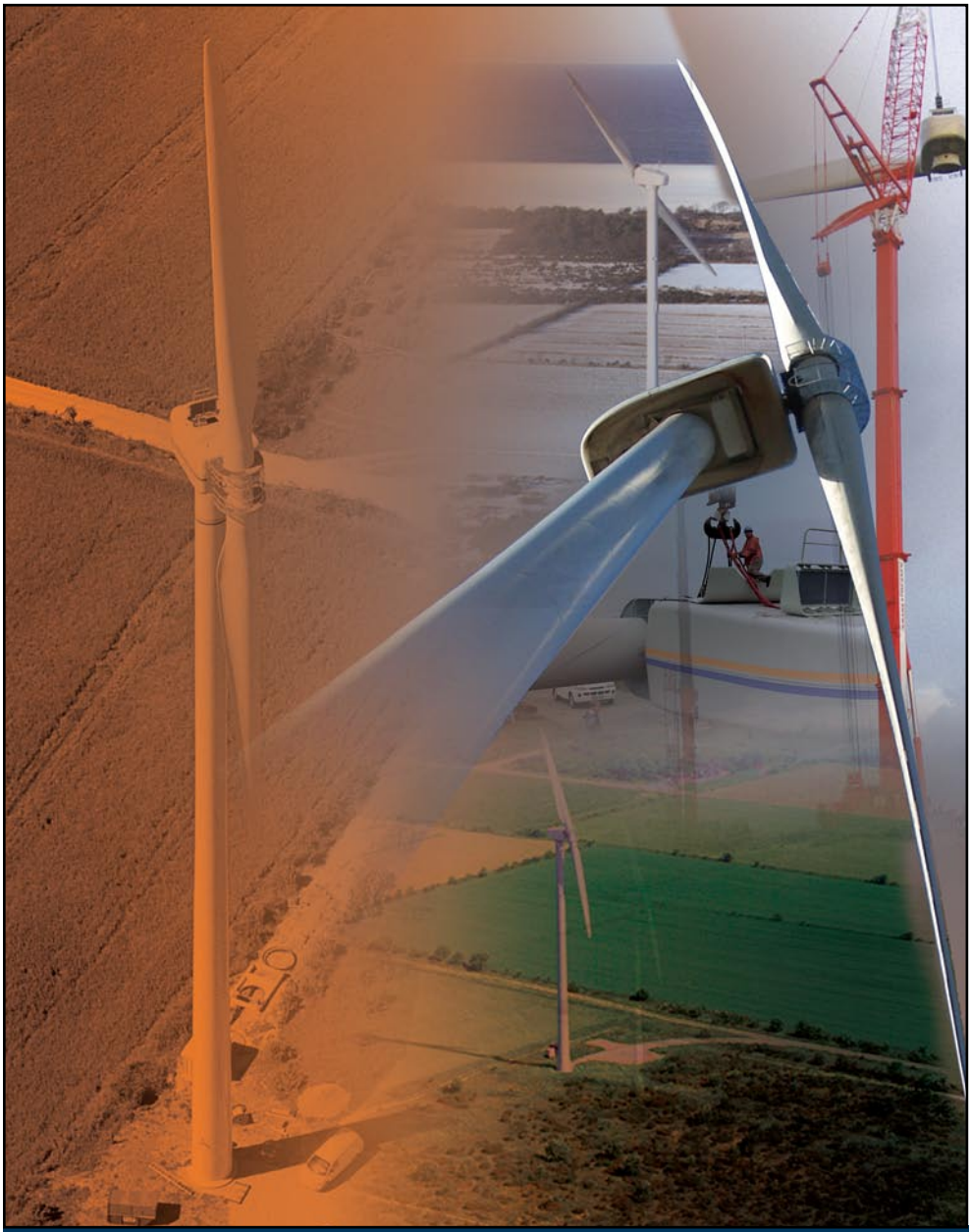
ROY DANIEL (Chief Operating Officer)
rdaniel@energystorageandpower.com

MAIN OFFICE NUMBER: 908-393-7177
www.EnergyStorageAndPower.com
info@EnergyStorageAndPower.com

PROFILE

NORDIC WINDPOWER

By Russ Willcutt



With decades of R&D behind it, this company's two-blade turbines have been carefully crafted for utility-scale community wind projects.

IN MANY WAYS NORDIC WINDPOWER'S approach to harvesting the wind is highly academic in nature, backed by tens of millions invested over decades of research before the company began operations as a commercial entity. "And much of that R&D was conducted by university professors and scientists in Sweden, and funded by that government in the early stages, along with Swedish investors," according to Tom Carbone, CEO, adding that many technical enhancements and contributions have been made by experts based in the United States and the United Kingdom since that time. "The company's current owners—an impressive collection of wind power developers, wind technology experts, and clean-tech venture capitalists—eventually decided the time was right to bring this line of turbines to the U.S. market, officially launching the company in 2007."

Just as Nordic Windpower's history is somewhat nontraditional, so are its products. While the majority of wind turbines sport three blades, and some four, the company's units are of the two-blade design, which has led to a number of features making them ideal for utility scale community wind applications. Taking its premier model, the N1000 1MW turbine, as an example, you'll find an affordable, lightweight unit that can be raised atop a 70 m tower made in two sections—as opposed to the three- and four-section towers that most three-blade turbines require. The turbine nacelle and blades can be lifted by crane in one piece, with the blades assembled on the ground, decreasing installation time and costs and increasing safety. Maintenance is slashed due to a simple, reliable design, which also results in greatly increased service life due to lower loading of critical parts such as the gearbox and drive shaft. One of its most impressive features, however, is a proprietary "damped teeter hub" that provides a tuned flexible connection between the rotor and the gearbox. This flexibility prevents the wear and tear resulting from wind shear, turbulence, and other fatiguing forces on the mechanical drive train so prevalent in rigidly mounted rotor hubs in three-blade designs. The resulting long service life is well documented.

"During our lengthy research phase, which began in 1975, two large, multi-MW, two-bladed wind turbines were erected at two different sites in Sweden," says Carbone. "One was a 3MW, and the other a 2MW unit. They were both put into operation in 1982 and carefully monitored for six years, until 1988. Neither failed, and both delivered the energy they were designed to deliver, with high reliability and low maintenance for being prototype units."

Even more impressive was a 3MW two-bladed wind turbine erected in the early eighties at a time when the rest of the industry was manufacturing 150-225 kW machines. "By the time it was dismantled in 2006 it had operated continuously for 26 years and held the world power production record for a single wind turbine," Carbone says. "While that record is now being challenged by some of today's larger turbines, it stood as proof of the validity of our basic design."

Another benefit of its heritage is the fact that many European wind farms are sited closer to populated areas than they are in the United States, increasing community focus on size, appearance, and the noise generated by the turbine blades in particular. According to Carbone, while three-blade turbines of the same rotor diameter may produce less noise at full capacity, Nordic Windpower's two-blade units have been tuned to comply with the noise-level requirements for utility scale community wind turbines. "While noise may not be an issue with offshore developments, it's a critical factor in onshore installations," he says. "Once again, our years of development and testing really paid off."

That development is ongoing at the company's operations and assembly facility in Pocatello, Idaho, with marketing, sales, and finance activities based in Berkeley, California, and engineering services in Bristol, England. All told, Carbone and his colleagues believe that Nordic Windpower's technologies will continue to be met by an increasingly receptive audience throughout North America and around the world.

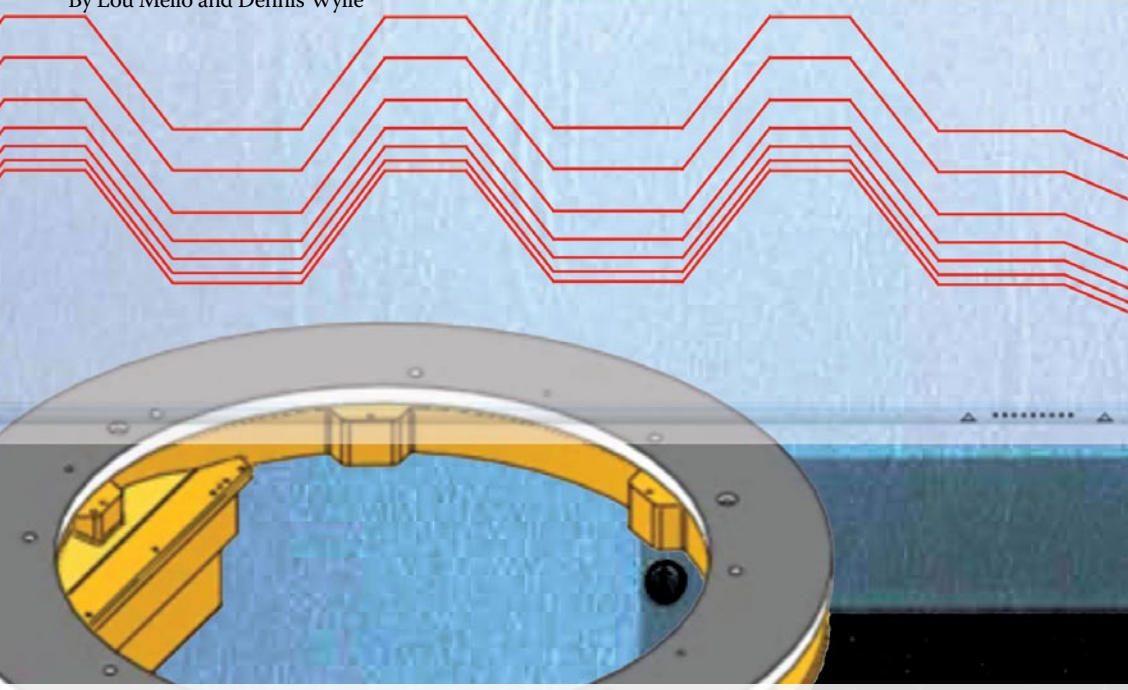
"If you design a wind turbine that makes the cost of energy competitive with that of fossil fuels, is easy to operate and more affordable, reliable, and acceptable to communities, then you have a winner," he says. "And that's exactly what we've done."

Call (888) 322-2080 or (510) 665-9463, e-mail info@nordicwindpower.com, or go online to www.nordicwindpower.com.

INCREASING PRODUCTIVITY WITH INTEGRATED CONTROLS

Control solutions such as Rockwell Automation's Integrated Architecture system help standardize safety, improve reliability, and reduce maintenance concerns.

By Lou Mello and Dennis Wylie



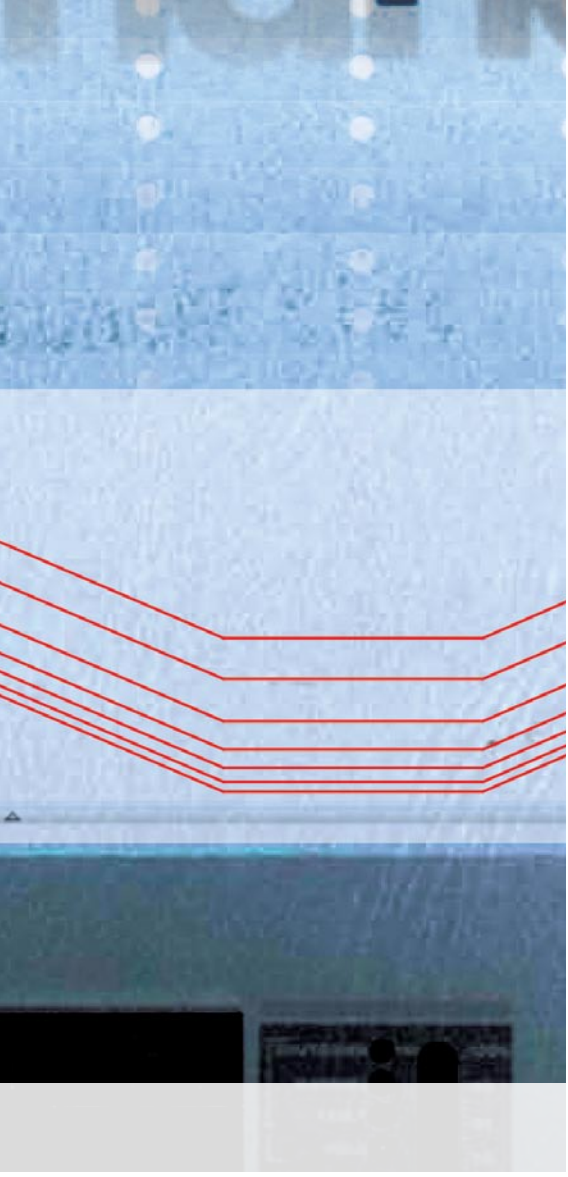
Lou Mello and Dennis Wylie are with Rockwell Automation.
Go online to www.rockwellautomation.com.

FROM BLADE MANUFACTURERS and wind farm designers to wind turbine operators and power providers, the companies involved in the production of wind energy have very different production applications. Yet both the personnel behind the blade production machinery and those responsible for wind turbine controls are tasked with similar goals: They must keep safety, reliability, and maintenance at the forefront to help their companies—and their customers—succeed. Key to accomplishing these goals is leveraging an integrated control solution.

The Rockwell Automation Integrated Architecture™ system provides that solution, integrating motion, sequential, safety, and power control on a single platform, all networked over EtherNet/IP for improved data communication and remote troubleshooting capabilities. Before discussing the system's attributes and capabilities, allow us to provide a real-world example of how one company is benefiting from this technology.

CASE HISTORY

Founded more than 13 years ago, Tecsis Tecnologia e Sistemas Avançados is dedicated to manufacturing blades for wind turbines. Tecsis is the only 100 percent Brazilian-owned company currently producing this type of blade. It exports all of its products, which are manufactured at its own production sites located in the city of Sorocaba, 96 km from São Paulo. Currently the company produces more than 12,000 blades, which have been installed in more than 10 countries in Europe (Spain, Ireland, and Greece) and



North America (the United States and Canada), as well as in Australia and Japan, among other countries.

Tecsis ships its blades to clients from the port of Santos, some 70 km from São Paulo. Due to the length and weight of the blades, transporting them requires complex logistics. They are moved from Sorocaba to Santos in convoys of 25 to 30 trucks that pass through the capital and descend from the mountains during the nighttime hours. To prepare the blades for loading in ships, they are placed in special packing to protect the product to make it easier to transport and move them.

THE CHALLENGE

The length of the Tecsis blades varies from 37 to 50 m, and weigh from between 6 to 12 tons. However, before initiating the manufacturing process itself, Tecsis develops a specific design for the molds based on a detailed profile to meet the customer's specific needs. The profile is determined by each customer's specific design and depends on the location where the wind turbines will be erected. Each project is therefore unique. "This requires the manufacturing of specific equipment and tools, as well as carrying out the necessary tests to put the product into production, which can take months," according to Aureo de Oliveira, electrical engineer coordinator at Tecsis. "Despite being highly 'engineered' in initial stages, the manufacturing of the blade is done completely by hand and requires about 24 hours."

Each blade is manufactured in a die, also produced by Tecsis, in which layers of materials are applied. Modern wind turbines are made up of three blades, manufactured with reinforced plastic (polyester and epoxy) and fiberglass. Other materials are also used such as carbon fiber, steel, aluminum, textile fibers, wood, and wood epoxy. The blades must be lightweight, resistant, and rotate easily to withstand winds that can reach 180 km/h. Although the blades are able to stand up to these wind speeds, the wind turbines normally operate at winds up to 90 km/h. Any higher speed will shut down the system, and the generation of power will be cut off as a safety measure to protect the structure.

Two key factors are responsible for keeping the blades lightweight and resistant: the temperature of the material that is applied to the mold, and the amount of time that this material is exposed to that temperature.

THE SOLUTION

Automation of the heating system plays an important role in the final solution because it allows precise temperature control throughout the entire process, eliminating safety and quality deviations. However, the system used by Tecsis did not meet all of the company's needs. Aureo explains how control was handled, and what the difficulties were. "Control and handling of the heating process data were limited because control was done individually by heat section, which made it difficult to balance the temperature between the controlled points," he says. "In addition, the generated reports did not provide information to track the heating process variables in real time, or to create production history. It wasn't possible to compare the temperature of the control zones and the different areas, which would require more homogeneous temperature stabilization in the mold."

With the CompactLogix controllers and RSViewSE Stand-Alone software, Tecsis was able to reduce mold assembly time, increase panel installation reliability, and allow employees to dedicate more time to other applications, in addition to decreasing indirect project costs.

THE RESULTS

In practice, the system is simple: There are dozens of

temperature measurement points (thermocouplers) for each mold. The signals emitted by the thermocouplers are transmitted to the CompactLogix PAC, which receives information about the temperature of each point and activates heating when needed. The need to heat each point at a lesser or greater degree is determined by the temperature profiles that control these variables throughout all production stages of the blade. Each customer has a unique design based on the process conditions of each blade, and the temperature curves change for each customer. In this regard Tecsis also obtained a degree of autonomy, because its own technicians defined the system parameters for the curves.

"We plan to apply Rockwell Automation controls to all systems where electric control of temperatures is required because the application is easy and configurable, and it reduces maintenance," says Aureo, emphasizing "the excellent service, information security, and broad product knowledge" he enjoys while working with the Rockwell Automation team of engineers.

THE DETAILS

After companies like Tecsis manufacture blades and other turbine components, wind-farm designers and turbine OEMs can leverage the same scalable Integrated Architecture system for all of their control needs, including:

- Pitch control systems to position the blades and spill wind when the turbine is operating above the rated wind speed, while also maximizing power output;
- Yaw control systems including across-the-line starters, soft starters, or variable frequency drives to keep the turbine facing the wind;
- Main control systems to calculate the power optimization algorithms based on available wind, pitch angle, and blade geometry. This system then sends a set point to the generator or grid tie inverter and can provide for many startup and shutdown safety checks as well;
- Condition-monitoring systems to monitor vibration on the main drive shaft bearings, as well as each gearbox and generator bearing.

STANDARDIZED SAFETY

In each of these applications, as in the manufacture of the blades themselves, safety is critical to protect both people and the large capital investment that a turbine represents. Any diagnostic failure would typically force the wind turbine into a shutdown mode, which commands the blades to a shutdown position.

An extremely important safety consideration for wind turbine manufacturers is overspeed protection. The turbine control system should include a safety-rated circuit to monitor both the high-speed and low-speed ends of the gearbox and hub, and help avoid

Our wind tower solutions will blow you away.

WELDING + CUTTING + AUTOMATION = WIND TOWER SOLUTIONS

Subarc Wire and Flux

Mechanized Cutting

Welding Automation

What's the most efficient way to produce your wind tower? Turn to ESAB for a complete manufacturing solution. We have everything you need, all in one place – from mechanized cutting machines to automated welding systems to the broadest selection of filler metals and fluxes. Our experts will provide a turnkey solution, from factory layout to unequalled support that will keep your operation running at maximum efficiency. So let ESAB power the fabrication of your wind tower.

esabna.com + 1.800.ESAB.123

ESAB® ESAB Welding & Cutting Products

Visit us at WINDPOWER 2010 Conference & Exhibition, booth #8629

SESSIONS DAY 1: SUNDAY MAY 23

8:30 am-3:45 pm:

- Wind Energy 101: Fundamentals of Wind Energy
- Wind Energy 201: What Makes the Development Process Successful
- Human Resources Seminar: Powering Our Organizations Forward
- Green Grids: Integrating Large Scale Wind

9:00am-3:30 pm:

- Co-Located Educational Program
- Wind Power Suppy Chain Workshop (separate registration required)

SESSIONS DAY 2: MONDAY MAY 24

10:30 am-12:00 pm:

- Project Development Track: Challenges in Project Development (2A)
- Finance Track: Optimizing Capital in the Current Environment (2B)
- Policy Track: Governor's Panel on Wind Energy Issues (2C)
- Utility Track: Critical Wind Power Issues for Electric Utilities (2D)
- Performance Track: Wind 101-The Business of Wind (2E)
- Technical Track: Wind 101-Laying the Technical Foundation (2F)

1:30 pm-3:00 pm:

- Project Development Track: Public Acceptance-Building Wind Projects & Transmission (3A)
- Finance Track: Cash Value Stream (3B)
- Policy Track: Legislative Panel of Wind Industry Leaders (3C)
- Utility Track: Learning from the Leaders-Case Studies in Utility Growth in Wind Power (3D)
- Performance Track: Project Performance Using Reliable Turbines-Part 1 (3E)
- Technical Track: Beyond 20%-Smart Grid, Electric Vehicles, Energy Storage, & Solar under Wind (3F)

3:30 pm-5:00 pm:

- Project Development Track: Airspace Conflicts: The Latest on Radar & Aviation Concerns (4A)
- Finance Track: Capital Sources for the Future (4B)
- Policy Track: Current Policy Issues (4C)
- Utility Track: Power Session-Utility Involvement in the Wind Energy Industry (4D)
- Performance Track: Project Performance Using Reliable Turbines-Part 2 (4E)
- Technical Track: Scientific Track (A4), Launch of Scientific Track: Research Future in Wind Energy (4F)

2010 WINDPOWER CONFERENCE & EXHIBITION

- **The wind industry's leading remote sensing system** — In commercial use since April 2008; over 800,000 hours of data gathered.
- **Ultra-low electric power requirement** — Triton's 7-Watt electric power requirement (2 solar panels and 2 internal batteries) greatly simplifies installation and site logistics.
- **Industry-leading reliability and uptime** — Triton's rugged construction and field serviceability keep it running.
- **Get your data anytime, anywhere** — SkyServe® Satellite Wind Data Service delivers your data over the Web every 10 minutes.

Visit us at WINDPOWER 2010

Dallas, Texas, May 23–26 – Booth 6613

See Triton at the new WINDPOWER 2010 outdoor demonstration area, Booth 30221

366 Summer Street, Somerville, MA 02144 USA
Tel. 617-776-8520 | tritonsales@secondwind.com
www.secondwind.com/triton

SECONDWIND
Wind assessment without limits

reaching a specified rotational speed. If the limit is reached, the circuit can initiate a shutdown sequence, protecting the turbine and any people on or near the equipment. In the past decade, safety-based control has made its way into manufacturing and assembly equipment controls designs. Similarly, wind turbine control designs are adopting many of the same safety design practices.

IMPROVED RELIABILITY

Wind turbines, particularly those located offshore, also require a control system with excellent reliablity that will stand up to the high-temperature and harsh, corrosive environments that exist out at sea. Controllers designed using hardened components suited for rugged environments can help provide OEMs and wind-power providers with excellent reliability and reduced panel costs. In addition, operational costs and carbon emissions are reduced because these controllers do not require the additional installation and energy costs associated with auxiliary heating and cooling systems.

Reliability also can be improved through predictive maintenance solutions. With the application of condition monitoring technologies such as vibration analysis, wind turbine operators can detect problems early, identify the cause, and take corrective action, all with minimal impact on energy production. This also helps optimize maintenance planning and costs.

EASIER MAINTENANCE

Unexpected shutdowns and maintenance of any kind can represent significant investments of time and capital. An integrated control system that is networked over EtherNet/IP can provide wind-power companies with remote-monitoring capabilities on the same platform as the standard control. This provides a smaller physical footprint with improved diagnostic and troubleshooting capabilities.

A commercially available, off-the-shelf solution like the Integrated Architecture system from Rockwell Automation helps reduce training needs and spare part requirements, offering global support no matter where the turbine is installed. In addition, with more utility companies using similar integrated control systems in their facilities, wind-power providers can more easily integrate with their systems to supply wind-generated power to customers around the globe.

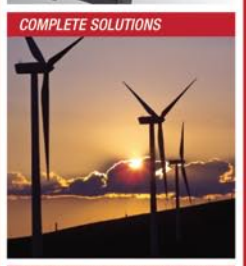
From end to end, companies across the range of wind-system applications are taking advantage of integrated control solutions to help standardize safety, improve reliability, and reduce maintenance concerns. Learn more about Rockwell Automation's solution by visiting www.rockwellautomation.com/solutions/integratedarchitecture/index.html.

I CHOOSE LINCOLN℠...

TO MEET THE DEMANDING WELDING NEEDS OF THE WIND TOWER FABRICATION INDUSTRY.

Lincoln Electric's advanced Power Wave® equipment platform, combined with our complete line of submerged arc wire and flux, delivers superior welding performance on typical wind tower applications, such as longitudinal and circumferential seams, flanges, door frames and more.

For a custom welding solution that delivers consistent, reliable performance while meeting the strict requirements for products used in wind tower fabrication–choose Lincoln Electric.



Booth# 10744

2010 WINDPOWER CONFERENCE & EXHIBITION

Dallas, Texas May 23 - 26

www.lincolnelectric.com
windtower@lincolnelectric.com

AR10-12

LINCOLN® ELECTRIC
THE WELDING EXPERTS®

INNOVATIVE TURBINE FOUNDATION SOLUTIONS

The Rammed Aggregate Pier system, designed by the Geopier Foundation Company, provides reliable support solutions for tower foundations.

By Brendan FitzPatrick, P.E.

Brendan FitzPatrick, P.E., is director of engineering and development for North America at the Geopier Foundation Company, Inc. He can be reached at (704) 799-3185 or bfitzpatrick@geopier.com. Go online to www.geopier.com.

ALTHOUGH WIND'S POWER has been harnessed for thousands of years, the demand for green, alternative energy in the United States has spurred significant growth in the wind industry over the last decade, and particularly the last five years. The American Wind Energy Association (AWEA) reports that tower construction in 2009 surpassed all previous years with over 9,900 MW installed, bringing the total power contributed by wind in the U.S. to more than 35,000 MW.

The push for more-efficient towers with increased power generating capacity is driving tower dimensions to new heights. Turbine manufacturers have developed towers with more than 5 MW capacity and exceeding 125m in height. While the larger turbines provide more capacity, engineering and construction of cost-effective foundations for these towers becomes an increasing challenge.

SOLID SUPPORT

Turbine foundation design considers traditional geotechnical engineering analyses for bearing capacity and settlement for static dead and live loading conditions much like conventional building foundation support. More importantly, though, the designs are often controlled by large transient pressures attributed to significant overturning moments from mean and critical wind characteristics applied to the turbine foundation. The geotechnical and foundation design must also provide stiffness characteristics of the

Fig. 1: Rammed Aggregate Pier (RAP) installation.

foundation soils for acceptable tower performance under the wind gust loading conditions. Most manufacturers specify horizontal and dynamic (rotational) stiffness criteria specific to the particular of tower type that must be met.

Designers, contractors, and owners must weigh a variety of different foundation support solutions for their towers based on performance, cost, and speed of construction. Priding themselves on being part of the green movement, designers also seek to provide sustainable solutions for projects. These decisions are often simplified when the ground conditions allow for large turbines to be supported on shallow concrete mat foundations bearing on competent soils or rock. Shallow foundations—often hexagonal or octagonal in shape—provide significant economy and speed of construction in these cases. In addition to meeting performance requirements this approach is often a relatively sustainable construction method as well, because it avoids the increased carbon footprints and other detrimental environmental impacts often associated with more-elaborate foundation support solutions.

Unfortunately, many tower sites are characterized by weak or soft soils that do not provide sufficient support for the high applied pressures or meet the foundation settlement or stiffness requirements. Design teams must consider alternative support solutions including massive grading operations to remove and replace the unsuitable soil, installing deep foundations to bear on competent soils or improving the existing poor soils.

DEEP FOUNDATIONS

The process of massive removal (overexcavation) of the poor soil and replacement in thin, controlled lifts with high-quality engineered aggregate (similar to roadway or building construction) is a desirable and cost-effective solution when the depth of poor soils is limited to only a few feet below the foundation bearing elevation. Tower foundations may be designed as large mat foundations, the same as those supported on competent soils. The overexcavation process becomes more complicated when poor soils extend deeper below the foundations, or shallow groundwater results in the need for dewatering of the excavation. These conditions not only adversely affect the economics, but also the construction schedule. From a sustainability perspective, the earthwork operation uses locally occurring, natural materials to create the engineered bearing layer. The carbon footprint of the construction activities begins to add up, however, when considering transportation of both the engineered material and the poor soils removed, as well as the large earthmoving construction activity.

Deep foundation support is typically used when poor soils extend to considerable depths below foundations. Deep foundations—such as driven piles made from timber, concrete, or steel, drilled concrete shafts, or grouted auger-cast-in-place piles—are used to transfer tower foundation loads through soft, compressible soils to bear on competent soil or rock. It is common for deep foundations to be used to treat sites with soft soils extending more than 50 or 100 feet in depth.

Although the geotechnical and structural design of the piles and foundation may be more intensive, the deep foundation system will provide superior performance for settlement and bearing. The superior performance comes at a high cost, both financially and environmentally. Besides the initial high material cost, pile-supported tower

Fig. 2: Construction of a wind turbine base (see finished base in fig. 3).

foundations may result in longer construction schedules, often related to slow installation of the piles, delays in material fabrication, or delivery to remote sites. Steel pile foundations incorporate energy- and resource-depleting manufactured materials such as steel or concrete. Piles typically utilize material that is manufactured or fabricated at locations hundreds or even thousands of

We challenge all comers...
find a faster and more accurate bolt installation system!

Booth# 15915
2010 WINDPOWER CONFERENCE & EXHIBITION
Dallas, Texas
May 23 - 26

VALLEY FORGE 1974

NO Extra Training or Special Crews.

We run all Torque Wrenches WIDE OPEN! Now you can too! Simply tighten with ANY pneumatic or hydraulic wrench while reading **TRUE BOLT LOAD** on our NEW Snap On Gauge.

No More Skidmore Testing, DTI's and Feeler Gages, Squirting Goo, or using Torque Charts!

Using our patented NEW ball-lock washers will enhance safety by eliminating the need for backup wrenches!

Every bolt is calibrated and conforms to ASTM F2482-08 or customer requirements. Our SPC4™ bolt measures true clamp load by bolt extension, not torque. Data gathering equipment to Excel spread sheet is available.

Our Revolutionary new ball lock washer acts like a back up wrench.

MAINTENANCE!

Six month bolt load inspections are finally quick and accurate.
Accurately check 25+ bolts per minute, save time and money by re-torquing only bolts below a designated limit.
Stop lugging hydraulic pumps around needlessly. Our SPC4™ System will instantly shut off your wrench at a pre-set tension.
Find out why so many have changed from torque to tension. Call us at (602) 269-5748 ext. 1 or email sales@vfbolts.com
Valley Forge & Bolt Manufacturing in Phoenix, Arizona, 85009

WWW.VFBOLTS.COM

Fig. 3: Octagonal wind turbine base (preliminary work shown in fig. 2).

miles away. Although local, concrete production is also energy intensive and ozone depleting. The combination of the energy-intensive manufacturing process and the significant transportation efforts required for deep foundations to arrive at the site increase the carbon footprint of the foundation solution, adversely impacting the sustainability of the solution.

RELIABLE REINFORCEMENTS

A trend that has continued to grow with the wind industry is the use of soil reinforcement to improve the existing poor soils to support shallow turbine foundations. Soil reinforcement approaches attempt to balance the critical factors of cost, performance, ease of construction, and environmental sustainability that could control the success of the project.

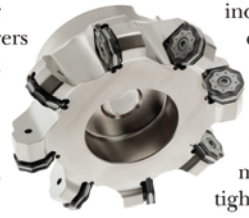
Soil reinforcement for tower support using Rammed Aggregate Pier® (RAP) systems designed by the Geopier Foundation Company have continued to gain momentum and provide value on wind projects. Intermediate foundation solutions using RAP systems have provided

BUILDING BIG THINGS FOR TOMORROW

BEGINS WITH MAKING THE RIGHT CHOICE TODAY

With expected increases of wind power generated electricity, many manufacturers will be faced with new challenges when producing components such as gear boxes, casings and shafts.

To meet those challenges, while providing consistent and timely results, Seco offers coordinated families of



indexable and solid carbide cutting tools designed for versatility, quality and productivity. To get the most from our innovative tooling, we offer highly-developed strategies for machine tools, processes and analysis to optimize machining, improve cost savings and tighten control.

SECO

www.secotools.com/us

MILLING • TURNING • HOLEMAKING • THREADING • TOOLING SYSTEMS

building foundation support in the commercial, industrial, manufacturing, and power markets for over two decades. The same soil reinforcement technology has been supporting turbines in Europe for over a decade and it is now commonly used to provide improved strength and stiffness of soft or compressible soils, eliminating the need for massive overexcavation and replacement and deep foundations for the support of wind turbine foundations in the U.S.

Installation of RAP elements (also known as Geopier® or Impact® elements) involves drilling a 24- to 36-inch diameter cavity or driving a specially designed hollow mandrel to design depths ranging from 10 to 40 feet, depending on design requirements. Thin lifts of aggregate are then placed within the cavity and vertically rammed using high-energy patented beveled impact tamping devices.

During construction the high-frequency energy delivered by the modified hydraulic hammer, combined with the beveled shape of the tamper, not only densifies the aggregate vertically to create a stiff aggregate pier but also forces aggregate laterally into the sidewall of the hole, resulting in lateral stress increase in surrounding soil. The lateral stress increase reduces the compressibility of the surrounding soil and promotes positive coupling of the RAP element and the soil to create an improved composite, reinforced soil zone.

RAP systems are designed to reinforce the poor foundation soils and provide adequate bearing support for the large foundation pressures. The soil reinforcement system is also specifically designed to deliver total and differential settlement control (angular distortion) of the foundations, and to improve the rotational and dynamic stiffness values to achieve the desired tower performance. The soil reinforcement designs are developed on a project-specific basis depending on the site conditions and the tower loading conditions.

The system utilizes locally available natural aggregate, or even recycled concrete for pier construction. In addition, the volume of material utilized for Geopier elements beneath the foundation is typically only 10 to 20 percent of the material required for massive overexcavation and replacement. These factors limit excessive fossil fuel required for material delivery and disposal, as compared to other solutions. The use of small, mobile excavators further limits the fossil fuel consumption and dramatically reduces the carbon footprint of the foundation construction activities, making the RAP solution a uniquely sustainable solution for the wind industry.

TEAM APPROACH

One such project that incorporated the Rammed Aggregate Pier solution was the Winnebago 1 Wind Farm in Winnebago County, Iowa. The project incorporated 78 meter Gamesa G83 2.0 MW wind turbines with static vertical loads of 2,936 kN (660 kips), horizontal base shear of 676 kN (152 kips), and overturning moments of 50,335 kN-m (37,120 ft-kips).

Soil conditions at the tower locations explored by geotechnical engineering consultant Terracon Consultants with supplemental borings provided by Barr Engineering Company showed variable-strength clay soils extending to depths of up to 18 feet, followed by competent soils. Combined with a groundwater level as high as 5 feet below the ground, the overexcavation alternative was expected to be costly and time consuming.

At the recommendation of the project geotechnical engineer, the project team—led by Iberdrola Engineering and Construction—elected to incorporate a RAP foundation system to support the "inverted tee" octagonal foundations. The system was designed to improve the bearing support, to control settlement, and to provide acceptable levels of rotational and dynamic stiffness values. The 2.5-ft diameter piers ranged from 7 to 15 feet in length depending on the site conditions. To get the wind turbine towers up and running, Peterson Contractors installed 640 RAP elements in less than one month as they moved from site to site. The rapid installations allowed the sites to be quickly turned over for foundation construction with little time delay.

Performance of the RAP system was verified in the field using quality control observations and testing, including full-scale modulus load testing. The modulus load testing is performed to evaluate the stress-deflection behavior (stiffness) of the pier and verify the performance under the design stress levels. The system performed well, with less than 0.2 inches of pier deflection at a stress of over 18,000 psf; a pressure over four times the maximum applied pressure from the foundation.

CONCLUSION

Engineers, owners, and contractors continue to search for the most cost-effective and reliable support solutions for tower foundations. The balance of cost, speed of construction, quality, sustainability, and performance are paramount in the decision process. With over 1,000 MW of towers supported, the use of Rammed Aggregate Pier soil reinforcement solutions has helped maintain the proper balance for many project teams.

SESSIONS DAY 3: TUESDAY MAY 25

2010 WINDPOWER CONFERENCE & EXHIBITION

8:30 am-10:00 am:

General Session-Wind Energy, Powering America Forward (open to all attendees)

10:30 am-12:00 pm:

- Power Track: State of the Wind Energy Industry & Implications for the Future (5A)
- Siting/Safety Track: Latest Wildlife Research and Planning Tools for the Development and Operation of Wind Energy Facilities (5B)
- Transmission/Policy Track: Strategic Transmission Policy (5C)
- International/Legal Track: International Wind Energy Update (5D)
- Technical Track: Developing, Understanding and Testing Reliable Drive Trains (5E)
- Scientific Track: Advances in Utility Wind Integration (5F)

1:30 pm-3:00 pm:

- Power Track: Power Session-Texas Experience (6A)
- Siting/Safety Track: Wind Power Development - Permitting and Policy (6B)
- Transmission/Policy Track: Number One Transmission Issues Session (6C)
- International/Legal Track: International Panel: Working Abroad (6D)
- Technical Track: Wind Turbine Technology: Aerodynamics & Blade Design (6E)
- Scientific Track: Wind Forecasting: Current Research Topics (6F)

3:30 pm-5:00 pm:

- Power Track: Southwest Power Pool-Wind Successes (7A)
- Siting/Safety Track: Worker Health & Safety (7B)
- Transmission/Policy Track: Innovative Policy to Expand Wind (7C)
- International/Legal Track: Legal Issues-Lessons Learned & Case Studies (7D)
- Technical Track: Power Session: Technical Challenges (7E)
- Scientific Track: Performance & Reliability (7F)

REEL-O-MATIC,

THE POWER BEHIND THE WIND

Visit us at:

2010 WINDPOWER® CONFERENCE & EXHIBITION

Dallas, Texas
May 23 – 26

Booth 2129

Reel-O-Matic supplies contractors and manufacturers with reel & cable handling solutions.

Whether you need:

- Cable Reel Stands
- Reel Jacks
- Turntables
- Cable Reel Racks
- Cable Distribution Equipment
- Cable Manufacturing Equipment
- Cable Installation Equipment
- Re-Reeving & Re-Spooling Machinery
- Reel Lifters
- Custom Reel Handling Machinery

Model RRT15
Cable Reel Trailer

WE'VE GOT YOU COVERED!

CRS 120 Cable Reel Stand

Model BRT 10 Turntable

REEL-O-MATIC® Inc.

6408 S. Eastern Ave., Oklahoma City, OK

Ph: 405-672-0000 / 888-873-4000

Web: www.reelomatic.com

SOLAR SUPPORT FOR WIND ENERGY

By merging wind and solar power technologies, harvesting sites can increase their productivity by a significant factor, as the following paper makes abundantly clear.

By Chris Pattison

Chris Pattison is an IGERT doctoral fellow in Wind Science and Engineering at Texas Tech University. For more information call (806) 535-1720, e-mail chris.pattison@ttu.edu, or go to www.ttu.edu.

AS MOST PEOPLE KNOW, the Texas Panhandle is an ideal place for wind energy. With Competitive Renewable Energy Zone (CREZ) high voltage transmission lines scheduled for completion by the end of 2012, wind power plants should begin to pepper the region. Texas Tech University is in the ideal location, boasting the only doctorate program in Wind Science and Engineering, and the only graduate certificate program in the wind energy industry. Here at the Wind Science and Engineering (WiSE) Research Center students are addressing "everything wind," from tornados, hurricanes, and the damage they inflict to multifaceted wind energy research and education. Some current projects are titled Turbulent Far-Wake Development behind Wind Turbines, Innovative Gearbox Design for Reliability, Turbulence-Driven Gear and Bearing Test Systems, Quantifying Effects of Turbulence from Large-Scale Wind Energy Development on Local area Microclimate, and Firming Wind Energy with solar Photovoltaic (PV).

Independent system operators of various electrical grids have long been adept at handling the variability of the electric load. However, there is greater renewable energy penetration into the grids than ever before. Combining the variability of the electric load with the variability of intermittent generation sources such as solar and wind is creating a greater challenge for grid operators. By combining wind and

solar PV on a utility scale, the uncertainty of generation is greatly reduced and a more reliable energy source is created.

On average wind energy is best at night, when the atmosphere is stable. While there are times when the wind does blow during daylight hours, wind energy tends to produce less during the day when the atmosphere is unstable due to solar heating. Solar PV energy is only available during the day, when the sun is shining and atmospheric mixing takes place. By combining these two inexhaustible and renewable resources, a single power plant can take advantage of Mother Nature and produce more-reliable and less-intermittent power.

Texas Tech operates one of the only 200-meter towers specifically utilized for atmospheric data collection as well as a 58-station MesoNet—learn more at www.mesonet.ttu.edu—that records a plethora of data above and below the surface at five-minute intervals for public use. By utilizing data from the 200-meter tower at heights equivalent to the blade-swept area of large wind turbines and the nearby Reese MesoNet station's solar radiation data, times of intermittency can easily be identified. Currently in the early stages of research, analysis of the first six months of 2009—an average wind and solar year—has produced some interesting results.

For wind energy, times of intermittency were relatively small since the winter and spring months produce the best winds. A five-minute time scale is used since some electric grids will be converting to a "smart grid," which utilizes increments of that same length. Over the first six months there were 640 occurrences of too-low or no wind which lasted from five minutes to one hour, 40 occurrences of no wind power production from one to two hours, 17 occurrences from two to three hours, 11 occurrences from three to four hours, and 19 occurrences of greater than four hours. A five-minute breakdown of nonproductive wind occurrences can be seen in (fig. 1).

Over the same time period in 2009, times of no solar energy, sunset to sunrise, ranged from nine to 14 hours. By combining the two data sets, the synergy is quite obvious. Times of no energy production from either wind or solar dropped by 50 percent or more for each time. Periods of no energy production from five minutes to an hour dropped to only 300 occurrences, from one to two hours occurred 18 times, two to three hours occurred 10 times, and greater than three hours only occurred 13 times. Figure 2 shows a five-minute time scale of the combined data.

Wind and solar's combined output also shows their collective advantage. Given a one-megawatt wind turbine and one megawatt of solar panels placed immediately south of the turbine, they can both utilize the same pad mount transformer and electrical collection system, reducing installed costs. While periods greater than one megawatt did occur, they were only for short periods of time. For prolonged times of overproduction, either the wind power or solar power production would need to be curtailed to protect the transformer equipment. To take advantage of this dual "bonus" production, a larger transformer could be utilized. However, there would be greater energy loss when production would be lower than 50 percent of the transformer's capabilities. The losses during low production times could be greater than the

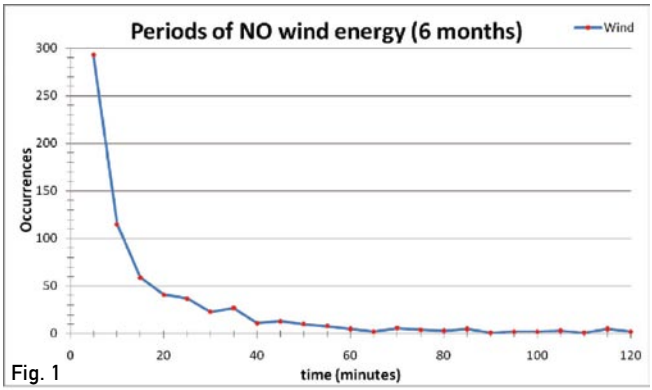


Fig. 1

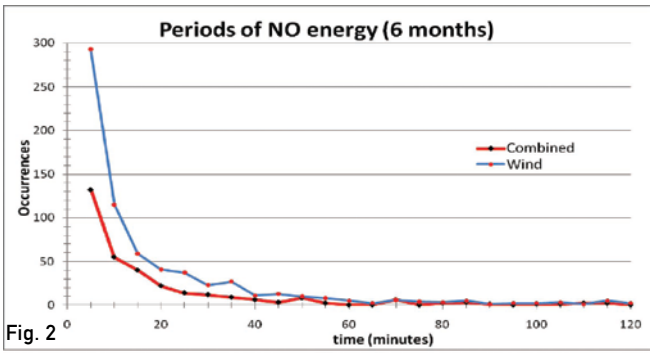


Fig. 2

added production by utilizing the larger transformer.

During the winter months when wind energy is greatest and solar energy is at its lowest maximum, the colder temperatures would allow the transformer to be slightly "overtaxed" to capture more than the allowed energy without the transformer overheating and losing efficiency. During windy summer days, this would not be the case.

Figure 3 shows the synergy that wind and solar produce together. Expecting a smooth bell curve centered on 1,000 kilowatts, the data does not support this with a smooth transition. Instead, there is an abrupt change shown by the tremendous difference between the 900 and 950 kilowatt values and the 1,000 and 1,050 kilowatt values. These abrupt changes negated the standard curve

with longer transitions over time and exemplified the benefit of combining wind and solar power together. As both the wind and solar production values should be evenly distributed, the greatest concentration of values should be toward the middle, with smaller "tails" located at the maximum and minimum values. Together, however, because of the "clock-time" of the recorded values, they match precisely, creating a large pronounced peak at one megawatt. This demonstrates how decreasing wind energy values during the morning hours matches with increasing solar energy values, as well as full solar energy during the day coupled with full wind energy during the night. This is similar to two gas-turbine engines operating in tandem, as one is turned up and down and the other is adjusted opposite the first. By pairing the two individual one-megawatt systems that have nearly opposite production phases, a gross capacity factor of 0.608 was attained when not curtailing either wind or solar.

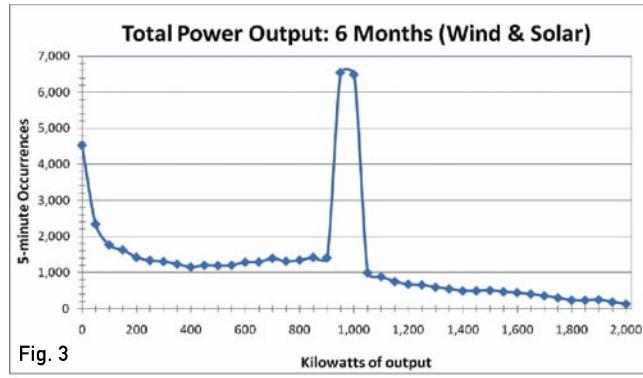


Fig. 3

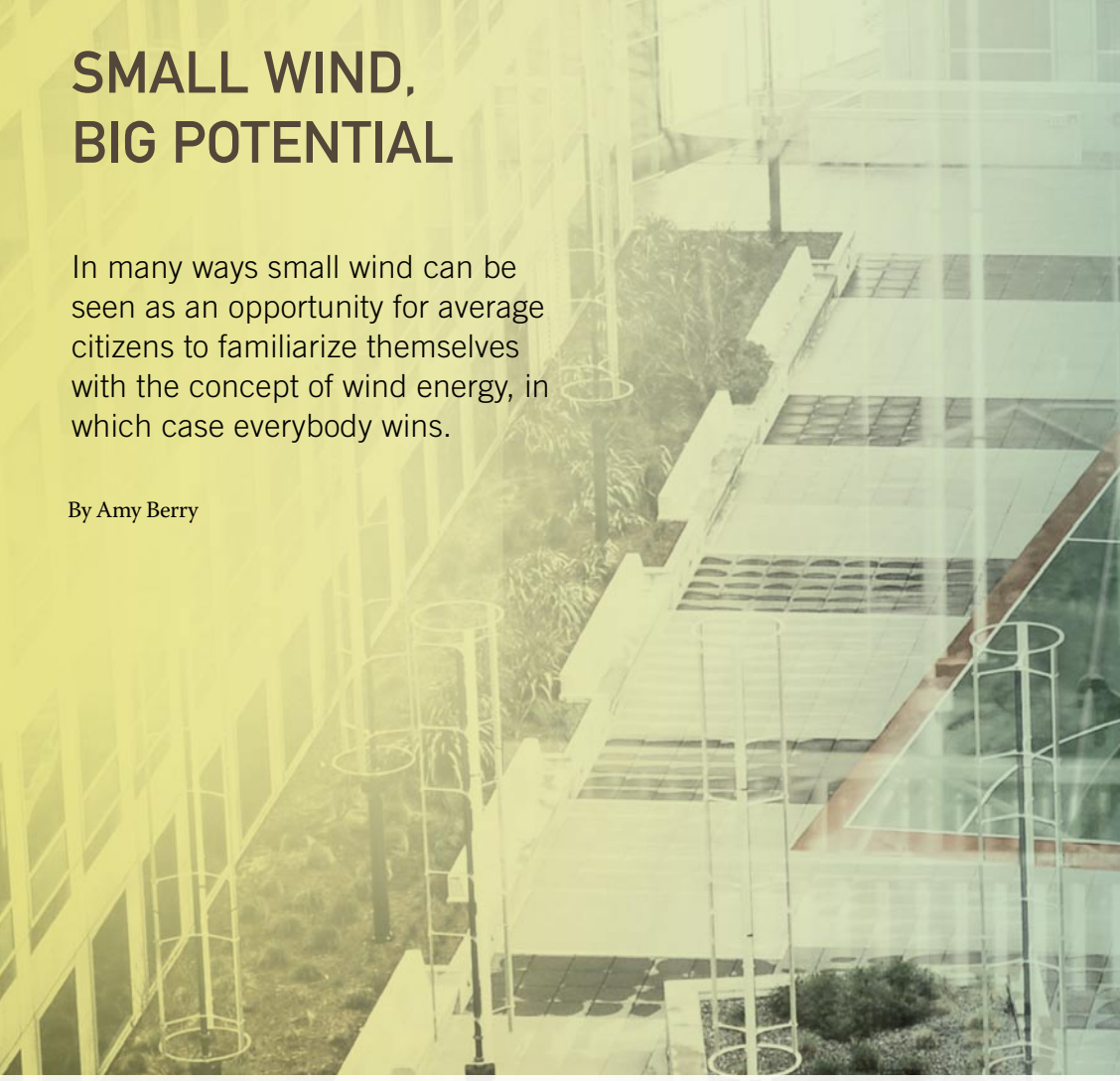
By combining wind and solar power plants, the whole is greater than the sum of its parts, and the intermittency of renewable energy is significantly reduced. The Texas Panhandle has considerable amounts of both inexhaustible resources. Once the CREZ lines are operational, there is no reason not to see more reliable renewable energy power plants being constructed. The only question remaining is: Why not take advantage of Mother Nature?

Note: The author is a fellow in the Integrative Graduate Education and Research Traineeship (IGERT) program of the National Science Foundation.

SMALL WIND, BIG POTENTIAL

In many ways small wind can be seen as an opportunity for average citizens to familiarize themselves with the concept of wind energy, in which case everybody wins.

By Amy Berry



Amy Berry is the director of marketing for Windspire Energy, formerly Mariah Power, which is developer of the Windspire vertical axis wind turbine. She can be reached at aberry@windspireenergy.com, or go to www.windspireenergy.com.

AS THE GIANTS OF THE WIND INDUSTRY gather for WINDPOWER 2010, the American Wind Energy Association (AWEA) is projecting that this year's show will be the biggest yet. Walk the show floor and you will no doubt be overwhelmed by the size of the booths, the scale of the equipment within them, and the huge interest shown by industry members. Given that the event takes place in Texas, it should surprise no one that BIG is a major theme, but what about small… as in the small wind industry?

Lurking among these literal giants is the small wind industry. Generally referred to as turbines with 100kW capacity and less, the small wind industry is enjoying incredible growth as homeowners and businesses around the country take advantage of an uncapped 30-percent federal tax credit and improved technologies that make harnessing your own clean energy easier than ever before. AWEA reported that the U.S. small wind market grew by 78 percent in 2008, and it is expected to release similar figures for 2010. How do these two dichotomies of the industry go together? Is it possible that small wind can actually help big wind?

Few members of the industry realize that AWEA was founded by a group of small wind enthusiasts in the seventies during a time of incredibly high oil prices. The first conference was timed to coincide with the World Energy Conference in Detroit, Michigan, and was attended by 20 people. AWEA's first president, Allan O'Shea, reminisces about the early days when the industry focus was on small

wind. "When we—me and 15 other founding fathers—started AWEA it was under the premise that small wind begets big wind," he says. "We got together and put up a wind-powered billboard welcoming the World Energy Conference, because at the time they were only talking about oil."

While big wind is generally sited far away from the urban and suburban centers of most communities in order to avoid noise pollution and height restrictions, with shorter towers and quieter systems small wind turbines are designed to be installed in the heart of communities. By having turbines on display in inhabited areas, more people within the general community gain firsthand exposure to wind power.

"It makes it real to people," according to Dan Loundy, vice president of Devon Bank in Chicago, Illinois. Loundy installed six 1.2kW vertical axis wind turbines at the bank's newest retail branch to help with energy costs and to make a statement to the community about the bank's commitment to being green. "When it's out in a field it's what some other guy is doing. Until you see it on a regular basis, it's an abstraction," he says, adding that he even installed benches below the turbines to encourage the community to interact with the technology.

This accessibility of small wind turbines gives the public the opportunity to live with the technology on an everyday basis. This can lead to a better understanding of how wind power works, while at the same time addressing classic concerns such as noise, wildlife, and the visual impact that often hamper large wind installations. Acceptance of wind power on a small scale can lead to acceptance of wind power on a big scale. Think of it as traditional product sampling done by packaged good marketers. The concept is to give a taste test that is so satisfying the consumer will want more.

Spirit Lake, Iowa, is an example of a community that used small wind to "taste test" future wind power development. The community started with the installation of a 250 kW system at a local school in 1993. In 2001 the school district installed a 750 kW system based on the success and community support for the original turbine. The community eventually welcomed multiple large wind farm developments. Not surprisingly, Iowa now hosts 22 MW of locally owned and 814 MW of commercial-scale wind.

"You go into any township and put in a small wind system and that ends the whole discussion about bird kill, fall zone issues, tower height, and sound," O'Shea says. "All of the things that big wind has to deal with."

SMALL WIND, BIG CONSERVATION

Few will debate that larger turbines are a more-efficient way to generate energy. But installing small turbines at the site of energy consumption, as you can uniquely do with small-scaled turbines, can create benefits that make up for any loss in efficiency.

A welcome side effect of on-site installations is that having energy generation right outside an office or home can impact energy consumption within the building. Suddenly energy doesn't come from a switch or outlet in a wall, it comes from the turbine spinning just outside. Once people start thinking about where their energy is coming from they tend to start thinking about their use of this energy, and ways to conserve.

In fact, building operators and energy providers are using visible small wind installations as a tool to encourage building occupants to conserve the energy they can see being produced outside their windows. Leading software company Adobe Systems of San Jose, California, recently installed 20 vertical axis wind turbines at its corporate headquarters. "Adobe

SESSIONS DAY 4: WEDNESDAY MAY 26

8:30 am-10:00am:

- Business/Supply Chair Track: Large Wind Turbine Manufacturer Forum-Part 1 (8A)
- Economic Development Track: Moving the Workforce Forward with Education (8B)
- Project Development Track: Wind Project Construction-Meeting New Construction & Site Mobilization Challenges (8C)
- Community/Resource Assessment Track: Financing and Policy Issues for Community Wind (8D)
- Technical/Transmission & Integration Track: Wind Turbine Technology-Structures, Loads & Control (8E)
- Scientific Track: Resource Assessment (8F)

10:30 am-12:00 pm:

- Business/Supply Chair Track: Large Wind Turbine Manufacturer Forum-Part 2 (9A)
- Economic Development Track: What the States Are Doing (9B)
- Project Development Track: Tools and Insights to Power Small Wind Forward (9C)
- Community/Resource Assessment Track: Ways of Supporting Growth for Community Wind (9D)
- Technical/Transmission & Integration Track: Grid Interconnection of Wind Power Facilities (9E)
- Scientific Track: Deepwater Offshore Wind Technologies (9F)

1:30 pm-3:00 pm:

- Business/Supply Chair Track: Manufacturing the Future-Challenges in the Wind Energy Supply Chain (10A)
- Economic Development Track: Beyond RES-Maintaining the Playing Field (10B)
- Project Development Track: Developing the Offshore Wind Industry in the United States (10C)
- Community/Resource Assessment Track: Resource Assessment-Part 1 (10D)
- Technical/Transmission & Integration Track: Challenge & Opportunity for Wind Power Forecasters & the Respective Roles of Public & Private Sectors (10E)
- Scientific Track: Turbine Structures, Loads & Controls (10F)

3:30 pm-5:00 pm:

- Business/Supply Chair Track: Transportation & Logistics-Getting Components from the Factory to the Field (11A)
- Economic Development Track: Wind Power and Economic Development (11B)
- Project Development Track: Regional Challenges for Development of Offshore Wind Farms (11C)
- Community/Resource Assessment Track: Resource Assessment-Part 2 (11D)
- Technical/Transmission & Integration Track: Wind Energy Integration (11E)
- Scientific Track: Inflow, Dynamics & Loads Modeling (11F)

2010 WINDPOWER CONFERENCE & EXHIBITION

Fig. 1: Windspire placements at Adobe headquarters.

Fig. 2: Another view of the Windspire placements at Adobe headquarters.

has a state of the art campus with a multitude of green attributes that have earned us three USGBC LEED-Platinum certifications, so our employees are very conscientious about their environmental footprint," says Randall H. Knox III, senior director of Global Workplace Solutions at Adobe. "We believe the wind turbines are a positive enhancement to our headquarters, and that their presence will

Fig. 3: Windspires mounted atop the Devon Bank building.

spur people to talk even more about conservation."

DONG Energy of Denmark is a leading European energy provider, and a market leader in the development and construction of offshore wind farms. DONG sees the value in installing small wind turbines at the sites of its energy customers, recently announcing plans to market vertical axis turbines throughout Denmark.

Jan Darville, manager of electric installations at DONG, recently told the *International Herald Tribune:* "It's about starting a chain reaction of thinking green. If people see wind turbines outside their office window, maybe they'll start thinking about what happens if everyone at the office actually shuts down their computer when the day is over, and all of a sudden energy usage is down 2 percent."

Conservation is an important piece of the energy puzzle for big wind and all energy providers. If we can reduce overall energy use we can better control the availability of energy and the cost to provide it to consumers.

SMALL WIND, BIG FUTURE

Small wind turbines are also an excellent tool for wind-power education. If the U.S. is going to be the leader of clean energy, younger citizens need to get in-

Fig. 4: A cluster of Windspires at Phelps High School in Washington, D.C.

volved now. It is nearly impossible for most schools to install their own 1 MW turbines, but schools all around the country are installing 1-3 kW systems right on school property. Teachers are able to incorporate the installation into a full wind energy curriculum, exposing the students to a firsthand wind experience while preparing them for a future in wind energy. Exposed to the power of wind, these youths are more apt to embrace a future with larger turbines spread across their local landscapes and the policies that will be required to make this vision a reality.

Caitlin Wargo is the director of sustainability and energy management at Far Hills Country Day School in New Jersey. She has recently ordered four 1.2kW wind turbines for the campus to compliment other renewable energy systems already installed. "It is our hope that by involving our students in our energy initiative, they will get a foundation in the issues surrounding renewable energy, from science and engineering to socio/political and economic," she says. "Coupled with the critical thinking and leadership skills that are the hallmarks of a FHCDS education, our students will be ready to take their place as the leaders of tomorrow in renewable energy."

GETTING STARTED

As an industry, small wind is ready to help big wind overcome current market adoption barriers that will lead to growth. The technologies that are currently available are efficient, silent, and attractive, and a wide array of rotors—from traditional horizontal axis to innovative vertical axis designs—are available to meet individual design needs. In addition, the newly announced small wind certification program will ensure that the turbines are safe and tested. It's time for big wind to start using small wind as a tool to grow the entire industry.

Shifting into a larger gear

A Driving Force Behind the Wind Revolution.

Mitsubishi introduces new and larger gear machines to complement the existing line of large VTL, Gantry-style, precision milling machines and horizontal machining centers for manufacturing gears from one to four meters in diameter. The new line includes hobbing, shaping, gashing and form grinding equipment.

Incorporating technological innovations such as high-horsepower direct-drive, hydrostatic bearings and torque enhancing kinematics, the new machines also offer the option of integrated deburring, turning, measuring, and pallet shuttling.

For additional information about the latest innovations from MHIA visit **www.mitsubishigearcenter.com** and shift into a larger gear today.

MITSUBISHI
HEAVY INDUSTRIES AMERICA, INC.

Machine Tool Division • Gear Technology Center
46992 Liberty Drive • Wixom, MI 48393
248.669.6136

ENCLOSURES FOR WIND ENERGY ENGINEERS

When choosing the right enclosure to protect your on-site electrical systems, it's important to understand the many factors that can impact the success or failure of your decision.

By Jeffrey Seagle

Jeffrey Seagle is president of Stahlin Non-Metallic Enclosures. To learn more call (616) 794-0700 or go to www.stahlin.com.

ENCLOSURES FORM AN INTEGRAL PART of a wind energy circuit protection system in which circuit integrity has to be provided. Typically the enclosure is a container for electrical controls, acting as a safeguard against tampering and providing environmental protection of the electrical connection. It can be made from metal or non-metallic material, but it must serve its protective function for the life of the installation, so durability is key. There are three typical types of enclosure materials available: metal, plastic, and composite.

Metal: Common metal enclosure choices include carbon steel, stainless steel, and aluminum, with carbon steel being the most prominent choice based on its low initial cost. Carbon steel is typically galvanized or painted to prolong the service life. Premium metals such as stainless steel and aluminum are used where long life, corrosion resistance, and weatherability are critical, such as protecting controls for junction boxes for wind installations.

Plastic: Thermoplastics such as polycarbonate, polyester, and PVC offer a degree of corrosion protection beyond painted carbon steel. Thermoplastics, though, are more susceptible to UV and weathering degradation over time. Certain stabilizers can be added, but ultimately the nature of the thermoplastics will yield to extended weathering.

Composite: Thermoset materials such as a

polyester resin combined with glass create a unique composite FRP (Fiberglass Reinforced Polyester) that is exceptionally durable and weather resistant (fig. 1). Like thermoplastics FRP provides a greater degree of corrosion than painted carbon steel, yet will perform better in more harsh environments.

There are risks associated with improper enclosure selection, including failure. Enclosure failures caused by environmental corrosion or impact damage resulting in a breach of proper sealing can cause a multitude of problems ranging from catastrophic and dangerous system collapses, production downtime, and increased maintenance costs, in addition to losses in customers and revenue. Proper product selection is therefore critical as it relates to both the design and the material of the enclosure.

When choosing an enclosure there are influential factors that will help reduce failure. Selection ultimately comes down to optimal performance and value. Often tradeoffs between performance, acquisition cost, and operating cost are made in the process to find the ultimate choice in a unique application. Consider three factors that influence the enclosure specification for wind applications and how an enclosure might stack up: environmental characteristics; physical characteristics; and material and material utility.

ENVIRONMENTAL CHARACTERISTICS

The foremost motivating characteristic influencing the enclosure choice for wind engineers and specifiers is the environment of the site. This consideration envelops temperature, chemical, moisture, and concern for the physical world of the permanent installation. Whether the environment is hostile or passive, an attempt is made to match the capabilities of the enclosure with the anticipated ambient environment. An over-specified enclosure will work effectively in a natural environment, but there are severe repercussions for using an under-specified enclosure in a hostile environment, thus making the environment the overriding consideration.

There are environmental conditions that are specific to the wind industry. Corrosive environmental conditions can act as accelerants for corrosion, just as gasoline does for fire. The factors that determine the level of corrosion in an environment include extreme weather conditions such as dust, moisture, ultraviolet radiation, and temperature (spread between the daily high and low temperatures as it influences condensation and evaporation of moisture).

Dust: Dust particles can cling to surfaces and retain moisture. Typical sources of dust include soil/sand, smoke and soot particles, and salts. Depending on the chemical composition of the dust it may contribute to the corrosive attack, or it may act as a catalyst. Even if the dust is chemically inert a concentration cell can be set up under the dust particles due to differential aeration.

Moisture: The level of corrosion typically increases with moisture content. In fact, if there was no moisture there would be no electrolyte, and hence no corrosion. Common atmospheric sources of moisture are rain, dew, and condensation. Rain can have a beneficial effect in that it washes away contaminants from exposed surfaces. If rain collects in pockets or crevices, however, it can be very detrimental because it supplies a source of continued moisture. When

Fig. 1: Stahlin provides a wide selection of composite enclosures.

relative humidity exceeds 70 percent a thin film of moisture will form on a metal surface, providing an electrolyte. This dew or condensation can become very corrosive if it is saturated with a contaminant like sea salt, or acid compounds from industrial sources.

Ultraviolet Radiation (UV): UV has been a concern with non-metallic manufacturers for many years. The rate at which the UV degradation occurs will vary depending on heat, humidity, and the altitude at which the product is installed (fig. 2). There are also differences in the way UV breaks down differing non-metallic materials. For instance, the effects of UV light become critical more quickly with thermoplastics than with thermosets of similar chemical structure. This happens because thermoplastic materials have a much lower

IT'S A WIN WIND SITUATION.

TOPEKA, KANSAS– A BREATH OF FRESH AIR. Located right in the middle of America's wind corridor, Kansas has the second highest wind energy potential in the nation as well as a 20 percent Renewable Energy Standard by 2020. We're in just the right place for the transport of energy, and we have the right strategic alliances to grow this innovative industry. Add to that the technical capabilities, readily accessible resources, and a smart and willing workforce for wind turbine and component manufacturing. Learn more about Topeka today by contacting Steve Jenkins at 785.234.2644 or sjenkins@TopekaChamber.org.

WE CAN DO THAT

GoTopeka.com

GREATER TOPEKA CHAMBER

GO TOPEKA

Fig. 2: UV exposure should be factored into your material choice.

mass (molecular weight) than thermosets, so breaking the bonds in thermoplastics cuts the polymers into much smaller fragments than does each breaking bonds in thermosets. In thermosets the cross-linking limits unzipping the polymer chain and requires more UV energy to break it down, thus giving increased UV resistance and weatherability.

Temperature: Increasing the temperature of a corrosive media will generally increase the rate of corrosion. Temperature gradients on the same piece of metal can create a basic corrosion cell. The part of metal with the higher temperature will become anodic to the area with a lower temperature.

PHYSICAL CHARACTERISTICS

When considering the physical characteristics of an electrical enclosure, there are certain basics to take into consideration. The most notable are:

- Corrosion resistance
- Size
- Weight
- Mounting
- Flammability
- Safety
- Security
- Flexural strength
- Hardness
- Impact resistance
- Tensile strength
- Sunlight (UV) resistance
- Hardness
- Heat transfer
- Radiused edges
- Water absorption
- Available access
- Cabinet design
- Bending radius limitation

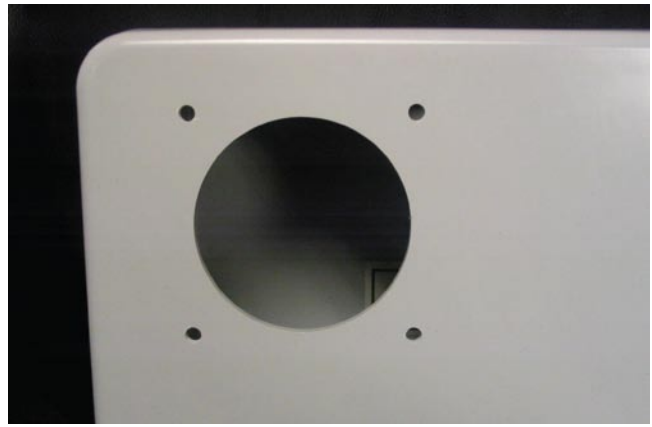


Fig. 3: An example of holes drilled to modify an enclosure.

Three physical characteristics are particularly important for wind-industry professionals to consider: strength, ultraviolet radiation, and electrical.

Strength: Strength measures the resistance of a material to failure, given by the applied stress or load per unit area, tensile and compression. Strength is a measure of a material's ability to withstand stretching or compressing under load. On the other hand the toughness of a material is its ability to withstand sudden impacts. Increasing strength, tensile or compression, usually decreases toughness and vice versa. Whereas steels often have high strength they exhibit low toughness, which means they dent easily and are difficult to drill or penetrate. Thermosets and thermoplastics, or composites, exhibit average strength but high toughness, meaning they can withstand sudden impacts and maintain their shape. Today's composites have improved dramatically, in that they can now be designed for both high strength and toughness via additives and fiber reinforcements.

Ultraviolet Radiation (UV): Many professionals are still unaware of how non-metallic composite materials are able to effectively withstand damage from UV exposure. In enclosure applications a unique formulation is now available to provide superior molded-in UV resistance, requiring no field maintenance and at no additional product cost. It is a double protection formulation technology that significantly enhances the molecular bond strength and cross-linking that occur during the curing process in thermosetting polyester sheet molding compounds (SMC). This new formulation

fights polymer degradation by making it much more difficult for UV light to attack molecular bonds of both primary chains and cross-links. This is accomplished by increasing the molecular density of the base resin system, thus increasing its resistance to UV degradation. An additional benefit of this formulation is its use of additives or antioxidants that help protect the polymer chain and resist photo induced oxidation from exposure to UV sunlight.

Electrical: Like the physical, there is concern regarding the protection offered for the installed components as well as protection of the enclosure itself. An enclosure that breaks down over time can no longer perform the duties for which it was specified. Therefore, the following characteristics are important: electrical conductivity, service temperature, thermal conductivity, grounding, and arc resistance.

MATERIAL SELECTION AND UTILITY

If you have the opportunity to select the material, make sure that you have investigated the material and that it is the most appropriate for the type of environment. Every application has its unique demands and elements of this list, and do not follow a precise order. Indeed, many of the capabilities are considered to be inherent in certain material choices. An errant or over-estimated material choice, however, can have many repercussions in the lifecycle of a product. It makes good sense to specify a product that qualifies in almost every category, insuring satisfactory results without regard for the type of installation.

Material utility addresses the consideration for machining, cutting, sawing, drilling, and modifying the material of choice. User preference plays a significant part in this selection, and material familiarity overrides practicality in many instances. A few things to keep in mind for both non-metallic and steel modifications are as follows.

Modifications can be made to non-metallic enclosures that make them particularly useful for a wide variety of situations and applications (fig. 3). Non-metallic composites offer the benefits of part integration and minimization, along with substantial savings in weight. Along with that advantage is a reduction in the requirements for machining operations that need to be performed to complete an assembly. Drilling and cutting operations can't be avoided completely in all cases, however. There are several types of machining operations that can easily be performed on composites, including turning, drilling, routing, trimming, sand-

ing, and milling. Most of these operations are similar to metal removal techniques, but there are some differences that need to be addressed in order to make clean, high-quality holes and cutouts in composites.

Delaminating of the outer surface and glass fibers directly below the surface are the main failure modes noticed when holes or cutouts are drilled, or cut out improperly. Most of the time excessive edge chipping around the perimeter of the cutout or hole is due to improper tools used and methods applied. A little upfront planning and understanding of the proper methods to machining composites can make all the difference in the final outcome of the operation. Factory-option modification is also a highly desirable alternative for many end users, because it enables the manufacturer to use its skill in providing enclosure modifications and shipping to the customer ready to use.

When approaching stainless modifications, keep the type of tools used in mind. If modifications such as custom sizes or shapes are required, both mild and stainless steel are good candidates. Both are fabricated from a flat sheet of metal, making them easier to form to custom specifications in the fabrication process. Mild steel is a viable option, and with the correct metalworking tool holes can easily be added in the field. Stainless steel, due to its hardness, is very difficult to cut and far more challenging to modify on site. The elements of chrome and nickel provide stainless steel great corrosion resistance to oxidation, but stainless steel can be contaminated by using carbon steel power tools and other tooling equipment. Skilled shops with proper quality control programs and knowledgeable craftsman can prevent stainless steel contamination.

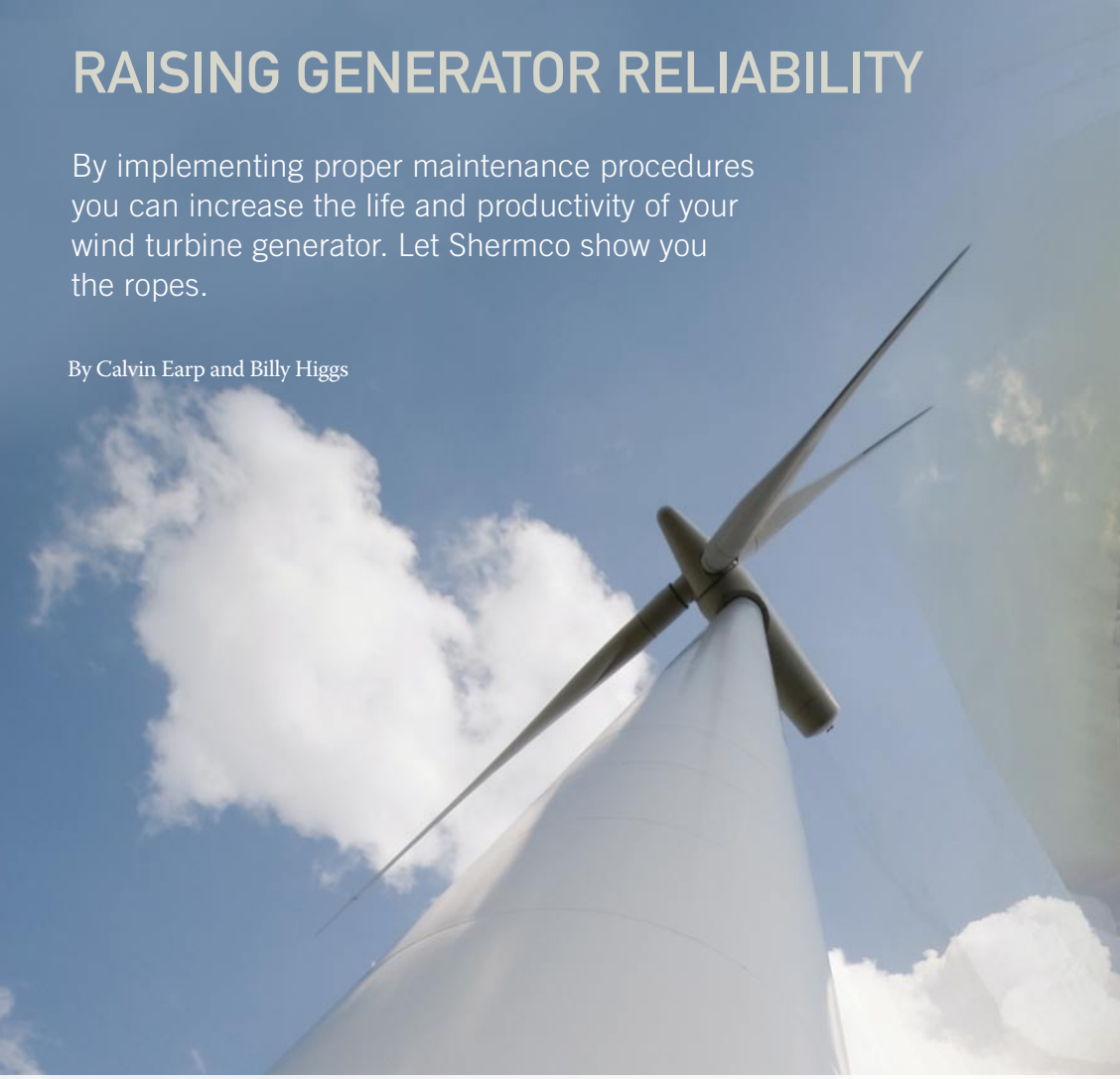
CONCLUSION

Specifiers for enclosures for wind applications must carefully evaluate all factors to ensure that an enclosure made of any material type will withstand its environment. The process for proper material and enclosure selection begins with a detailed consideration of the application. Each wind environment is unique, and all possible applications should be identified for the intended enclosure application. So start with a simple list of your needs and ask plenty questions, because failure of your enclosure can't be an option when so many are relying on the wind industry to help reduce our dependence on fossil fuels and reduce CO_2 emissions.

RAISING GENERATOR RELIABILITY

By implementing proper maintenance procedures you can increase the life and productivity of your wind turbine generator. Let Shermco show you the ropes.

By Calvin Earp and Billy Higgs



Calvin Earp and Billy Higgs are with Shermco Industries. To learn more call (888) SHERMCO, e-mail info@shermco.com, or go to www.shermco.com.

WHETHER IT IS CARBON BASED, nuclear, or alternative energy, production availability and equipment reliability are crucial issues for any power generation facility. For wind energy operations, managing multiple turbines in remote locations complicates how these goals are attained. Even with improved SCADA information, critical performance indicators are often recognized too late for any action beyond watching the generator fail.

This article will identify some of the actions owners or operators of wind generation systems can take to extend the life of their assets. Proper periodic maintenance and field data analysis—as well as winding design and other improvements while in a service facility—contribute to the safe, reliable performance of a wind generator throughout its lifecycle.

FIELD LESSONS

The owners of a wind power system have invested millions of dollars in capital equipment. To keep their venture paying back they must maintain and service the equipment as required per the manufacturer's recommendations—at a minimum. In saying that, there are additional "best practices" recommended in consensus industry standards.

Having a savvy and qualified field service group servicing your equipment is of the utmost importance, which will increase the life of generators and other related components. Because

these machines can be complex, managing common service items as well as unforeseen issues on a daily basis means the difference between acceptable uptime and unprofitable downtime. So, what maintenance philosophy should be used to maximize the return on investment and increase reliability? Let's begin with a discussion about the applications for preventive and predictive maintenance.

PREVENTIVE/PREDICTIVE

A combination of both preventive maintenance (PM) and predictive maintenance (PdM) go hand in hand when best practices are implemented within wind generator fleets. Preventive maintenance techniques would typically

Fig. 1: Qualified technicians pay attention to warnings such as this one.

be performed on carbon brushes, slip ring assemblies and the cleaning of internal generator components, etc. Predictive maintenance techniques would be used to circumvent possible mechanical and electrical failures of the wind generators by performing tasks such as vibration analysis, infrared thermography and monitoring electrical conditions.

Driving a car to and from work every day with the expectation of reliability and many years of service requires maintenance on a continuous basis, both preventive and predictive. The same is true of a generator fleet. Critical testing and maintenance tasks collected from many years of experience in servicing wind generators are identified in Tables 1 and 2. Following these basic guidelines will result in quicker return on investment by creating greater system reliability and longer service life.

It should be noted that the tasks outlined in Table 1 require the unit to be offline and de-energized. Because electricity is a highly toxic substance, only properly qualified and experienced personnel should be asked to perform these tasks. Technicians must be able to identify the hazards associated with their jobs (fig. 1) and receive the proper training and documented education to be considered qualified.

The second set of tasks outlined in Table 2 require even more experience and higher levels of qualification, since they involve energized and rotating components. Electric shock, arc flash, and mechanical hazards are all very real and prevalent during the process of performing these tasks. Don't take shortcuts on personnel training or work practices, because the results may be disastrous. These requirements should extend to on-site personnel and all outside contractors. Both must be qualified and properly trained.

Preventive maintenance techniques can help prevent common failures such as shorted or faulted slip rings due to excessive carbon build up or insulation failure, and predictive maintenance techniques can help predict common failures such as the electrical fluting of bear-

Table T-1 Typical Generator Maintenance Tasks Performed in the Field Tasks Performed While Unit is Off Line		
Maintenance Item	Task	Frequency (Note 1)
Carbon Brushes	Inspect Condition/Wear	Three Months
Slip Ring Assembly	Inspect Condition/Wear	Three Months
Electrical Connections	Torque and Clean	Six Months
Electrical Diagnostics (Off Line)	Rotor/Stator Insulation Resistance	Six Months
Electrical Diagnostics (Off Line)	Rotor/Stator Polarization Index (PI)	Six Months
Electrical Diagnostics (Off Line)	Rotor/Stator Overpotential Test	Six Months
Electrical Diagnostics (Off Line)	Stator Winding Resistance	Six Months
Electrical Diagnostics (Off Line)	Embedded Detector (RTD) Testing	Six Months
Electrical Diagnostics (Off Line)	Surge Comparison Test	Six Months
Electrical Diagnostics (Off Line)	Bearing Insulation Test	Six Months

Table 1: Typical generator maintenance tasks performed in the field while unit is offline. Note: While many factors affect the decisions on the frequency of maintenance tests, this table is based upon a generator application in which minimal down time is desired. Actual test frequency may differ based on differing site conditions and data.

Fig. 2: Upgrading to a class H system allows generators to run at higher temperatures.

ings. Using these various techniques can help with decision-making related to the frequency of testing and planned maintenance outages (see note, Table 1), and also help prevent a catastrophic generator failure.

Speaking of testing frequency, many factors must be considered when scheduling the work associated with the servicing of machines in the field. The idea is to perform scheduled maintenance and servicing as needed, but not too often or too little. Factors that affect the decision-making process include items such as equipment criticality and device significance, current condition, lubrication life, maintenance history, operational history, industry experience, maintenance philosophy, operating environment, time allowed for maintenance, and the manufacturer's recommendations.

SERVICE CENTER LESSONS

Just like field services, utilizing a quality service center will help increase the life of your generator and help assure wind park productivity. When evaluating a service center there are many important criteria. At a minimum, the service center should be a member of the Electrical Apparatus Service As-

The Industry Event for Sustainable Manufacturing

Reduce Costs
Conserve Resources
Improve Efficiency

- Clean Energy Systems
- CAD/Design for Sustainability
- Energy Management Software
- Bio-compostable and Recyclable Packaging
- Energy-saving Machinery and Components
- Consulting

...and much more!

Green™
MANUFACTURING EXPO

June 8–10, 2010

Jacob K. Javits Convention Center

New York, NY

For information on attending or exhibiting, visit

GreenMfgExpo.com

Register online for FREE expo admission with Promo Code: AB

Produced and Managed by: Canon Communications LLC
11444 W. Olympic Blvd. • Los Angeles, CA 90064-1549
Tel: 310/445-4200 • Fax: 310/996-9499

Table T-2 Typical Generator Maintenance Tasks Performed in the Field Tests Performed While Unit is On Line		
Maintenance Item	Task	Frequency (Note 1)
Generator Shaft Assembly	Measure Shaft Currents	Three Months
Infrared Thermography	Inspect Connections (Under Load)	Six Months
Vibration Analysis	Measure Vibration Level	Three Months
Output Voltage	Measure and Record Voltage	Three Months
Output Frequency	Measure and Record Frequency	Three Months

Table 2: Maintenance tasks performed while generator is online.

Fig. 3: Balancing the rotor is an essential part of service center work.

sociation (EASA) and perform repairs in accordance with the ANSI/EASA Standard AR-100, Recommended Practice for the Repair of Rotating Electrical Apparatus. Not only is being a member of EASA important, but having a Quality Management System (QMS) and being ISO certified are additional criteria to look for when evaluating a service center. Some of the highlighted requirements for service centers are shown in Table 3.

When generators find their way into a service center for repairs it is normally due to mechanical or electrical failures while in service. There are many lessons to be learned from the service center's failure analysis procedures if they have a QMS program in place. Evaluating the failure data can provide valuable information for the balance of your fleet. It's the "learn from your mistakes" effect that oftentimes pays back many times over. Improper lubrication, inadequate ventilation, brush grades and slip ring material choice, etc., can all contribute to failures, but if these are not identified at the initial inspection they are often missed.

EXTENDING GENERATOR LIFE

Wind generators come in all sizes and ratings, and the designs of these units certainly vary among manufacturers. They have one thing in common, however: they all eventually fail. A wind generator's life can be influenced by ensuring that the best-possible processes and procedures are in place during a shop repair.

When a wind generator has failed much time, effort, planning and money are needed to remove the generator from the wind-farm site and ship it to a qualified repair facility. Once

Table T-3 Typical Service Center Requirements that Lead to Extended Generator Life	
Item	Reason
EASA member	Provides resources for technical data and training
Have a QMS Program	Provides means of controlling quality
ISO Certification	Assures consistent repair process and evaluation
NIST-Compliant Calibration	Assures test instruments are accurate
Core loss testing	Verifies condition of core iron (stator/rotor) before and after repair
Advanced Winding Analysis	Provides greater degree of accuracy on winding tests
Motor Circuit Evaluation	Provides base line data for field inspections
Balance Rotor	Assures smooth rotor performance
Ultrasonic Shaft Inspection	Detects any shaft anomalies
Vibration Analysis	Detects bearing issues and provides data for field vibration
Run at Rated Voltage	Subjects machine to full voltage tests
Testing Documentation	Provide all test results for future trending/analysis

Table 3: Service center requirements that lead to extended generator life.

the repair facility receives the generator and inspects the unit after disassembly they can normally recognize what repairs are needed. However, what is crucial at this stage is understanding why the machine failed. This critical point of the inspection process—the root

cause failure analysis—is often left out, or forgotten. Corrective actions must be taken at this point.

Examples of the root failure causes include improper grease in a given unit, the breakdown of wire strand insulation due to heat over a long period of time or even improperly sized cable. Poor craftsmanship from a manufacturer or repair shop could be a culprit, as well. There are many possibilities that can lead to failure and, again, this must be investigated so corrective action can be put into process on the front end of the repair cycle.

As mentioned earlier, qualifying a repair shop is an essential part of the repair process and is detailed in Table 3. One additional item to look for in particular is the working area where the repair of the windings will be performed. When installing the windings in a wind generator, care must be taken and the condition of the work area must be considered. A climate- and condition-controlled winding area, or winding bay, should be a high priority for any repair facility to ensure the best possible results can be attained for the rewind of a wind generator. Any dust or foreign debris within a stator or rotor during the rewind process can cause serious problems for the generator once placed back in service, so contaminants need to be avoided.

INSULATION SYSTEM

The most-costly components of a wind generator repair are the electrical windings of the rotor and stator. Manufacturers mass produce wind generators, and many use the minimum insulation required. For example, many manufacturers still use class F (155° C rating) material for the insulation system in the stator or rotor windings. Heat developed during the operation of a wind generator is detrimental to stator and rotor winding insulation life. It is generally accepted that every 10° C rise in temperature will result in a halved life expectancy of the insulation. A simple upgrade to class H system (180° C rating) will enable the repaired wind generator to operate at a higher temperature with little additional cost (fig. 2). The entire insulation system and methods of application should be equal or better to the original machine manufacturer. All components of the insulation system must be compatible with each other with respect to electrical, mechanical, and thermal characteristics. At the end of the day, the insulation system should withstand the normal operational requirements of the machine, as well as necessary over-potential tests performed at the service center.

OPERATING SPEED

Many manufacturers originally designed their wind generators to operate at 50 Hertz. In the United States, the wind generators operate at 60 Hertz. It is imperative the fiberglass bands used to control rotational forces on rotors will accommodate the speed increase caused by 60-Hertz systems. A mathematical formula can be obtained to

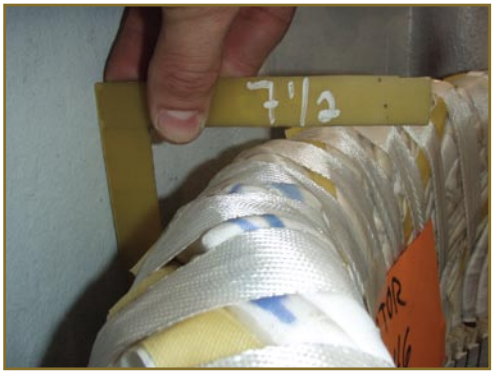


Fig. 4: Additional insulation takes up space, so be sure to stiffen winding end turns.

calculate the amount of banding material needed from organizations such as EASA. Another important aspect is to balance the rotor while at the service center (fig. 3).

CONDUCTOR TYPE

The conductor (or magnet wire) strand insulation is vital for the life of any repaired wind generator, as it is the primary insulator for the winding circuits. There are many different types of polymers and enamels for the wire insulation. Some materials may be very resistant to voltage spikes but susceptible to mechanical stress, while other types may be very tough mechanically but difficult to install. Additionally, some types of wire are very costly and are not beneficial to use. Choosing the proper wire strand insulation to be used can be difficult, but it is essential for the extended life of a repaired wind generator. It would benefit any end user of a repaired wind generator to be involved in deciding which type of wire insulation to use in this part of the process.

PROCESSING

Assuring proper spacing and clearances, correctly impregnating resin and bracing winding end turns is often overlooked. Airflow can be blocked around end turns, causing unwanted higher temperatures. This can lead to premature failure on any repaired wind generator. Additionally, vibrations of wire strands not bundled as a solid mass or without proper resin impregnation can also lead to premature failures. Many times this common mistake is made when a failure analysis is not properly conducted. Care must be taken when adding additional components to stiffen the winding end turns, because additional insulation uses more space (fig. 4).

INSULATING RESIN

The resin treatment of winding used in wind turbine generators should be done utilizing a vacuum pressure impregnation (VPI) system. Many wind generators have very long bores compared to the inside diameter of the stator or rotor core. Properly processed, the appropriate resin will penetrate and fill the slots of a rotor or stator, and it will also create solid end turns that can dissipate heat more readily.

SUMMARY

While this article highlights some of the key lessons from the field and the service center, the central message is to be involved with the service and repair process, pre-qualify service providers, and make sure all of the work is done safely. Uptime availability is important, and extending the life of generators will lead to higher performance values and greater financial returns.

< Continued from page 15

on Delivered Duty Paid (DDP) shipping. Kousa International, Los Angeles, is the exclusive agent for Korindo Wind. For more information go to www.korindowind.com.

BASF EXPANDS SHANGHAI TECHNICAL COMPETENCE CENTER

BASF has inaugurated a new section of its Technical Competence Center for intermediates at its Shanghai Pudong site. The new laboratory will specialize in epoxy systems for fiber-reinforced composites, which are used, for example, in wind turbine blades. BASF sells these systems under its Baxxodur® brand. The competence center integrates this new epoxy laboratory with BASF's existing PolyTHF laboratory, which will also expand the scope of its services.

"With our local competence center we provide our customers in Asia a fast and reliable technical support tailored to their needs," says Dr. Guido Voit, who heads the Regional Business Unit Asia Pacific in BASF's Intermediates division. "We utilize BASF's integrated global knowledge network to benefit our customers in the region."

In the new epoxy laboratory BASF can simulate its customers' production processes using Baxxodur epoxy systems under production conditions. BASF's application engineers develop tailored solutions and provide onsite technical support to their customers.

The rotor blades of today's state of the art wind turbines are mostly made of epoxy-resin-based composites. Baxxodur epoxy systems from BASF allow blade manufacturers to reduce the cycle time to produce the blades, thereby enhancing their productivity. With their specific properties the BASF systems can be used to reliably produce high-quality key components like spar caps and root sections of rotor blades. BASF systems outperform traditional epoxy systems especially in the production of large rotor blades. The systems are approved by Germanischer Lloyd AG (GL), which offers assurance, consulting, and classification for the maritime and energy industries.

At BASF's expanded Technical Competence Center various polymer synthesis facilities can be used to customize new formulations, improve existing ones and adjust mechanical and thermal properties of PolyTHF-based products to specific applications. Sample and specimen analysis as well as laboratory support for starting up customer plants round off the service offer.

BASF is the world's leading chemical company, with a portfolio ranging from chemicals, plastics, and performance products to agricultural products, fine chemicals, and oil and gas. As a reliable partner BASF creates chemistry to help its customers in virtually all industries to be more successful. With its high-value

products and intelligent solutions, BASF plays an important role in finding answers to global challenges such as climate protection, energy efficiency, and mobility. Learn more by visiting www.basf.com.

SHERMCO HIRES NEW BUSINESS DEVELOPMENT MANAGER

Shermco Industries has hired Mike Hancock as manager of business development for its Engineering Services Division. An electrical power industry veteran of over 17 years, he will work with all levels of the organization, applying his broad expertise on business development to the organization's current operation and planned expansion. Hancock will focus on business growth and major project execution, as well as supporting and working with all of Shermco's district operations managers, coordinators, sales engineers, and approximately 100 field operations personnel.

"Mike has extensive experience in this industry and he has a very impressive track record of success," says Thad Brown, vice president of Engineering Services. "He's overseen some large scale projects in his career, including one related to Hurricane Ike relief efforts and another associated with the 2009 Iowa area floods."

Shermco Industries is a provider of safe, reliable testing, repair, professional training, maintenance, and analysis of rotating apparatus and electrical power distribution systems and related equipment for the light, medium, and heavy industrial base nationwide. Founded in 1974 in Dallas, the company is comprised of two strategic business units; the Machine Services Division, and an Engineering Services Division. With a corporate location in Irving, Texas, a sales office in Brussels, and service centers in Austin, Texas, and Tulsa and Sweetwater, Oklahoma, Shermco has more than 250 full-time employees. The company is a member of the Electrical Apparatus Service Association, the American Wind Energy Association, and the International Electrical Testing Association. For more information go to www.shermco.com.

GE ANNOUNCES MAJOR EUROPEAN OFFSHORE WIND EXPANSION

GE will invest approximately €340 million to develop or expand its wind turbine manufacturing, engineering, and service facilities in four European countries—the United Kingdom, Norway, Sweden, and Germany—signaling GE's deep commitment to the promising European offshore wind sector. "Offshore wind will play a vital role in meeting the growing global demand for cleaner, renewable energy and has a bright future here in Europe," says Ferdinando (Nani) Beccalli-Falco, president and CEO of GE International. "These investments

will position us to help develop Europe's vast, untapped offshore wind resources, while also creating new jobs for both GE and our suppliers."

At the core of GE's European expansion plans is the development of its next-generation wind turbine, a 4-megawatt machine designed specifically for offshore deployment. As the largest wind turbine in GE's fleet, it will incorporate advanced drive train and control technologies gained through GE's acquisition of ScanWind. The 4-megawatt wind turbine will feature GE's innovative technology that eliminates the need for gearboxes. This technology is already being demonstrated at a test site in Hundhammerfjellet, Norway, where the first ScanWind direct drive unit has been operating for more than five years.

"GE's proven reliability on more than 13,500 land units coupled with ScanWind's proven offshore, gearless design enables us to provide our customers the reliable solutions necessary for the offshore wind industry," says Victor Abate, vice president of renewable energy for GE Power & Water. "These announcements lay the foundation for us to begin scaling our offshore business, technology, and supply chain locally in Europe where we see the greatest growth opportunity."

The European Wind Energy Association expects that Europe's offshore wind sector will grow more than 70 percent in 2010, with continued growth forecast over the next several years. If all of the offshore wind projects currently in development are completed, they could produce 10 percent

of the European Union's total electricity while avoiding 200 million tons of CO_2 emissions each year. Overall, offshore wind is expected to make a major contribution in helping the European Union reach its goal to have 20 percent of its energy produced from renewable resources by the year 2020. For more information visit the company's Web site at www.ge.com.

SIEMENS NAMES NEW CEO OF WIND POWER BUSINESS UNIT

Jens-Peter Saul has been appointed CEO of the Siemens Wind Power Business Unit headquartered in Brande. He succeeds Andreas Nauen, who is leaving Siemens at his own wish. He was previously managing director of Siemens Energy in the UK and also responsible for the North and West Europe regions.

Saul earned a degree in engineering at the University of Hanover in 1994. He joined Siemens' Fossil Power Generation Division in 1996 as project manager, where he held various managerial posts. Following a short term as project manager with a consulting company in the automobile sector, he assumed managerial functions at Siemens in 2002, including responsibility for power plants sales and marketing in the Middle East. In 2005 he was appointed head of power plant business for the Siemens Power Generation Group in the UK.

"We would like to thank Mr. Nauen for his achievements for our company," says René Umlauft, CEO of Siemens' Renewable Energy Division. "In Jens-Peter Saul we have found the right successor to push ahead with achievement of our ambitious targets in the field of wind turbines."

The Siemens Energy Sector is the world's leading supplier of a complete spectrum of products, services, and solutions for the generation, transmission, and distribution of power and for the extraction, conversion, and transport of oil and gas.

Learn more by visiting www.siemens.com/energy.

Why attend the World's Largest Annual Wind Conference & Exhibition?

The aggressive growth the wind industry has experienced is opening many exciting opportunities for new players to enter this market, helping expand wind's growth and strengthen the economy.

Come experience the excitement with leaders of the wind industry and take advantage of all the growth opportunities.

WINDPOWER® 2010
Dallas, Texas • May 23-26, 2010

www.windpowerexpo.org

AWEA®

ADINDEX

Jeff Anthony
Director of Business Development/American Wind Energy Association

TELL US ABOUT WHAT AWEA IS DOING IN THE WIND ENERGY SUPPLY CHAIN AREA.

AWEA has had an active supply chain initiative in place since early 2008. A report from the U.S. Department of Energy called "20% Wind Energy by 2030," which can be downloaded at www.20percentwind.org, identified supply chain issues—the manufacturing capacity to produce wind turbines and turbine components—as one of the major challenges facing the wind energy industry's growth in the coming years. So AWEA has made it a priority and spent considerable resources focusing on encouraging wind turbine and component manufacturing, as well as services, transportation, and installation of wind turbine components. The scope of our initiative covers all aspects of the supply chain, from raw materials through completion of installation and commissioning of the wind turbine. We also recently increased our outreach to our businesses in the supply chain, engaging directly with current and potential members to answer questions and provide information about industry trends and expectations. AWEA has multiple working groups that serve to provide technical support by bringing participants together to identify issues affecting the industry and working to reach consensus on the action needed to move forward. Two of those working groups include the AWEA Transportation & Logistics Working Group and the AWEA Manufacturing Working Group.

HOW IS AWEA HELPING MEMBERS LEARN ABOUT AND ADDRESS SUPPLY CHAIN ISSUES?

Our Web site provides a wealth of information that's being expanded as we compile information into fact sheets. AWEA also hosts several regional supply chain conferences each year, in addition to the supply chain track at our annual WINDPOWER Conference and Exhibition. Participation in these programs is not limited to members of AWEA or affiliated organizations, but is open to all interested parties. Additionally, we're working to increase engagement with other groups such as the Society of Manufacturing Engineers (SME) to develop programs that benefit our mutual members and the industry as a whole. Efforts are underway to develop a series of webcasts to expand the distribution of wind industry information.

WHAT ARE THE PRIMARY SUPPLY-CHAIN CHALLENGES WIND ENERGY COMPANIES FACE?

For manufacturing, developing a domestic supply chain for nacelle components is a priority for many OEMs, and maintaining competitive pricing in line with offshore suppliers is proving to be difficult. One cause is the lack of integrated forging and foundry facilities dedicated to producing wind components. As the components move from raw material to finished component, they change location and service provider, which adds transportation and handling cost and reduces margins. Another cause is the open capacity that exists due to the drop in orders worldwide. For transportation there is a shortage of cartage equipment, particularly the specialized trailers and rail cars needed to move components and erection equipment. As the number of turbine installations increases annually, demand will outpace supply, yet investments aren't being made due to market uncertainty. For installation, heavy lift equipment availability has been and will continue to be a challenge, and with few OEMs supplying the world scaling up output is difficult. As hub heights and component weight increase, larger cranes will be required. In coming years the construction of new coal and nuclear plants will create competition for the available rigs. A primary cause of these challenges is the lack of a national energy policy. The number of installations has been affected as the wind energy Production Tax Credit (PTC) toggles on and off. Without a continuous market, companies have been reluctant to make major investments in assets that would be underutilized. AWEA is lobbying for a Renewable Electricity Standard as a means to provide long-term market stability and predictable demand from a national level, which would provide the necessary signal for investment in the manufacturing sector to address these issues.

Go to www.awea.org or www.windpowerexpo.org.

Capture the full potential!

Invite a yellow coat.

The wind power business is growing rapidly leading to new metal cutting challenges. As a Sandvik Coromant partner, you can always rely on a specialist nearby, focused on your success. Smart solutions for every component; from the base of the tower to the blade.

24-hour delivery of premium tools to almost every corner of the world is only one promise. Measurable results on the bottom line is another. Let's optimize your potential together!

Call 1-800-SANDVIK (1-800-726-3845) to talk to a Sandvik Coromant representative near you, or visit www.sandvik.coromant.com/wind

Think smart | Work smart | Earn smart

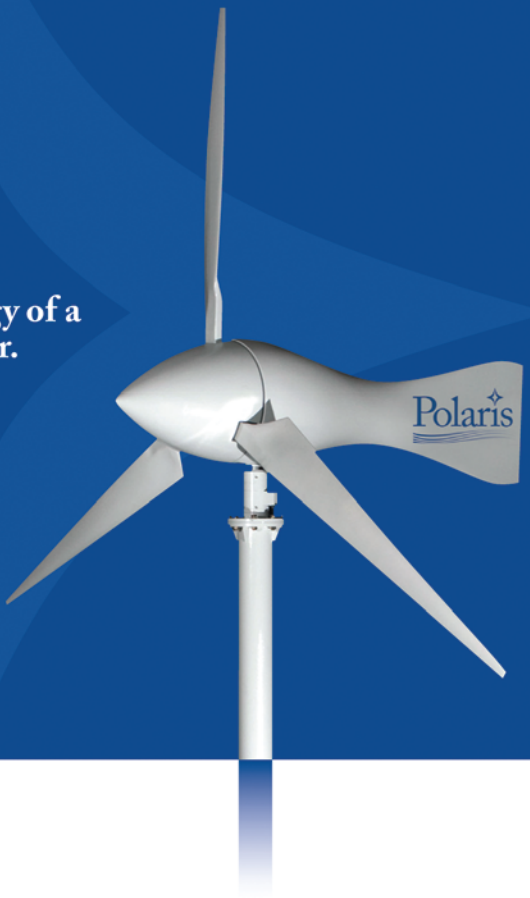
Visit us in booth #10657 at Windpower 2010 Conference & Exhibition.

SANDVIK Coromant

Your success in focus

www.sandvik.coromant.com/us

Capture the energy of a brand new star.



Harness over a century of experience in large precision machining. Turn it loose on a whole new class of innovative wind turbine designs that feature exclusive technologies and superior engineering. Then focus it all on truly cost effective community wind energy production.

In communities around the world, citizens will see a new star when they look up in the sky. And it's as reliable as the wind itself. **Polaris**.

For more information visit our web site at www.polarisamerica.com, e-mail us at sales@polarisamerica.com, or call 614-540-1710.

Polaris

1 to 1 - Your Total Community Wind Provider

Booth# 6829

2010 WINDPOWER CONFERENCE & EXHIBITION

Dallas, Texas May 23 - 26

Looking for Dealers