JULY 2011

WIND SYSTEMS

FEATURES

Company Profile:
NAES Corp.

Composite Blades
of the Future

Hybrid Wind Turbine
Integration

Shaft Alignment
Made Easy

Optimizing Offshore
Efficiency

THE IMPORTANCE OF OIL-RESISTANT CABLES

DEPARTMENTS

Construction—NAES Corp.
Maintenance—Rev1 Renewables
Technology—Penn State Wind Energy
Logistics—Professional Logistics Group

Q&A: Dan Janisch
Mesabi Range College

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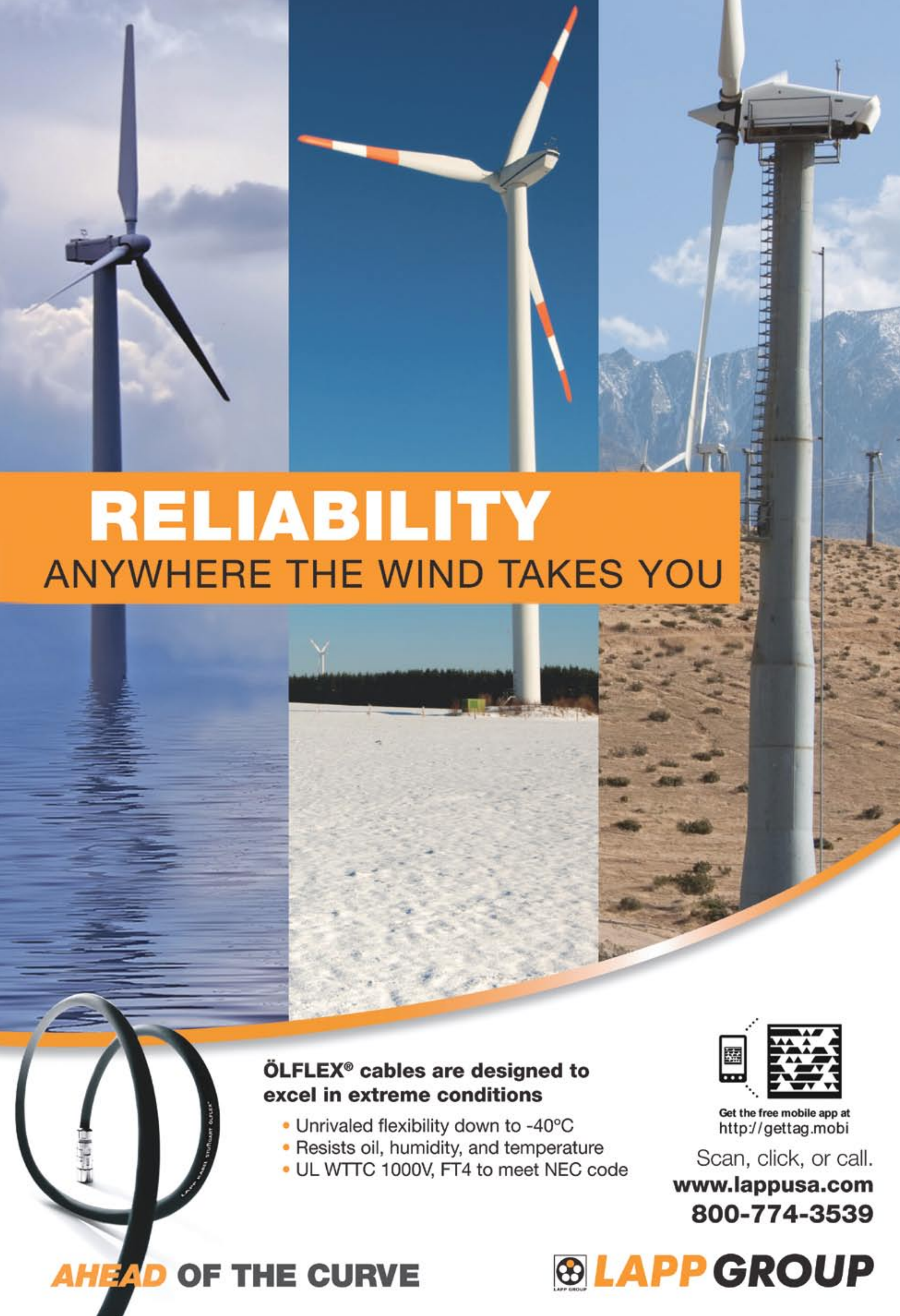
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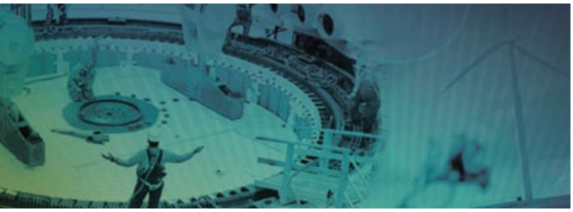

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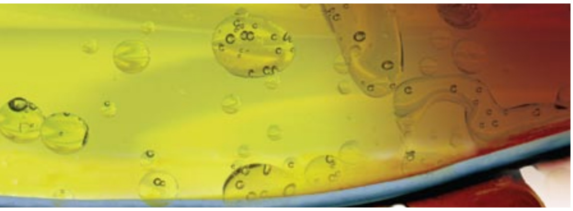

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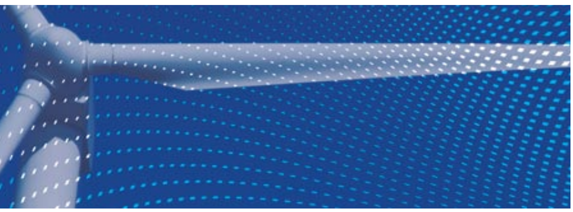

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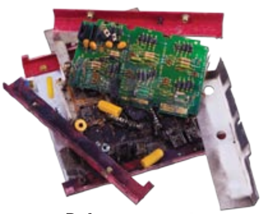

Before

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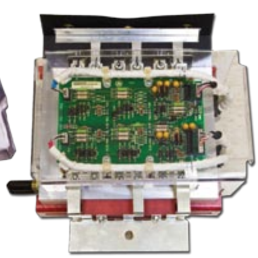

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EDLETTER

While speaking with Dan Janisch—director of the Wind Energy Technology Program at Mesabi Range Community and Technical College—for this month's Q&A, I recalled the many students we met at the recent AWEA Windpower show in Anaheim. Many of them had never attended the conference before, and from my conversations with them it was clear how excited they were to be entering such a vibrant, growing industry. Even though they were already fired up about their future, of course, there was a lot they weren't prepared for. One young man in particular said "I didn't know there would be so many cool people." I don't think I could've said it better myself, because it's true. From top executives in suits, to professors and scientists in khakis, to tattooed tower technicians in denim and leather from all over the world, the wind industry is made up of an incredibly diverse mix of people who all seem to respect each other, and the different roles each of them plays. The wind program at Mesabi Range is just one of many that have been—and are being—established around the country, and they deserve your support. Just read about the difference that Clipper Windpower has made for Dan's students, and you're sure to want to get involved yourself. I would encourage you to do just that.

This issue is filled with articles written by a host of cool people, starting with Dr. Olivier Guillermin of VISTAGY who discusses "Composite Blades of the Future." Brian Shanovich of VibrAlign describes the proper tools and techniques that will result in "Shaft Alignment Made Easy," and Jussi Vanhanen of The Switch has contributed "Optimizing Offshore Efficiency," in which he explains how offshore wind presents opportunities for those with the ability to harness it. John Gavilanes of Lapp has written "The Importance of Oil-Resistant Cables," and Gina Heath of Marsh Creek LLC presents a study of a unique wind/diesel system is powering a remote Alaskan village that is completely off the grid in "Hybrid Wind Turbine Integration." John Brewster, who is president and CEO of the NAES Corporation, was very kind to take the time to share his own and the company's story with me. This is a company to watch, and one you need to know about.

As for our columnists, I'd like to welcome Susan W. Stewart, Ph.D., of the Penn State Wind Program to our pages, in which she writes about building-integrated wind energy in her technology column. Anne Puhalovich of the Professional Logistics Group discusses demurrage and detention fees—and how to avoid them—in her logistics column, and Ron Krizan, P.E., of NAES asks what construction strategy you will choose once your project has been cleared, examining a number of different approaches. "Maintenance Master" Merritt Brown of Rev1 Renewables provides pointers on how to keep a clear sightline from maintenance reliability to business success in his monthly column. And, yes, I believe they would all qualify as cool people in that young student's eyes, too.

While I consider many of these individuals to be old friends at this point, I've made many new ones as well—as is the case with every issue we produce. I hope to have the same opportunity to get to know you and your work if you're interested in contributing an article for an upcoming issue yourself. Just shoot me a short e-mail explaining your idea, and let's go and ahead and get started! All best:

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MFG MARKS WIND BLADE MILESTONE

The Molded Fiber Glass Companies (MFG), announces that the company's plant in Gainesville, Texas, celebrated the shipment of their 1,000th set of 37-meter composite wind blades. Located 60 miles north of Dallas in the wind farm hotbed of the United States, the 155,000 square-foot facility has been manufacturing wind blades since 1997 and employs approximately 200 skilled workers. The shipment marking the milestone was comprised of 37-meter blades, for 1500kw turbines. This factory has also produced another 500 sets of other blades ranging from 24 to 34 meters.

MFG Texas is part of the Molded Fiber Glass Companies, which has been manufacturing wind turbine components since the 1988. Today wind turbine components comprise one of MFG's largest business segments. With two factories building wind blades, two factories building nacelles, and one factory building spinners, MFG is one of North America's leading supplier of composite components for the wind industry. They currently have wind component manufacturing facilities in Ohio, South Dakota, California, Alabama, and Texas.

"What's interesting to consider is that collectively these blades have generated on the order of 4,234,000,000 kwh of electricity—enough power to supply 1,154,000 average households," according to Gary Kanaby, director of sales for wind energy. "Our team is gratified to be part of an industry that is poised to make a meaningful contribution to cleaner, independent energy generation for North America."

MFG is unique among suppliers of composite components to turbine equipment manufacturers, both in output capacity and in composite manufacturing technology. Well known around the world for pioneering the mass production of commercial products out of composites, the company's internal R&D center is still at the forefront of innovation for composite materials and processes. For example, MFG's newest 325,000 square-foot blade facility in Aberdeen, South Dakota, opened in 2007, is the most advanced facility of its kind with an automated spray booth and robotic root drilling.

Molded Fiber Glass Companies is a leader in the field of reinforced plastics and composites, serving diverse markets with a variety of composite material

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.

systems. The company has 16 operating entities in the United States and Mexico, strategically focused to supply high value, high quality products and manufacturing services for applications such as wind energy, automotive, heavy truck, defense, and construction. For more information on the company's wind component manufacturing capabilities e-mail Kanaby at gkanaby@moldedfiberglass.com or visit www.moldedfiberglass.com.

MORTENSON BUILDS 19TH WIND PROJECT IN HOME STATE

Mortenson Construction will soon break ground on the 44 megawatt Oak Glen Wind Farm, located on a 3,000-acre agricultural site located in Blooming Prairie, Minnesota. The project's owner is the Minnesota Municipal Power Agency and its 11-member utilities. Avant Energy, a leading Minneapolis-based energy supply management company, is the developer and the overall project manager.

Mortenson's scope of work will include the erection of 24, 1.8MW turbines and the construction of foundations, access roads, underground collection, and a 69kV substation. The project is expected to be operational by the end of 2011. "We're delighted by the opportunity to partner with Minnesota Municipal Power and Avant Energy on our first project together that will help promote the continued growth of wind energy in our state," says Tim Maag, a vice president and general manager of Mortenson Construction's Renewable Energy Groups.

According to the American Wind Energy Association, Minnesota installed 2,192 megawatts of wind energy in 2010 and is ranked as the fourth largest wind market in the United States. Mortenson has installed 1,466 megawatts of renewable energy in Minnesota through the first quarter of 2011, which represents approximately 55percent of the total megawatts throughout the state. Oak Glen is Mortenson's 19th wind project built in Minnesota.

Since entering the renewable energy market in 1995, Mortenson Construction has become a leading builder of wind power facilities in North America, having built more than 100 wind projects throughout the United States and Canada. In addition to wind power, Mortenson's Renewable Energy Groups also constructs facilities that generate solar power and other renewable resources, and it is a leading provider of transmission and distribution infrastructure. Go online to www.mortenson.com/wind.

NEW WIND TURBINE PITCH SYSTEM FROM MOOG

At the WINDPOWER 2011 conference, Moog Industrial Group—a division of Moog Inc.—

unveiled a new electric pitch system that offers wind turbine operators higher performance, reliability, additional safety, and lower maintenance costs to address key challenges faced by wind turbine manufacturers and operators. The Moog wind turbine pitch system is equipped with Moog's new AC synchronous electromagnetic brushless servo motor, which meets the requirements of onshore and offshore wind turbines. The pitch systems also include Moog's pitch servo drive and backup systems.

Pitch control systems are responsible for the precise positioning of blades, which enable wind turbines to operate at optimum speeds to ensure the highest availability and safety. The harsh conditions that turbines operate in require the pitch system and its components to face, among other things, low and unsteady wind speeds and ambient operating temperatures ranging from -30° C up to +50° C (-22 to +122° F).

"Striking a fine balance between parameters like performance, reliability, safety, and costs are key challenges facing wind turbine OEMs and operators," says Mauro Gnecco, business development manager, wind energy. "When compared with conventional DC pitch systems, the AC brushless technology is designed to be a very high performance system with lower maintenance costs."

"A key challenge for wind turbine manufacturers is the selection of a motion control supplier who is capable of providing a pitch control system that maximizes reliability and minimizes mechanical complexity," according to Sal Spada, research director at ARC Advisory Group. "Pitch control systems combined with synchronous servo motors harness advanced technologies that deliver reliable and consistent performance enabling wind turbine manufacturers and operators to maximize productivity and ROI."

Moog designed its new wind turbine pitch servo motor to withstand extreme temperatures, vibrations, and humidity. When coupled with the associated Moog wind turbine pitch servo drive, the motor has a very high peak power density and also has the capability to be controlled in sensorless mode, which enables the servo drive to control the motor in situations where position information is lost from the servo motor's encoder or resolver.

Moog built its pitch servo motors to meet the requirements of corrosion class C5M (according to DIN 12944 standards) and with wind-proof connector technology. The motor is suitable for Hot Climate Versions (HCV) as well as Cold Climate Versions (CCV) in both onshore and offshore environments. For more information please visit www.moog.com/wind.

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Ron Krizan, P.E.
NAES Corporation

Once your project has been cleared to proceed, which construction strategy will you choose? This installment provides a comparison of two methods, including pros and cons.

ONCE YOUR WIND FARM PROJECT becomes approved, you will eventually need to decide what construction strategy you will use. Many developers have traditionally gone with the Engineer, Procure, and Construct (EPC) or "turnkey" approach. However, the General Contracting (GC) method is another basic approach that is easily adaptable to the wind industry and has seen success on a number of projects. Both methods have their own advantages and disadvantages, as well as multiple variations that address specific shortcomings.

The EPC model has typically been the one of choice in the wind farm industry. This model usually involves using a sole source contractor to provide all of the engineering, procurement, and construction for the entire project. The greatest advantage to this method is the convenience it offers to the developer. This method is usually termed turnkey, as in many cases the project is as simple as handing over a check and then waiting the allotted time to get the keys to your brand-new wind farm. Besides the turbines, the construction cost is your next largest expenditure generally making up 25-30 percent of the overall project cost. Unlike the turbine purchase, the construction phase may involve hundreds of assorted subcontractors and vendors, so developers rely on the EPC contractor to pull that together and give them a singular price.

The disadvantage is often tied to the price tag, since the EPC contractor must include additional contingencies for all of the unseen risks that they may encounter during the engineering and construction process. Some of these costs can be offset through the efficiencies and buying power of the EPC contractor. However, most costs are pushed back onto the developer. The percentage of risk that is transferred back to the owner can be anywhere from 5-20 percent of the EPC contractor's total cost. That number is heavily dependent on how much is actually known about the project site, the level of upfront effort that went into the constructability review, and ultimately the proposed schedule.

The general contracting or GC method of wind farm development has recently emerged as another way for developers to lower their installed MW costs while giving them more control over the construction process. In order for the method to be successful it requires a hands-on approach, in stark contrast to the EPC model. Instead of a single contractor pulling in all of the pricing for the construction aspects, the developer will now handle all of the procurement and construction management. The work is generally divided into six or seven smaller, more-manageable scopes of work, but it can be many more. These typically include engineering, civil work (access roads, general grading, and restoration), foundation construction, tower erection (usually includes down tower wiring), collector system work, substation/switchyard work, and the turbine supplier.

The smaller and more-concise scopes, in conjunction with the completed engineering drawings, drastically reduce the amount of unknown risks. Those reduced risks are the source of the cost savings utilizing this method. The developer also has more latitude in determining the bid lists, which is not customarily the case on EPC projects. The GC method gives the developer the advantage of not only selecting the prospective bidders but also authority over the review process of each proposal. This authority allows developers to select the lucky bidder based solely on price or by any other parameters that are important to them.

The principal disadvantage is also the key to this method's success. The GC method requires significantly more experience in wind farm construction than does the EPC method. When this method is taken to the extreme, the developer is just a few pieces of equipment and some manpower away from actually functioning as an EPC contractor themselves. While this may sound daunting, there are several construction management companies that specialize in pure construction management. These companies can either augment a developer's existing team, or they can supply all of the day to day management activities with the developer just making command decisions. A full management team from a consultant typically does not cost more than 1 percent of the overall project value, and if they are just supplementing the developer's team then the cost will be significantly less.

In summary, both distinct methods have their advantages and disadvantages. These are only two of the countless methodologies to exploit the cost/risk relationship present on wind farm projects.

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

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To be proficient in managing your maintenance plan, it should be both a common practice and a team effort to focus on the sightline from maintenance reliability to business success.

WHEN WE SPEAK OF WIND TURBINE maintenance we often refer to the scheduled, semi-annual, or annual service that involves such tasks as replacing filters, checking bolt torques, and other time-based activities found on the manufacturer's checklist. But let's say your technician returns from one of these scheduled maintenance activities with a new work request after he found a broken midsection ladder hatch hinge. The issue is noted on a service document, perhaps in a maintenance spreadsheet or CMMS application, and is tracked with the intent to schedule a time when the hinge can later be repaired. Since the issue does not impact actual production, the probability of a separate shutdown of the turbine just to repair this broken hinge is highly unlikely. The issue may in fact continue to remain unaddressed for a long period of time simply because of the priority placed on it, and may one day present a safety hazard that has an unfortunate outcome. While this isn't a problem exclusive to the wind industry, it becomes more of a significant driver for managing ancillary maintenance of wind turbines because of the intermittent nature of wind turbine service work. The broken hinge in itself does not affect production, but repairing it would require additional downtime above what is planned for annual scheduled maintenance. Conversely, in other power generation technologies, the hinge could be repaired the very next day without impacting generation.

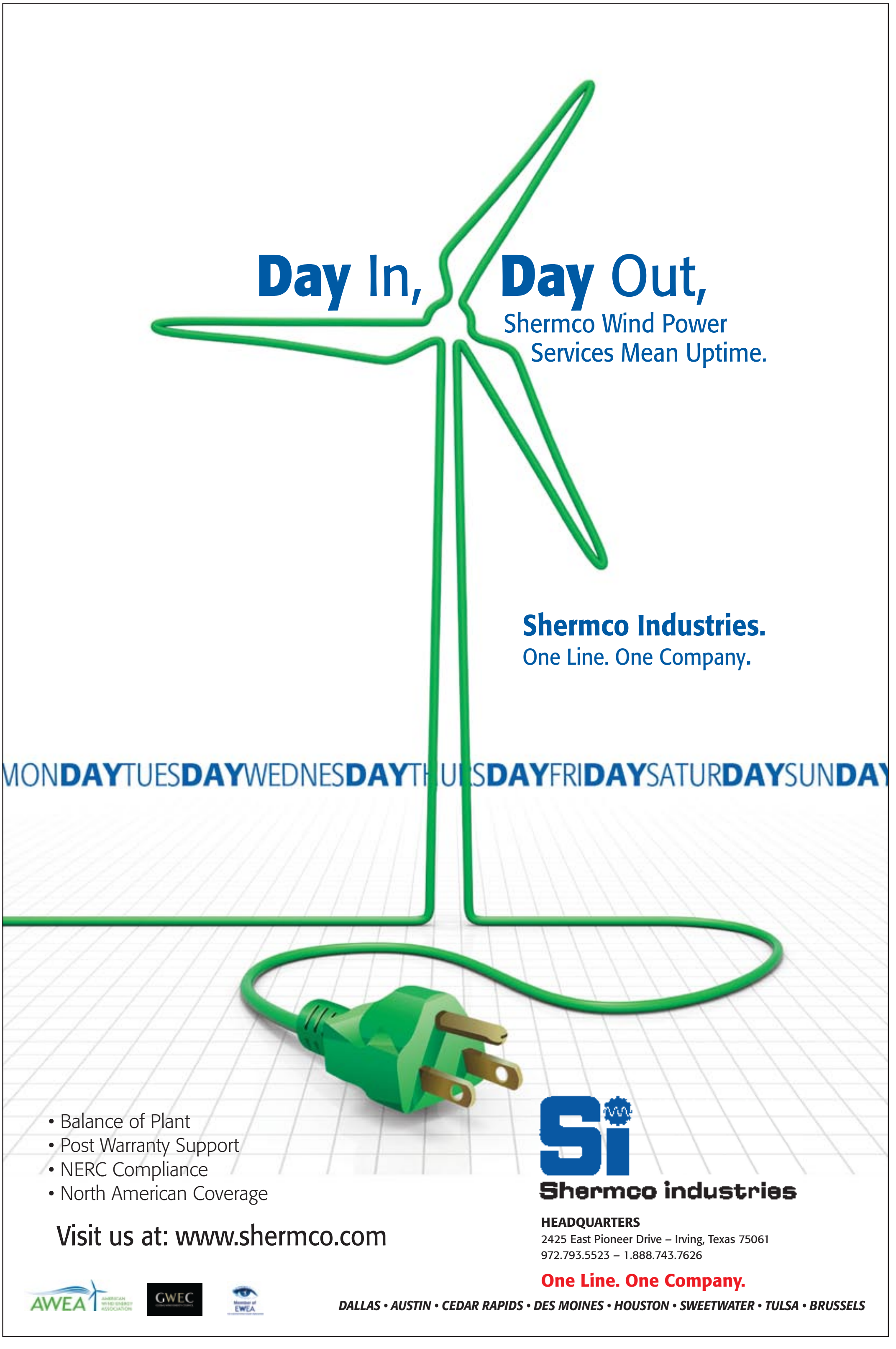
Determining how long an issue will remain on the work list is part of the strategy that each project operator must focus on when planning for scheduled maintenance. Time, money, and scope can each be compromised in efforts to return turbines quickly to service, but the consequences of not addressing serious issues in a timely manner can have later, distressing results to the bottom line. To emphasize this, the top 10 OSHA citations each year always include familiar issues to those of us who work in the wind industry. Fall protection, ladders, PPE, lock-out tag-out, training records, and hazard communication have consistently been on OSHA's worst offenders list. While such findings may not be part of your reality today, having a solid program from the beginning of a project is the only way to assure you do not end up being a government statistic. Smaller maintenance issues might seem inconsequential to the greater goal of high availability, but they will need to be addressed at some point, and at a time before they become big maintenance issues or impact production.

The overall objective of the maintenance process is to reduce downtime, increase mean time between failures, prevent deterioration of equipment, and ensure that there are no incidents in the workplace due to mechanical failures. Smarter ways of managing the additional burden of compliance, addressing safety maintenance issues such as the broken hinge, and dealing with an expandable work list can be approached with best practices from other industries. Conventional power generation, for example, makes use of system or failure downtime to perform corrective and preventative maintenance work without further productive loss. This opportunity maintenance is performed on a machine or a facility when an unplanned opportunity exists during the period of performing planned maintenance activities to other machines or facilities. For a wind turbine, this same approach can be used when the system operator declares an outage, or when one component causes the turbine to fault and requires downtime to correct the failure and other corrective work can be completed during this downtime opportunity. The team must always be ready to take advantage of such opportunities, however, as this methodology requires the pre-planning of corrective maintenance tasks that can be performed during the unscheduled outage. Simply stated, the turbine is offline anyway, so we may as well replace that hinge.

Effectively planning opportunity maintenance and scheduled maintenance events while maximizing operational reliability is key to any planning and scheduling effort. Having a detailed list of prioritized issues, proper supply of materials that are available when needed, and an assessment of time and labor resources needed to accomplish each task are all variables in the scheduling equation. Using such tools as a "cause and effect matrix" or a Pick chart can help in the decision-making process. These exercises assist in organizing and categorizing each pending task, and will help determine which ones can be deferred until a scheduled maintenance and those that should be resolved at the next opportunity maintenance. When faced with multiple tasks on multiple turbines, they can be used to determine which ones will result in the greatest benefit.

To be proficient in managing your maintenance plan, it should be both a common practice and a team effort to focus on the sightline from maintenance reliability to business success. The entire team should understand the value of each downtime hour, how they create value, and what their specific contribution to the project's overall performance is.

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



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Susan W. Stewart, Ph.D.
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The challenges involved in building-integrated wind energy include wind flow, structure siting, unit certification, and even aesthetic concerns. Read on to learn more.

BUILDING-INTEGRATED WIND turbines (BIWT) are becoming more prevalent in the landscape across the United States, as well as in Europe. There are many challenges with integrating wind turbines into existing buildings that are not entirely obvious, even upon thorough investigation of a proposed installation.

One of the most serious challenges is probably that the building itself is an obstruction in the flow, thus creating a completely different environment for harvesting wind energy than what is found in a typical open-space turbine installation site. For instance, in a conventional turbine installation in an open area there is generally a wind shear effect that causes the wind speed to increase with height as the flow gets farther away from the ground (i.e. a boundary layer over a no-slip condition). Thus, it is often assumed that placing a wind turbine on top of a building would help capture more wind energy, since "higher must be better." As the building causes a disruption in the flow, however, the behavior of the wind in the vicinity is not directly comparable to the wind field in wide-open terrain.

There are two distinct differences that must be considered in a BIWT siting analysis: 1) a single location on a building will see very different wind speeds than the free stream upwind conditions, and 2) this variation is dependent on the direction from which the wind is blowing. So, while a wind turbine in a wide-open field will capture the free stream velocity of the wind equally from any direction, a wind turbine on a building is going to see quite altered wind speeds from the upstream values as the wind shifts direction. In fact, it is even possible that placing a turbine at some central location above a building could actually place it in a vortical dead spot during some periods. As there are very few rules of thumb for siting wind turbines on buildings, finding the optimal location is no simple task. Several research studies have been conducted in recent years addressing this issue, showing that the difference between poor siting and optimal siting on a building can mean an improvement factor of 1,000 in available power density.

Assuming a free stream estimated wind resource that merits further investigation, a general guideline one might consider today would be to place the turbines above a predicted wind shear layer over the building, as was done by ZGF Architects. Additionally, it is likely that coastal locations or sites with a consistent wind flow direction would see better performance than sites with more distributed prevalent wind directions—and thus more variability in performance for a specific site on a building. For urban areas, as with conventional installations, it is important to consider any upstream obstructions in the wind flow in addition to the obstructions caused by the building itself. In the end, an anemometer placed in the exact proposed location of the turbine is the best bet for a performance prediction. Fluid dynamic simulations can also be quite useful, but also expensive.

The next challenge is the structural integration of the device with the building. Depending on local requirements, a structural engineer may need to sign off on the tower and integration design. Building codes should be referenced, and safety issues should be addressed. This building integration can cost significantly more than one on the ground and should be considered in the economic analysis. Turbulence is also more severe in the built environment and may limit the selection of turbines that are designed to operate in this setting as well as cause unwanted structural vibrations and/or noise.

Aesthetics may also be more important for installations in the built environment. Personal experiences with architects have shown that vertical axis wind turbines (VAWTs) are more aesthetically pleasing to those in the field of building design. Many vertical axis machines are also marketed for this use. While VAWTs may or may not prove suitable for the built environment (a whole other discussion), any potential end user of a small wind turbine should be aware of the certifications of such devices. Currently in the U.S. few small wind turbines on the market have any level of third-party certification. I recommend checking the Small Wind Certification Council's Web site at www.smallwindcertification.org/certified_turbines.html for the most up to date information on certified turbines.

As many challenges as there may be, projects will still move forward with motivations to be green or make a statement. New construction projects open to building orientation and augmentation opportunities will likely have more prospects for enhancing turbine performance than integrating turbines onto existing buildings. There are still many open areas of research needed to address cost effective structural integration, establish a better understanding of turbine performance in the highly turbulent conditions around a building, and develop rules of thumb for siting that can be applied more broadly.

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

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Anne Puhalovich
Professional Logistics Group, Inc.

Demurrage and detention fees are penalty charges that owners apply when transportation equipment sits idle. Here's how they can be mitigated, or avoided altogether.

LOGISTICS COSTS ACCOUNT for 10-15 percent of the total turbine cost. Understanding and controlling these costs is an important part of managing the overall budget. An area of costs not typically budgeted, but which may contribute significantly to the overall logistics costs, are demurrage and detention fees. Under certain circumstances these charges may increase the logistics costs by 20 percent or more.

WHAT ARE THEY?

Demurrage and detention fees are penalty charges that owners apply when assets such as vessels, rail cars, containers, or truck transportation equipment sit idle through no fault of the asset provider. The purpose of the charges is to encourage the consignee to load and unload quickly. It is standard practice for the asset owner to provide a set amount of "free time" for loading and unloading, but once the allotted time expires demurrage and/or detention fees apply.

The more expensive the asset, the higher the fee charged. For example, demurrage for project cargo vessels can range in cost from between $15,000-$22,000 per vessel per day. Rail demurrage and detention costs will vary by equipment type. Charges typically escalate by the number of days per car type. Charges are fixed by the published rail tariff. Detention for heavy haul truck equipment varies from $1,500-$5,000 per truck per day, depending on the asset type. The actual detention charges are subject to negotiation.

WHY DO THEY OCCUR?

Demurrage and detention charges usually occur when planning schedules are out of balance. Transloading wind components require the right type and amount of cranes, labor, fixtures, bracing materials, and transportation equipment. Delays will result if any one of these items is not available in sufficient supply. A lack of proper paperwork or state-induced permit restrictions can also lead to costly delays. Some delays are a result of poor weather conditions, such as high winds or lightning storms, and cannot be controlled. Nonetheless, the consequences of the event will still need to be managed. Finally, if a wind farm site is not ready to receive components due to delays in road construction, lack of proper lift equipment, or site preparation, trucks will remain idle at the site waiting to be offloaded. Not only will detention charges apply, but the equipment is unavailable to move other components.

HOW CAN THEY BE MITIGATED?

When components are transported en masse, in trains or in vessels, it may be critical to obtain suitable land to pre- or post-stage components. Ideally, it is best to transfer components directly from one transportation mode to the next (vessel to rail), but in many cases this situation is not possible. If not enough crane equipment, labor, or transport equipment is available to balance the transfer of components directly, equipment will sit idle and detention and demurrage charges become a much greater risk.

Attention to detail and paperwork is important to avoiding unnecessary delays. Component measurements and specifications need to be exact and documentation filed correctly and approved in advance. Managers should understand and plan for specified transportation rules for large components including the potential need for pilot cars, police escorts, and restrictions on hours of travel. For rail transport, managers need to ensure that cars are ordered correctly and, if applicable, ordered in the correct sequence. When cars are unloaded they need to be released as quickly as possible.

Clearly defining and assigning responsibility for "shipment-ready" conditions for each component will reduce unforeseen delays with shipments. Fixtures and bracing requirements vary by component and shipment mode. Deciding in advance who is responsible for shipment-ready conditions (the component manufacturer, the buyer, or the logistics service provider) reduces confusion and ensures that materials are ready when the transportation equipment arrives.

On-site logistics management at loading and unloading points is an important link in managing the fluid and multivariable conditions that can lead to delays. If weather issues arise, or if the next link in the supply chain is not prepared as planned, on-site managers can make tactical and executional adjustments to the schedule to get back to plan as quickly as possible. The presence of on-site management facilitates communication, clarifies project details, and improves the quality and speed of decision making.

Fees caused by unexpected logistics delays can contribute substantially to the overall logistics budget. While not all delays can be anticipated or controlled, applying a few important project management techniques will reduce the risk of detention and demurrage costs getting out of control.

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




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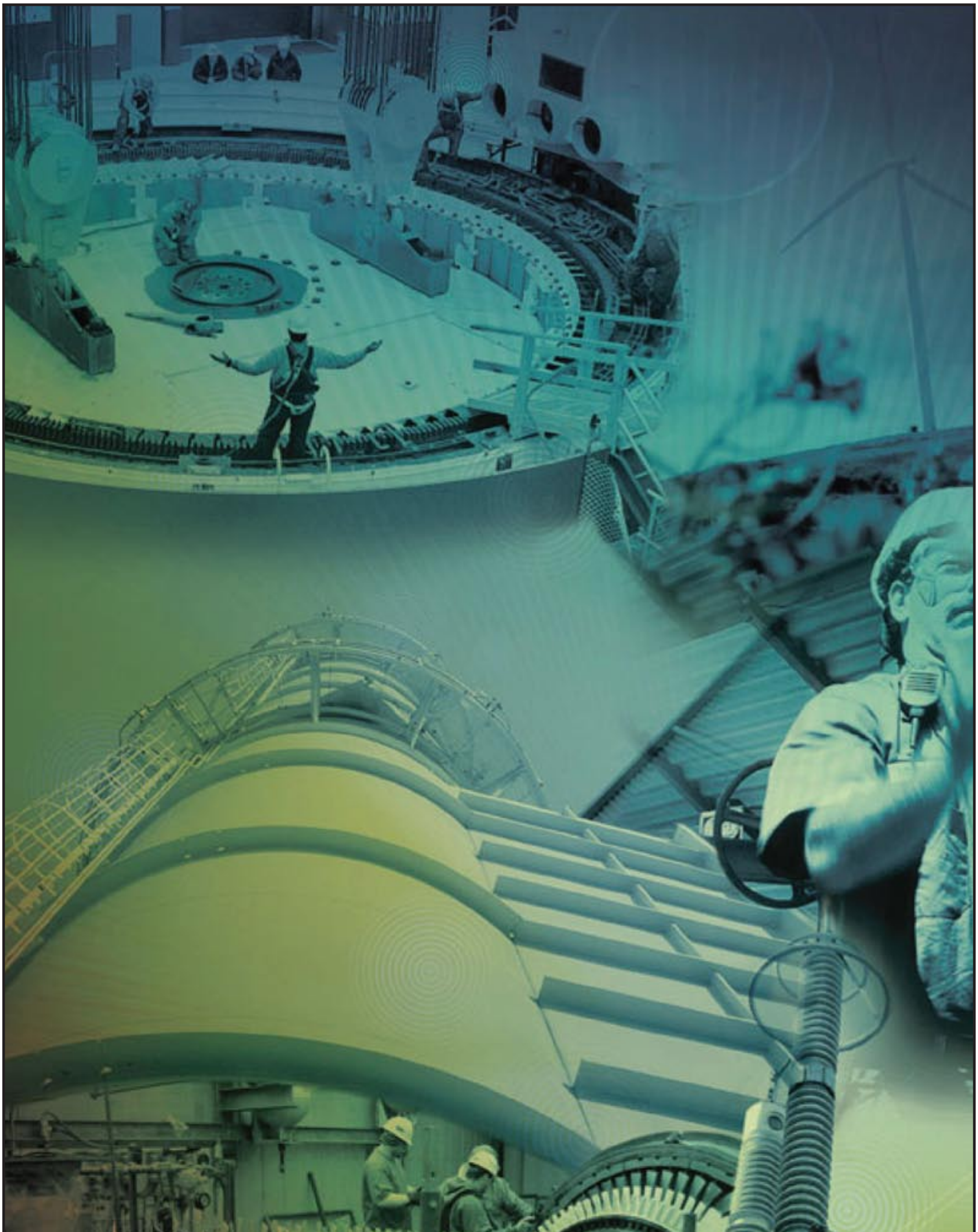
www.smallandcommunitywindexpo.org

NAES CORP.

By Russ Willcutt



Providing engineering, construction, turbine repair, and O&M services, this company has the infrastructure and expertise to help wind developers and owners succeed.

WHEN A COMPANY IS THE ENERGY industry's largest independent provider of operations and maintenance services—currently operating about 120 plants producing some 34,000MW throughout the Americas—and has also been providing maintenance services for nearly three decades, it's in a position to provide its customers with a depth of experience that is unmatched. But there's another thing it can offer, as well.

"And that's leverage," according to John Brewster, president and CEO of NAES Corporation. "We are constantly leveraging our experiences and skill sets to new technologies and customers, and leveraging our purchasing power by entering into arrangements with a variety of service and materials providers for better economics, which enables us to pass the resulting savings along to our customers."

Formed in 1980 by four northwest U.S. utilities to provide project management services, NAES has evolved into a significant enterprise with distinct areas of service expertise including plant operations, maintenance and construction, technical support, turbine field services, and staffing. Headquartered in Issaquah, Washington, the company has multiple offices and plant sites housing some 2,600 employees.

NAES continues to grow. The plant operations segment continues to add new contracts and typically hires new employees as contracts are signed. The majority of recruiting is conducted by in-house staff, and a focus on maintaining continuity of leadership is used. New employee growth is incremental and predominately from the local region, so that the local economy benefits. By contrast, the maintenance and construction segment tends to fluctuate with the work. "We currently employ about 1,000 maintenance and construction personnel," Brewster says, "but our workload has been growing. In fact, we've recently created a new division called the Engineering and Construction Group, which provides support for our two wholly-owned subsidiaries. NAES Power Contractors has served the union maintenance and construction market for many years now, and NAES Constructors will pursue maintenance and construction projects in the open shop market."

As for wind, NAES is using its leverage to provide a springboard for growth. "We are building upon our experiences and proven processes and now providing plant operations, maintenance and construction, staffing, and technical support to owners of wind farms, and we expect to see our business expand in each of these areas," Brewster says, adding that NAES is adapting services to match needs in each segment.

In plant operations, NAES is currently operating nearly 500MW of wind. The scope of work includes the development of customized operational programs and procedures, installation of maintenance management systems to provide the basis for compiling maintenance history and promoting knowledge capture, and oversight of all other service providers such as the WTG OEM, micro weather forecaster, and environmental consultants. Other services include the development of annual budgets and operating plans, interface with power off takers, and other tasks in order to attain safety, compliance, cost, and production requirements. "Owners hire NAES because they realize that the investment is necessary to mitigate their risk exposures and meet their financial targets," Brewster says.

In the technical support segment, NAES is providing NERC support because NERC requirements can extend into wind, and program and procedure development since owners still require safety, compliance, and maintenance management/knowledge capture. In staffing, NAES services range from placing temporary field technicians to the conduct of defined search.

Extending into maintenance and construction on the basis of its turbine services history seems logical. "Targeting scheduled and unscheduled maintenance, retrofits and upgrades, storage repair and maintenance, and end of warranty inspections takes advantage of our pedigree in quickly mobilizing a skilled workforce with the right tools to get the job done effectively," he adds.

Having joined NAES in June of 2010, Brewster is leveraging his own 32 years of industry experience in plant operations, maintenance, and executive management, saying that he is definitely bullish on the wind industry. "Renewable energy is the future, and wind will take a leading role in its growth. Our deep involvement in the energy sector, our ability to leverage our skill sets—all of which support one another—give us an ideal platform for continued growth and success."

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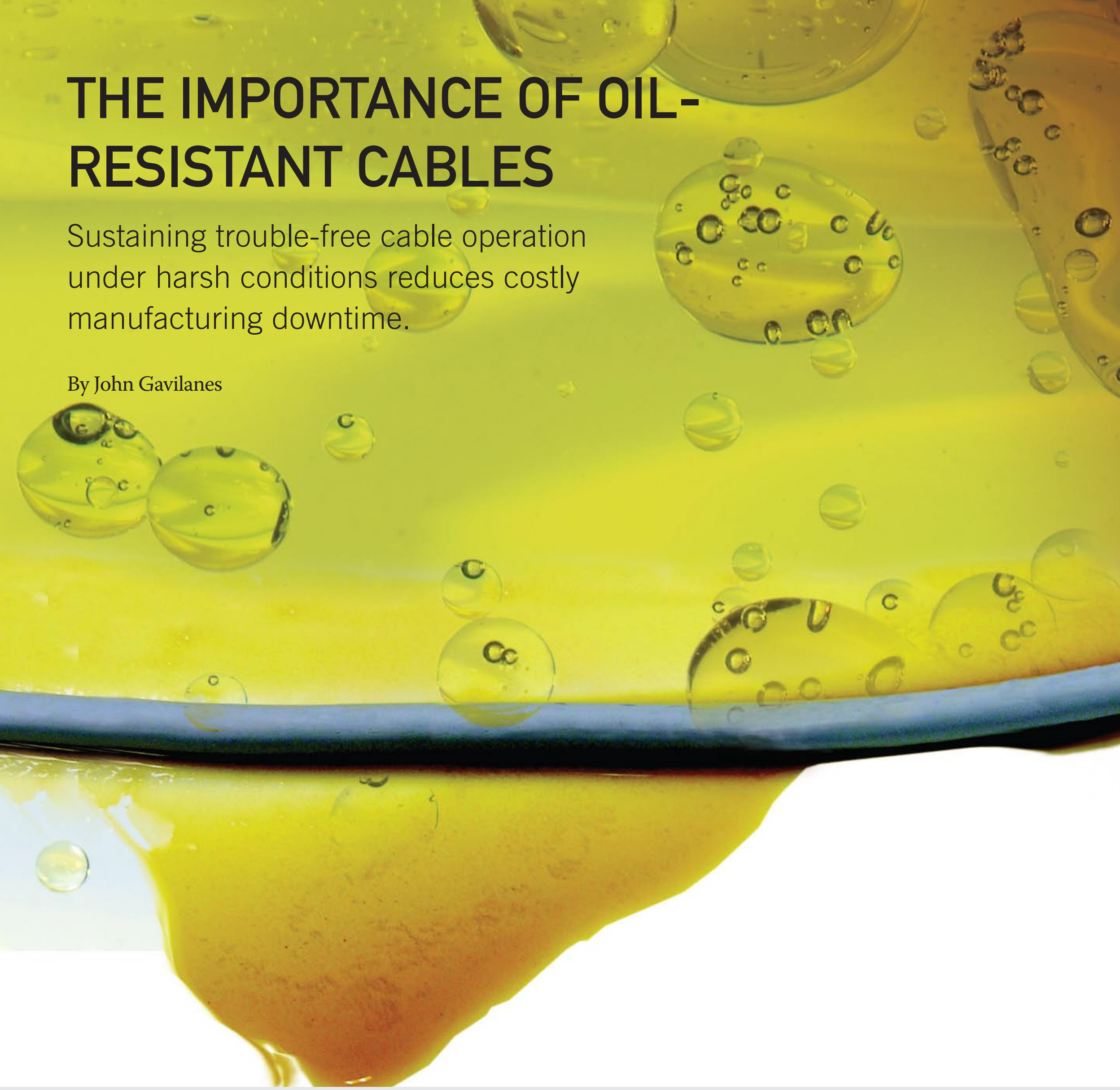
THE IMPORTANCE OF OIL-RESISTANT CABLES

Sustaining trouble-free cable operation under harsh conditions reduces costly manufacturing downtime.

By John Gavilanes



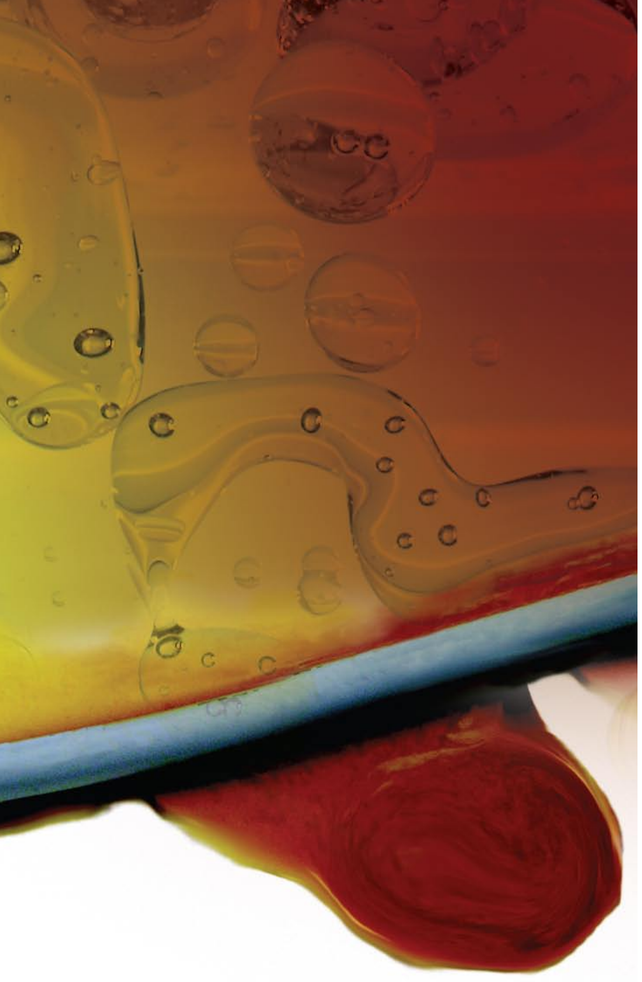
John Gavilanes is director of engineering at the Lapp Group North America.
Go online to www.lappusa.com.

THE DEMANDS OF THE INDUSTRIAL environment are ongoing, with ever-changing trends. Cables that were able to sustain functional and operational integrity a decade ago would not be adequate to survive in the environment of a presentday manufacturing site. Everywhere from the renewable energy industry and automotive assembly plants to the factories that manufacture small office machines, and even in some commercial buildings, the oil resistance of cables has become increasingly important.

Oils serve a dual-purpose role in industrial applications, both as a coolant and lubricant, depending upon the requirements mandated by the end use application. Sustaining trouble-free cable operation under harsh chemical and environmental conditions reduces costly manufacturing downtime and helps to eliminate or minimize periodic maintenance and costly cable replacement. All of the factors mentioned play a major role that is critical to a consistent, smoothly run manufacturing operation, which in the end results in higher profit margins.

REGULATORY AND CODE CHANGES

With the changes to the National Electrical Code (NEC) in the past 10 years, protective conduit or raceway is no longer required when running an exposed run (-ER) cable



from the tray to the equipment or device. Previously, when the cable was extended from tray to machine, conduit or raceway was used primarily as a protection mechanism in helping to prevent cable damage. Originally TC-ER cable (previously printed "open wiring") had a length limitation of 50 feet from the tray to the equipment. The 50 foot allowances resolved a large "grey" area in the industrial environment and was initially a well-received solution by the industry.

Due to the overwhelming acceptance of the 50-foot length allowance, the NEC committee enacted further changes shortly thereafter, permitting unlimited length of TC-ER under Article 336. With the advent of unlimited length, Article 336 also brought other issues, like a greater area of cable exposure and susceptibility to the surrounding industrial environment. Under the typical conditions of operation, consideration for factors such as ambient temperature, a cables' mechanical strength, unintended movement, and constant exposure to industrial lubricating and coolant oils must be taken into account. When exposed to these conditions the cable inevitably will begin to deteriorate; the overall jacket may swell and/or crack, creating a potentially hazardous condition, along with machine and production downtime. These possible problems are undesirable and necessitate the need to implement cable protection measures.

When referring to NFPA 79, the electrical standard for industrial machinery, Machine Tool Wire (MTW) is one type of cable permitted. Under the standard for machine tool wire, UL 1063 passing the Oil Res I test is required, and further severe testing such as the Oil Res II is optional. Environmental resistance tests, such as those per UL Standards were implemented in response to the globalization of industry with the goal of standardizing the oil resistance requirements of cables used in manufacturing industrial machinery throughout the world.

PURPOSE AND APPLICATION

Why does oil cause such excessive damage on certain types of insulations and jackets, and how does this occur? All compounds are not the same. For example, certain types of PVC have a higher degree of flame resistance while others have better oil resistance, and some demonstrate improved flexibility characteristics. PVC formulations vary greatly depending on the desired properties and applications. These properties can be achieved by adjusting the formulations of a particular PVC compound. The modification or addition of flame retardants (iodine), stabilizers, and fillers allow the compound to exhibit these types of enhanced characteristics. However, when certain PVC characteristics are improved, the enhancement sometimes comes at a cost, with the cost being that other performance traits are affected or completely lost.

The specific application will determine if oil is used as a lubricant and/or coolant. Acting as a lubricant, oil would be applied to a gear system driven by motors to prevent premature wear down and insure smooth operation. Acting as a coolant, oil is applied during the machine lathing process to keep metal from becoming too hot. In the field cables can be exposed to oil in a wind turbine nacelle where oil is used in the gearbox. Cables that lay in the floor of the nacelle are subjected to oil that is unavoidably spilled. These cables are then exposed to oil for very long periods of time, along with other extreme high and low temperatures, causing the lower quality jacket compounds of a cable to crack. There are many factors involved regarding how oil will attack wire and cable such as exposure, ambient temperature, and also possible continued immersion. In general, increases in the amount of exposure, the frequency and the ambient temperature, the faster oil will

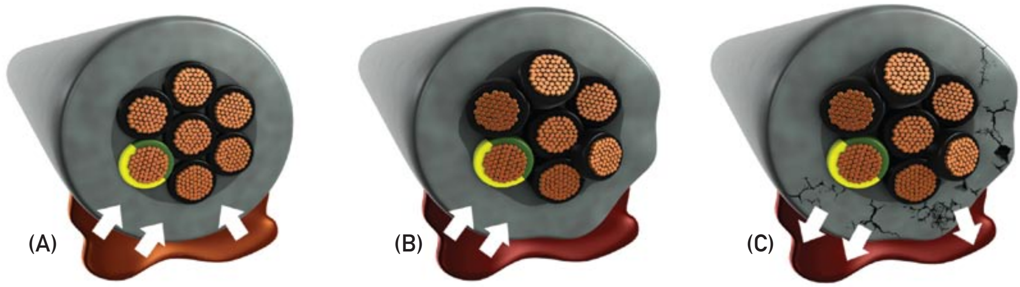


Fig. 1: When process oils come in contact with PVC & Polyolefin compounds, the process oils are attracted to the plasticizers in the cable (A). The oils can be absorbed by a Polyolefin material resulting in swelling and weakening of the cable jacket (B). The oils can extract the plasticizers from PVC materials making the cable jacket hard and lead to failures. (C)

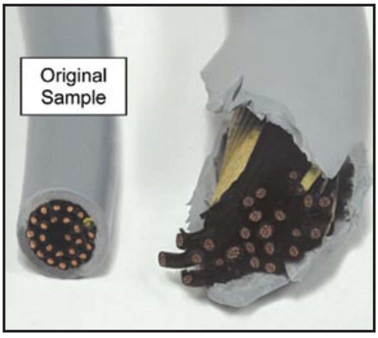


Fig. 2: Cracking – Caused during exposure of the PVC to oil or other chemicals due the complete removal of plasticizers, resulting in hardening and eventual cracking of the insulation and jacket.

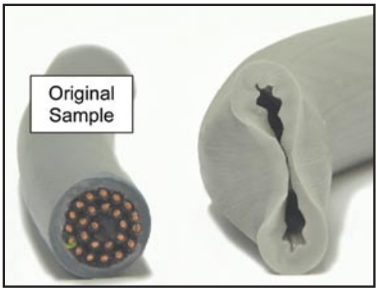


Fig. 3: Melting – Caused during exposure of the PVC to oil or other chemicals due to the absorption and combination with the plasticizer, resulting in softening and the high elasticity noted in the compound.

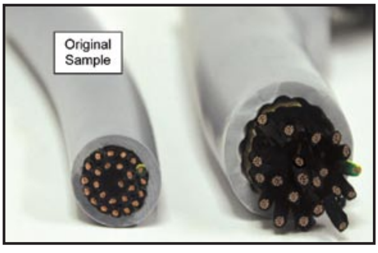


Fig. 4: Swelling – Caused during exposure of the PVC to oil or other chemicals due to migration of the oils into the plasticizer, resulting in noticeable increases in insulation and jacket diameter.

Fig. 5: Discoloring – Caused during the exposure of the PVC to oil or other chemicals due to the diffusion of the plasticizers along with colorant from the insulation and jacket.

start the deterioration process. In short, oil attacks the insulating compound, where it will become virtually ineffective in its primary role as an effective insulator. This action can create a possibly very hazardous situation, and not only to human life, but also to the overall function of the industrial machinery to which it is connected. This results in very expensive downtime, costly repair, and in the worst-case scenario, entire replacement of the machine.

WHAT HAPPENS

All wire and cable insulations are not created equal. Electrical, environmental, mechanical, and chemical attributes will vary depending upon the individual compound formulations. Insulating compounds contain a specific amount of plasticizers in their individual formulations, which help promote flexibility and resistance to fatigue. When compounds are exposed to lubricating and coolant processing oils, the material either absorbs the oil or the plasticizer will diffuse from the compound. When oil is absorbed it causes severe swelling and softening of the compound resulting in degradation of tensile properties. When the oil causes diffusion of the compound plasticizer, hardening will result,

Name	Method	UL Requirement
UL 62	Oil Immersion for 7 Days @ 60°C	75% retention of unaged tensile and elongation
UL Oil Res I	Oil Immersion for 4 Days @ 100°C	50% retention of unaged tensile and elongation
UL Oil Res II	Oil Immersion for 60 Days @ 75°C	65% retention of unaged tensile and elongation
UL AWM 21098	Oil Immersion for 60 Days @ 80°C	65% retention of unaged tensile and elongation

Table 1: Industry oil exposure tests.

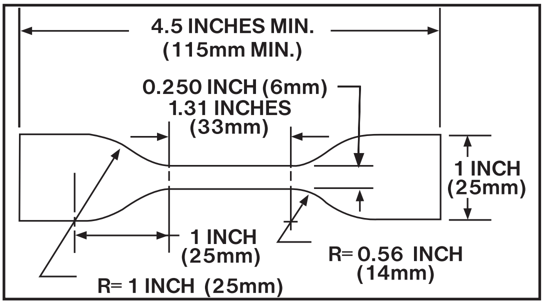


Fig 6: die-cut specimen.

and all flexibility and elongation properties are lost. The attached pictures will illustrate the effects that oil can inflict on cable jackets and insulation.

These pictures verify that the damage caused by oil exposure is irreversible and creates hazardous conditions. Now, in addition to cable replacement costs, there is also the expense ofreinstallation to be taken into account. To avoid these types of unwanted scenarios the customer must review the properties of the cables they are about to consider for their application and determine suitability for the oil environment. There are UL tests that help determine how a cable will react in the industrial oil environment. These tests are more commonly referred to as the Oil Res I and Oil Res II tests, which involve continuous immersion of the cable samples in IRM 902 at elevated temperatures for a specified period of time. Passing results are determined by the evaluation of mechanical properties and observations of physical damage caused by the oil exposure. In 2000, Lapp as an innovator and leader approached UL about creating tougher standards, which resulted in the creation of AWM style 21098. Table I indicates the industry standard tests that are used to evaluate wire and cable oil exposure performance.

EXAMPLE OF TENSILE AND ELONGATION TEST METHODS

Let us assume, for example, that the cable jacket of your product is going to be tested for compliance to UL Oil Res II. Tensile and elongation tests must be performed both on the original (unaged) and oil immersed (aged) test samples

Sample	Tensile Strength (PSI)	Elongation (%)	Tensile Retention (%) Pass / Fail	Elongation Retention (%) Pass / Fail
Original	3698	167	--------	--------
Aged	3625	129	98 / Pass	77 / Pass

Table 2: Oil Res II test results.

and must be prepared as defined under UL Standard 2556. Die cut dumbbell specimens are taken from the jacket and are then tested for tensile strength and elongation. As for sample preparation, two marks are applied approximately 1.3 inches apart from each other and equidistant from the center of the dumbbell sample (see Fig 6). These marks are applied at right angles to the direction of the pull in the testing apparatus. The sample is then clamped on the tester with one-inch marks outside of and between the grips. The grips are then separated at the rate of 20 inches per minute until the sample breaks. Results are then recorded for elongation and pound force breakage; tensile strength is calculated by dividing the pound force by the cross sectional area of the specimen.

Untested die cut samples are aged under the UL Oil Res II requirement of 75°C for 60 days. After 60 days, the samples are removed from the oil for a minimum of 16 hours. They are then tested for tensile and elongation, which must retain 65 percent of the unaged values. You will find an example for an Oil Res II test accompanying this article.

CONCLUSION

The oil resistance of cables has now become a critical performance parameter when electrical contractors, engineers, and installers specify cables for end use application designs. The continued growing popularity of oil resistance requirements is due to changes in standard regulations and the increased performance characteristics

65% of the original tensile and elongation values
65% (3698 Psi) = 2404 Psi, min. 65% (167%) = 109%, min.

Unaged Tensile Strength:	3698 Psi
Aged Tensile Strength:	3625 Psi
Percent Retention:	$\frac{3625\ \text{Psi}}{3698\ \text{Psi}} \times 100 = 98\%$
Unaged Elongation:	167%
Aged Elongation:	129%
Percent Retention:	$\frac{129\%}{167\%} \times 100 = 77\%$

Table 3: Oil Res II test requirement.

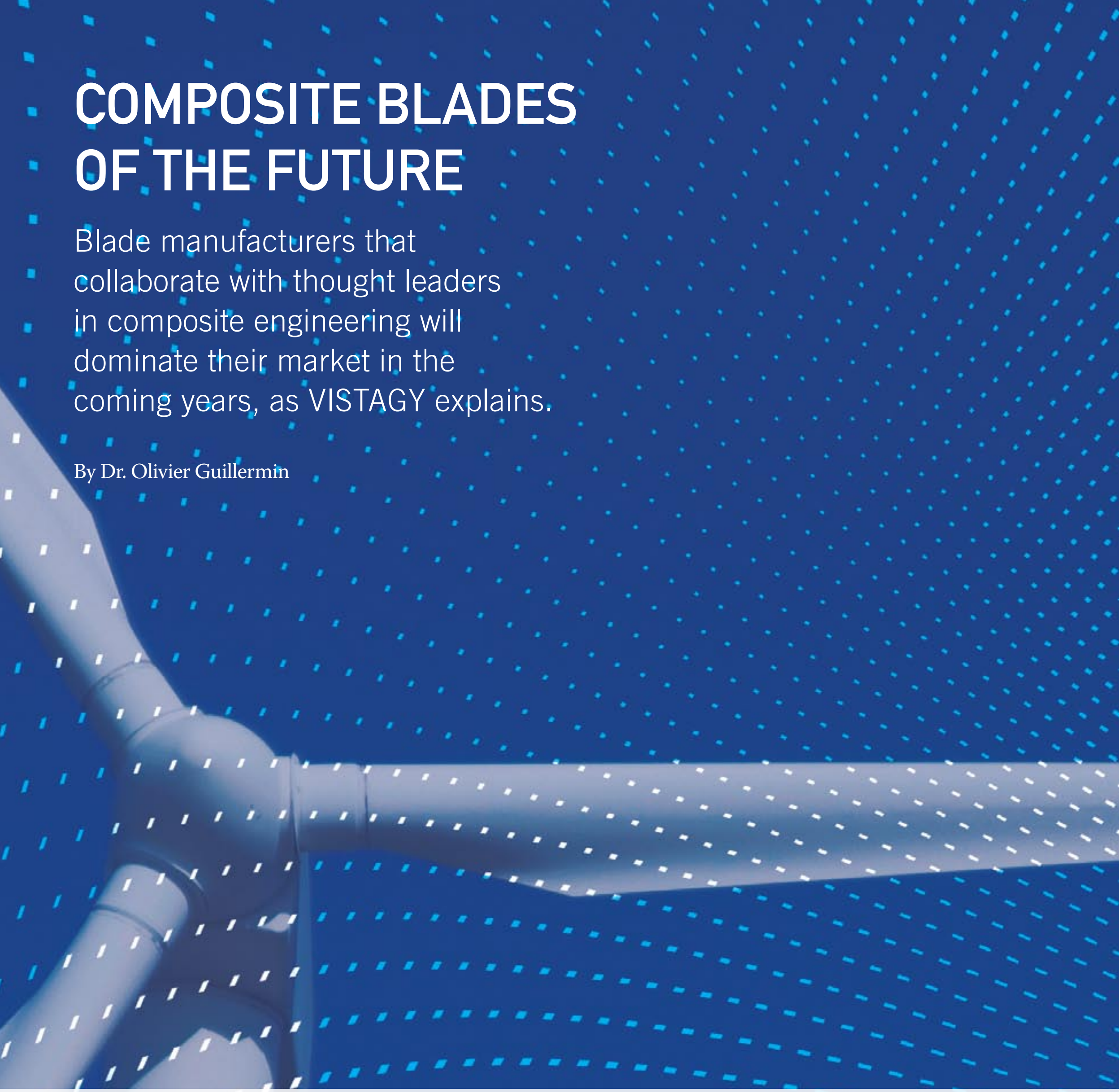
that are mandated by certain industries: renewable energy, automotive assembly plants, and other production facilities. As time moves forward superior oil resistant cables will become standard rather than the exception, and the demand for this type of operating performance will only continue to grow.

The Lapp Group has established a laboratory in the United States that is devoted entirely to the testing, research, and development of wire and cable. Brand new state of the art equipment provides the highest degree of accuracy and insures that all tests performed are compliant with the rigid performance requirements mandated by UL Standards. The laboratory has attained acceptance to the UL Client Test Data Program. This is a milestone that is unique in the wire and cable industry.

COMPOSITE BLADES OF THE FUTURE

Blade manufacturers that collaborate with thought leaders in composite engineering will dominate their market in the coming years, as VISTAGY explains.

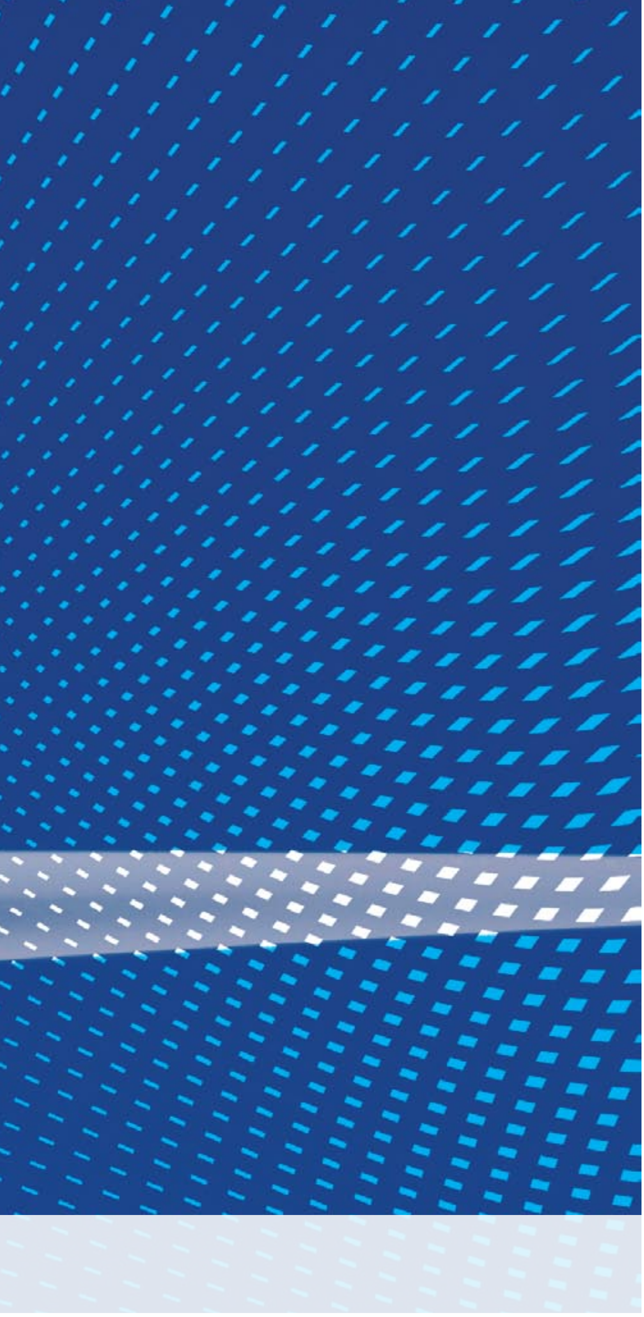
By Dr. Olivier Guillermin



Dr. Olivier Guillermin is director of product and market strategy at VISTAGY, Inc. Go online to www.vistagy.com.

IF YOU ASK A WIND TURBINE BLADE manufacturer what he or she is most concerned about, they will tell you without hesitation that it is getting to market faster. The vast majority of firms are expressing the need to produce more blades in less time. They are setting the bar very high, in fact, seeking to produce blades sometimes two to three times faster than is now the case.

Indeed, current engineering and manufacturing processes typically entail numerous manual steps, including the creation of technical drawings based on sketches and paper-based data. Multiple verbal interactions between stress analysts, designers, and manufacturing engineers also occur, requiring meetings, phone calls, and even trips. Cutting with scissors and kitting of the hundreds or thousands of composite plies and pieces of core that go into a blade is also required, as are manual layup operations using human labor at high costs and long cycles, and there are many untracked corrective actions coming in the form of last-minute decisions taken on the factory floor. As a consequence, what is manufactured is often different from what is designed or analyzed. Worse yet, many changes



are typically not documented so that everyone concerned can appreciate their impact and cost.

Further, the blade development process also ends up being quite disconnected between design, stress, and manufacturing engineering as well as tooling and production methods and processes. That's because different tools and software may be used, and information does not flow freely and easily between disciplines and geographical locations.

TRIMMING COSTS

In today's competitive environment, it is incumbent on wind blade manufacturing companies to reduce engineering and production costs, the number of prototypes and pre-production units, labor costs and material waste, and the length of engineering and production cycles. Manufacturers also need to maintain better control of blade quality. A more repeatable manufacturing process leads to easier control of laminate quality and detection of recurring defects. By adhering to a more cohesive approach, better quality is achieved and results in less downtime in the field and premature blade failures. Those failures are extremely detrimental to the company's bottom line and image. Ultimately, the goal is to reduce the total cost of blade ownership.

Finally, manufacturing companies must support continuous improvement of their blade and turbine performances. Lighter blades are needed in order to continue extending the size of wind turbines and to offer added yield. More customization is demanded to adjust and optimize the turbines to wind and site profiles. New designs are investigated to further modularize blade construction and offer variants at lower cost. Here the composite design environment must enable the engineer to easily and quickly explore more complex designs without incurring undue costs of time and money.

DESIGNING FOR MANUFACTURING

Designing composite parts requires unique expertise. For instance, in contrast to the metal industry, composite designers and stress engineers have both the ability and the burden to actually "design the material." We can choose any arrangement of fibers and resins, weave or stitch architecture, tow size, fiber directions, and sequences. Ply shapes and many other parameters enter into the making of the final part from the various elementary constituents.

Then we can choose from a number of manufacturing processes and variants, both old and new. More and more, robots are replacing—or are being considered to replace—manual operations. This will create a more repeatable process that will result in time and cost savings. But the challenge is in the details, and there are many on the spot decisions currently made by layup experts that a machine will not make unless told to do so by some built-in intelligence that understands the design intent in all of its complexity.

So in order to draw all the possible benefits from the use of composite materials, we must be able to design the part specifically for the selected manufacturing process. We must be able to account for the limitations, as well as all the capabilities of the tools that we have decided to use to make the part. And the design must also accommodate the pre-

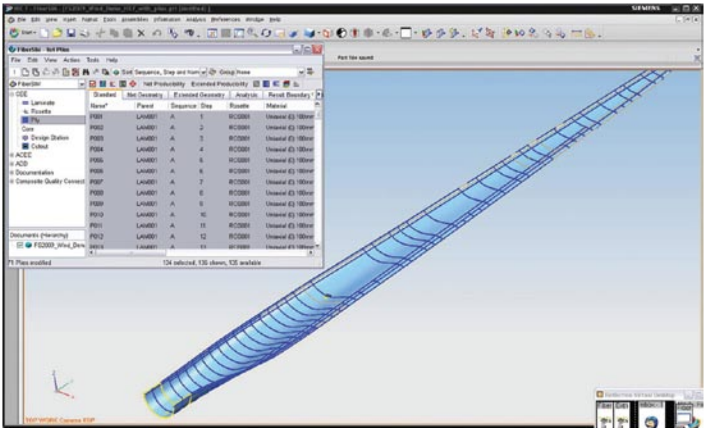


Fig. 1: VISTAGY's FiberSIM composites engineering software pictured running within the Siemens PLM NX CAD system.

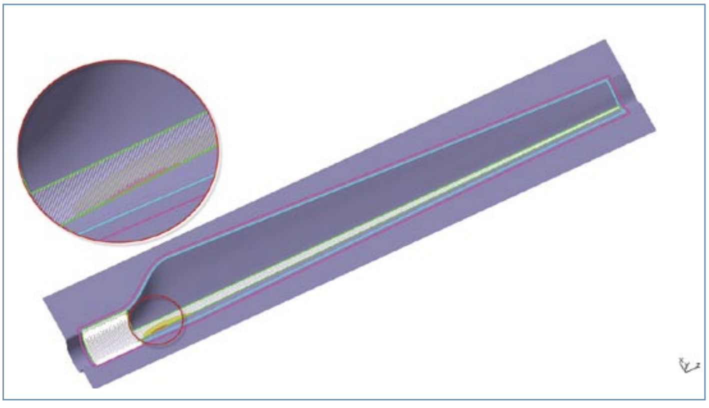


Fig. 2: FiberSIM predicts areas of manufacturing concerns on a composite blade. Compound surface curvature induces wrinkling and bridging in the material, shown in yellow and red, as it is laid up inside the mold.

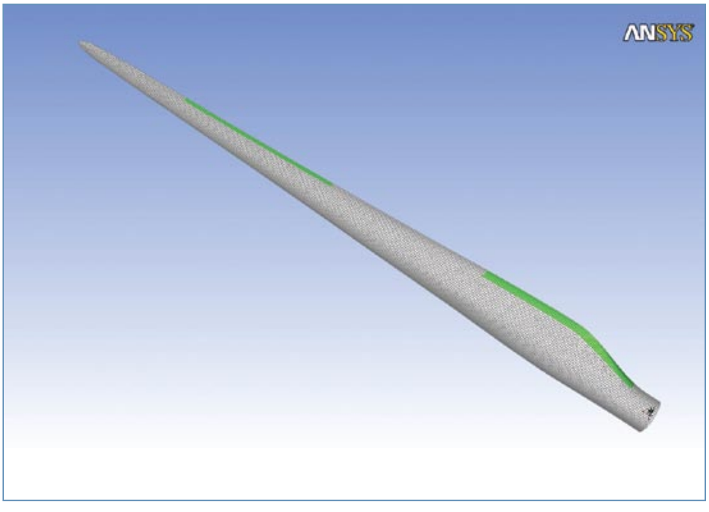


Fig. 3: Shown is a ply definition that has been automatically transferred from the FiberSIM model to the Ansys finite element analysis (FEA) model.

cise interfaces between components and mating parts.

One often-overlooked aspect of advanced composite engineering is what can be referred to as "the cascading impact of design changes." With composite assemblies made of thousands of pieces of plies and cores, one single design change will typically affect tens or hundreds of parameters in the design. This must be understood and managed during the design cycle. It is well known that designers and stress analysts spend a majority of their time making changes; it is such an expected part of the process that they don't even think of it as the burden even though it impedes the entire development process. Understanding and predicting the impact of design changes is one of the major benefits brought about by modern composite design software.

Composite engineering software has been around for at least 15 years, but it has borrowed surprisingly little from the metal industry. The fact is that composite parts are made from fabric or fiber tows impregnated with resin, which from a design and manufacturing process standpoint is light years away from any process found in metallurgy. For the most part, specialized software tools developed for metal manufacturing have little applicability to composites. By and large the composites industry has had to devise its own specialized software for design, analysis, and manufacturing.

EXAMPLES FROM AEROSPACE

The aerospace and defense industries were early adopters of advanced high performance composites, so it is no surprise that the bulk of the expertise is owned by people who have worked in those industries. Some of that expertise is transferable to other applications, such as wind turbines. For instance, the preliminary design methodologies used to develop aircraft wings and fairings are similar to the process for developing blades. Similarities also exist in the areas of:

- Detailed ply layup definition developed for complex laminates;
- Producibility simulations developed for a large spectrum of fiber and resin combinations;
- Automated exchange of accurate composite definition between design and stress analysis;
- Automated creation of ply books, technical drawings and manufacturing instructions;
- Automated creation of manufacturing data, including for cutting, positioning, and automated layup.

However, it is important to note that the wind energy industry is by no means a carbon copy of aerospace and defense. The wind industry presents some major differences in terms of part size, material types, layup processes, and design approach. For example, a large variety of multi-axial and multi-layered matte/woven/uni materials are used on wind blades. Some ply draping and covering techniques are more pertinent to composite blade design, such as the extensive use of 2D-to-3D mapping of rolls of material, as opposed to aerospace where most plies, which are much smaller, are defined in 3D and then flattened for cutting.

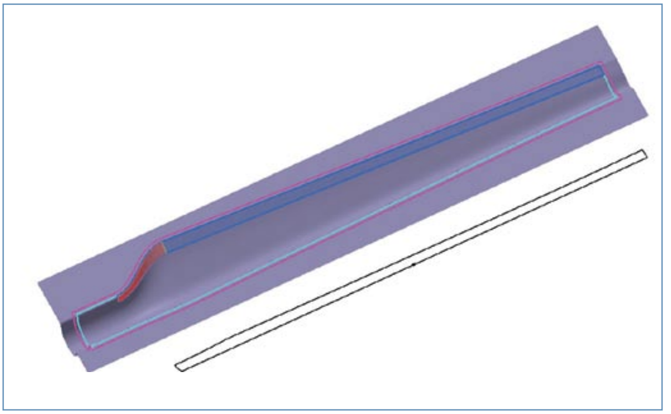
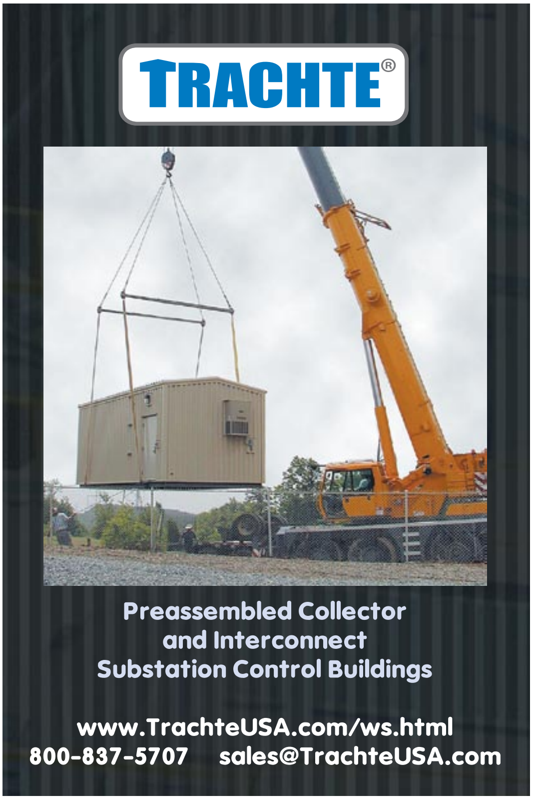


Fig. 4: Accurate flat patterns ensure that the blade will be lighter and more durable. Flattening is based on the simulation performed by FiberSIM.

At the end of the day, most wind blade manufacturers are currently looking for the right partners to develop their new processes and tools for composites. These partners can share knowledge from other industries and use that expertise to ac-



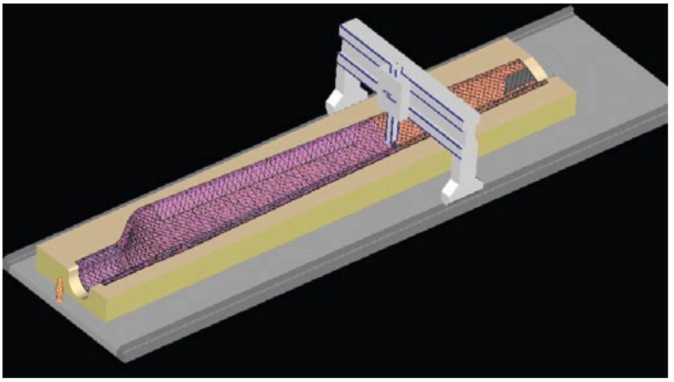


Fig. 5: Shown here, FiberSIM ply data is transferred to CGTech's Vericut software for manufacturing process simulation.

commodate the unique challenges of wind blade design as well as rapidly adapt the existing methods and processes or develop new ones.

FLEXIBLE ENVIRONMENT

In order to support their new advanced composite engineering and manufacturing processes, wind blade manufacturers must look beyond just acquiring a collection of point solutions. What companies are really looking for is to create an open and flexible Product Lifecycle Management (PLM) environment with the best in class assets that can maximize efficiency and effectiveness.

Indeed, implementing a PLM-integrated composite design, analysis, and manufacturing methodology is a must if you want to develop a better and faster engineering process. The PLM environment must be open and flexible so that engineers can easily and rapidly adapt to the needs of the wind turbine industry, as well as specific customer requirements. It must also allow the company to select the best software components, be it the CAD platform for design, the CAE solution for analysis, CAM software for manufacturing, or a PDM system for data management.

The fact is wind firms are finding that efficiency, profitability, and optimization are most readily attained by working within a flexible environment that is comprised of best in class solutions as opposed to a rigid, one-stop vendor solution. The problem with an inflexible, single-vendor solution is that typically it will not only fail to provide the best elements, it will also end up being more expensive to purchase and maintain. In the end, such a setup is more convenient and effective for the vendor than the customer, and that fact should not give potential customers a good feeling.

As the linchpin of the PLM environment, the composite design software must support a diversified CAD and CAE base. It must also account for easy and reliable data transfer across the supply chain and different engineering sites that may use different CAD, CAE, CAM, and PDM platforms.

COMPOSITE SOFTWARE ADVANTAGE

There are many benefits to adopting an open and flexible design environment anchored around best in class composite engineering software, including:

- Single, complete, and detailed master model of the blade;
- Streamlined end to end process for moving from conceptual design to manufacturing;
- Automated creation of geometric and composites data;
- Integrated design and analysis loop for faster structural optimization and more accurate design validation;
- Design-based simulation of the manufacturing process;
- Direct link from design to the manufacturing floor;
- Design for manufacturing process (DFM) approach;
- Support for manufacturing aids and future robotic systems;
- Reliable and rapid engineering change management process.

By putting a composite design environment in place and taking advantage of the above mentioned features, users typically reduce prototyping costs, cut material waste, ensure a quality design process, and enjoy the enhanced accuracy that results from a having a repeatable manufacturing process.

LEVERAGING COMPOSITES EXPERTISE

As recently as two years ago there were only a few composite wind turbine blade manufacturers that were truly focused on improving their engineering processes. Now it is a hot topic for most of these companies, especially the top global players. In fact, VISTAGY has seen a tremendous uptick in interest in composite design software among the leading companies in the wind blade industry; indeed, a number are reengineering their processes around our FiberSIM® composites engineering software. These firms tell us that being able to draw on our nearly two decades of experience developing software and services for composites was a big consideration in how they decided to move forward.

Given the inherent challenges of working with composites, it is our belief that the wind turbine blade firms that collaborate with thought leaders who possess extensive and hard-won composite engineering software experience are the ones that will achieve dominance in the years to come.

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HYBRID WIND TURBINE INTEGRATION

What does a remote Alaskan village do when it's completely off the grid and can't afford to transport fuel? Marsh Creek's answer was to design a unique wind-diesel power system.

By Gina Heath

Gina Heath is office/marketing manager at Marsh Creek, LLC. Call (907) 258-0050 or go to www.marshcreekllc.com.

THE RAIL BELT STRETCHES FROM THE SOUTH in Seward all the way north to Fairbanks, Alaska's second-largest city in the center of the state. The remote communities—otherwise known as "villages," which are situated along the rail belt corridor—are able to tap into the existing power infrastructure for electric service to power individual residences and public facilities. The Southwest Alaska community of Kokhanok, like most villages in the state, is a beautiful and remote settlement of just under 200 people located on the south side of Lake Iliamna, within the Lake and Peninsula Borough. Kokhanok is not in close proximity to the rail belt, and villages such as these that are completely off the grid must maintain their own infrastructure for power generation. The challenge involved finding a realistic way to make this happen.

CENTRALIZED POWER GENERATION

Because electricity in remote Alaskan villages usually costs six to eight times more than it does in villages along the rail belt, the State of Alaska tasked the Alaska Energy Authority with implementing the PCE (Power Cost Equalization) pro-

Fig. 1: A map showing the location of the Alaskan village of Kokhanok.

gram to assist remote communities with meeting their power generation needs. In its literature the authority writes that "PCE fundamentally improves Alaska's standard of living by helping small rural areas maintain the availability of communications and the operation of basic infrastructure and systems, including water and sewer, incinerators, heat and light. PCE is a core element underlying the financial viability of centralized power generation in rural communities."

In order to assist residential village customers in offsetting costs, the PCE program requires communities to provide monthly and annual reporting to remain in compliance with state regulations. Kokhanok's village utility clerks were diligent and accurate in their reporting, so in an effort to ensure uniform and regular payment schedules "Ampy" prepay meters were installed in residences to ensure collections. These units also assisted community members in learning how to conserve energy and lower their individual usage. The Ampy meters eliminated disconnect and reconnect fees, allowed those customers with overdue balances to restore their service with PCE, and provided the utility with consistent collections.

Luckily, the village's power plant already possessed properly sized and loaded diesel gensets, and the utility's operating procedures demonstrated a history of consistent documented maintenance practices that maximized their fuel savings. This standard of excellence set the stage for a wind-diesel hybrid project, which can only succeed with a well-maintained diesel plant and a well-managed electric utility.

INTEGRATED ENERGY

The village electric utility currently operates a diesel power plant with a total installed capacity rating of 490 kW with a peak operating load of approximately 110 kW. The Lake and Peninsula Borough (LPB) considered their ever-present wind as a viable source for alternative energy. The subsequent Alaska Energy Authority study of 2006 showed that Kokhanok has a Class 6 wind resource with negligible turbulence, no adverse avian issues, and no other permitting problems.

Transporting diesel fuel from Anchorage or Seattle to the village of Kokhanok is an expensive logistical challenge. Fuel must be barged to the village, preferably up the Kvichak River. When that route is unavailable due to low water levels, fuel must be traversed from Anchorage or Seattle to Williams Port, transferred to trucks and driven over the mountains, then transferred to a barge for shipment across Lake Iliamna for delivery to Kokhanok. When the fuel barge could not navigate the Kvichak River in the fall of 2008, fuel had to be flown into the community at $7.20 per gallon for an entire year. In 2008 the Kokhanok Electric Utility was forced to charge residents $.90/kWh for power in order to cover their cost to produce power.

In July of 2009 the village and the LBP committed to integrate wind energy with diesel power to provide a local renewable low-cost energy resource for the community. Marsh Creek, LLC, was awarded the engineering, procurement, and construction contract on July 11, 2009, for a high penetration wind-diesel system with coincident thermal energy production; the first of its kind in Alaska. "High penetration" means that diesel generators may be shut down during high wind availability, that auxiliary components are required to regulate voltage and frequency, and that a sophisticated control system is required. Peak instantaneous penetration is 100-400 percent, while the annual average is 50-150 percent.

"Kokhanok Village, as with many villages, faces uncertain times when it comes to the future of electrical power production and heating due to high fuel prices," according to Nathan Hill, village administrator. "Installing a high penetration wind-diesel system will help us stabilize these costs, thus making village life as we know it more sustainable. We are looking forward to working with Marsh Creek as we build capacity to operate our new system and of course reap the benefits of a more predictable and sustainable source of energy."

OFFSETTING TRADITIONAL SOURCES

Construction began on the $1.94-million project in May 2010 and was completed on time and on budget in October 2010. Included in the project were two reconditioned Vestas V-17 turbines rated at 90kW each on 85' lattice towers with 56' rotors, and 180 kW of connected wind capacity. The 1991 turbines were remanufactured by Halus Power Systems in 2010.

Fig. 2: The two Vestas V-17 turbines rated at 90kW each on 85' lattice towers with 56' rotors, and 180 kW of connected wind capacity were remanufactured by Halus Power Systems.

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Fig. 3: Village Elders Francine Andrew and Annie Mike attended the ribbon cutting ceremony in October of 2010 to celebrate their new wind tutrbines.

A synchronous condenser and grid forming inverter were installed, along with 336 kWh of nominal battery storage. As of February 2011, the refurbished Vestas wind turbines were fully operational, as they remain today.

The system stores excess energy to the battery bank for use during non-wind times. Additionally, the excess electricity from the wind turbines heats up water and feeds it to the existing jacket water heat recovery system and into the local school's recirculation system. The hybrid system is expected to displace half of the village's previous annual fuel consumption.

The Hybrid Wind Turbine Integration Project also included a substantial power plant controls upgrade, a remote operations monitoring and control system, and wind system operator training. The advanced supervisory control and data acquisition (SCADA) system allows engineers in Anchorage to view wind turbine production and to manipulate the parameters of the controls via a computer connection. The SCADA system monitors and gathers information and relays it back to the central site in Anchorage. It displays information in a clear and logical fashion and creates an instant alert if there is a problem. Remote monitoring, and the ability to manipulate the system operations from Anchorage, provides the community's local operators with a measure of confidence in their ability to manage the system with advice from engineers available at a moment's notice. It also saves travel expenses, making the project possible.

This unique hybrid system, with an installed wind capacity of 180 kW, has the potential to offset the traditional diesel power plant production by 19,297 gallons of fuel, or 51 percent, potentially saving the village over $110,000 in fuel costs annually.

"We normally burn upwards of 141 gallons of fuel in a 24 hour period," says John Mike, power plant operator. "When the wind is blowing and the turbines are operating, we only burn about 70 gallons, or half the amount of fuel we usually do. When the computer controls are fully operational this coming July the system will be completely automatic, making our lives a lot easier."

Villagers and project team members attended the ribbon cutting ceremony in October of 2010 to celebrate their new wind turbines. Village Elders Francine Andrew and Annie Mike were two who took advantage of the beautiful day to mark the occasion.

Fig. 4: This photo of a rainbow behind one of the village's two turbines seems to signify a brighter energy future.

On March 10, 2011, the Kokhanok Hybrid Wind Turbine Integration Project was awarded "Most Innovative Project" at the 2011 International Wind-Diesel Workshop in Girdwood, Alaska. The workshop was designed to bring the wind-diesel community together to share the status of current technology, discuss applications that work and those that do not, and to shed light on areas for improvement. Following the workshop, approximately 17 attendees boarded planes and flew from Girdwood to Kokhanok for an on-site tour of the wind turbines. Commissioning activities were completed shortly thereafter.

PROJECT SUMMARY

With this successful project completed on time and on budget, Marsh Creek will enter into a five-year maintenance and training agreement with the village, which is a key element in the program. This long-term commitment of training, operation, and maintenance between the village and Marsh Creek will ensure continuity of maintenance provided by professionals, and it is a critical component for both parties. The agreement will also ensure that the village remains current on training with Marsh Creek's professional staff.

OPTIMIZING OFFSHORE EFFICIENCY

Offshore wind presents opportunities for those with the ability to harness it, and turbine reliability is more critical than ever. The Switch offers two ways forward.

By Jussi Vanhanen

Jussi Vanhanen is director of sales and marketing at The Switch. Go online to www.theswitch.com.

UNTIL NOW, THE WIND POWER INDUSTRY has been moving forward at a relatively steady climb. The onshore industry is powered today primarily by two types of drive train technologies: one based on double-fed induction generators, and the other based on permanent-magnet generators (PMG). Double-fed induction generators have been a good choice for smaller powers in onshore installations. At less than 2MW, they prove to be competitive in price and performance. However, when moving offshore, double-fed induction generator drive trains are no longer a viable option. With extra components, slip rings, and greater losses, the risk of maintaining at sea is simply not one that wind turbine manufacturers are willing to take.

Therefore, critical components used offshore must unquestionably be more reliable than their onshore counterparts. Unscheduled maintenance is extremely difficult, and even though offshore winds are in fact more consistent, wind turbines must be able to withstand powerful storms, corrosive elements, and turbulent atmospheric conditions.

The drive train and all other critical components

must have an exceptional track record onshore before they have a chance to be considered for the much more challenging offshore application.

THE NEXT FRONTIER

At the same time that offshore is gaining momentum, wind farm owners and utilities are moving toward higher powers with onshore installations. The 3MW range of wind turbines are quickly taking over as the new mainstream power for onshore. For these new wind turbines, the obvious choice is PMG. That is because PMG offers superior energy output, even at partial loads. Furthermore, PMG guarantees proven reliability in highly volatile wind conditions and better quality energy for the grid. Therefore, most of the major wind turbine manufacturers have now switched over to this next-generation drive train technology.

Other new trends that are emerging in the 3MW onshore range are that turbines are featuring bigger rotors and longer blades to be able to capture more energy from winds at low speeds. Here, too, PMG is ideal. Permanent magnet generators come in a range of speeds—low, medium, and high—with each filling a specific need when it comes to the environmental and wind conditions in question at the actual site of installation. Offshore is now showing more encouraging signs of taking off in a big way, with new projects getting green lights in different parts of the world. Many believe—as we do at The Switch—that offshore wind generation will be the next new frontier.

A few European countries such as the U.K., Germany, Belgium, and Denmark are leading the growth. Other European countries are currently struggling to obtain permits while the United States, although enthusiastic, is still wrestling to get the financial backing required. Another trend is the increase in power classes, from multi-megawatt to offshore-class turbines of 6MW through 8MW, and even up to 10MW of power generating capability. The technology for these super-power offshore turbines already exists, in fact.

OFFSHORE ELECTRICAL DRIVE TRAINS

As far as we have seen at The Switch, it is extremely difficult to deploy turbines with a double-fed induction generator for offshore use. We already have had success with our 4MW direct-drive PMG and full-power converter packages now operating in some of the gustiest coastline conditions in Norway. The Switch has been focusing on providing optimized PMG and full-power converter packages since the company's start in 2006. Today it has 5GW of installed capacity throughout the world in all kinds of challenging operating conditions.

As we currently prepare our concepts for optimized 6MW and 8MW offshore-class packages, we're planning to take two paths ahead. Although direct driven offers the ultimate in reliability and efficiency that is so critically needed in offshore applications, the generator alone can easily weigh up to 150 tons at these high power ratings, creating challenges with handling and overall costs. Therefore, we see that the direct-driven PMG drive train is the best option and most competitive for power ratings ranging from 1.5MW to 8MW.

For power ratings of 3MW up to 10MW, a medium-speed option may be the best bet, in his opin-

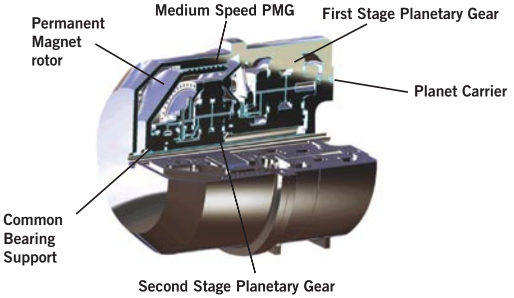


Fig. 1: FusionDrive is an integrated drive train with simple and lightweight structural design by The Switch and Moventas.

Fig. 2: The main design dimensions of the FusionDrive platform with a 400rpm generator enable ease in scalability from 3MW to offshore class.

ion, with reliability nearly as high as direct-drive drive trains. The Switch—together with another Finland-based company, Moventas—has launched a revolutionary wind power drive train called FusionDrive™, which provides an optimum balance of lighter weight and high reliability rates with its integrated gear and medium-speed drive train. FusionDrive is specifically designed for a power range from 3MW to offshore class. Additionally, the lightweight medium-speed model is compact, offering lower lifetime costs.

AN INTEGRATED SOLUTION

FusionDrive offers optimal availability by harnessing all the advantages of medium-speed wind power generation technology. It is extremely compact in size and offers the lowest weight in the market. "The lower the nacelle weight, the more cost competitive the turbine," adds Jukka Jäämaa, CEO of Moventas, one of the biggest wind gear manufacturers in the world. "Nacelle weight relates directly to both foundation and construction costs of the turbine as well as manufacturing, transport, and assembly costs in the whole supply chain."

The FusionDrive integrated solution with perfect alignment between gear stages and the generator, along with an integrated lubrication system, simplifies the nacelle structural design, which lowers

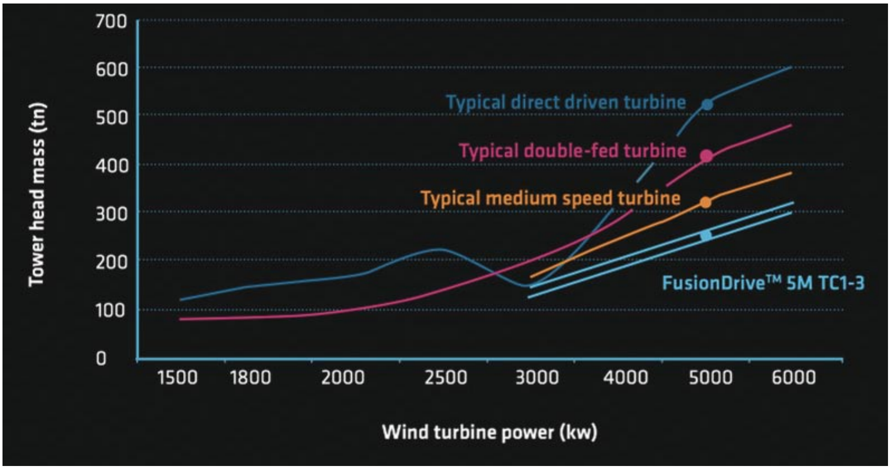


Fig. 3: When comparing various tower head weights, FusionDrive combines the components in a way to significantly simplify the structure. This leads to the lightest weight available and cost competitiveness.

the nacelle weight and improves total turbine cost effectiveness. The low number of bearings, low cogging torque, and the construction with no current passage through bearings, slip rings, or rotor windings also contribute to the proven reliability of medium-speed technology.

FusionDrive uses medium-speed wind power generation technology, as it has been proven for the highest possible availability in wind power generation. It is designed on a scalable platform that extends from 3MW to offshore class, all in an onshore size. The compact size of the complete drive train allows easier transport and assembly.

INGENIOUS FUSION

For wind park owners, reliability in practice means high availability and lower operation and maintenance costs. In addition, FusionDrive guarantees optimized efficiency, even at partial loads. Regardless of which path turbine manufacturers feel is best to go out to sea, these two paths forward will help them stay ahead of the pack.

SHAFT ALIGNMENT MADE EASY

With the proper tools and technique, the shaft alignment process can be both easy and accurate. VibrAlign shares the insights it has gained.

By Brian Shanovich

Brian Shanovich is the wind segment manager and the Midwest sales manager for VibrAlign, Inc. Visit online at www.vibralign.com.

HOW MANY OF US STRUGGLE WITH TASKS that should be easy and straightforward because we chose a tool that isn't right for the job? Have you ever tried to loosen a screw with a dime, hammer a nail with a wrench, undo a tight nut with pliers, or open a plastic container with your teeth? Pretty frustrating, and not so easy. Thinking we are saving time, taking a shortcut turns an easy job into a nightmare. We all know that if we choose the correct tool, the job is simple. The same can be said about aligning wind turbines, which is a fairly easy task with the right tool in hand. The main purpose of all advanced tools is to make the job fast, easy, and accurate. If we can take the human error out all of our daily functions then we would be less confused and frustrated, wondering where it all went wrong. Technology and innovation is supposed to make our daily lives easier, after all.

CHOOSING THE RIGHT TOOLS

There are several issues associated with wind turbine alignments that make the job more difficult than traditional shaft alignment. It starts with climbing the tower in all sorts of weather condi-

Fig. 1: The GO Wind is configured with customized mounting hardware for each OEM's turbine design.

tions; anywhere from well below zero to over 100° F, plus heights close to 300 feet. When we arrive at the top of the tower, being physically and mentally tired is a normal condition. Shaft diameters are large, so extension chains must be used. There is always the angst over the accuracy of dimensional inputs. Brake calipers are obstructing the rotation over the top, so measurements are made underneath and against normal rotation, which can induce backlash. The generator is mounted at an angle and can slide if all four feet are loose at the same time. To maintain the coupling gap tolerance at +/- 1 mm, only three feet (hold-down bolts) on the generator can be loose at a time. Generators are heavy, so we lift with hydraulics, and most sites don't have jacking bolts for the horizontal positioning. In most cases the thinnest shims used are only 0.5mm. However, we recommend taking shims from 0.1mm to meet current alignment tolerances. And finally, record-keeping has become essential so storing as found, and finished alignments are required. Now let's see how easy aligning wind turbines will be by eliminating all of these concerns.

After climbing the tower, the mental and physical condition is important. Take the time needed to make your brain and body ready for the alignment process—hydrate, clear your head, and recover your strength. First and foremost, complete all safety checks and lock out /tag outs. Then pre-alignment duties ensue, which involve taking off the coupling guard, in some cases installing a turning gear and a rotor lock, if neither are used the brake will be engaged. After pre-alignment is completed we need to mount the lasers on the gearbox brake disk and generator coupling hub. This step is extremely easy. The GO Wind and XA Wind kits by VibrAlign are configured with customized magnetic mounting hardware for each OEM's turbine design, including GE, Siemens, Gamesa, Mitsubishi, Vestas, Nordex, and Suzlon. This hardware is designed to eliminate chains and clear all obstructions. Also, the GO Wind and XA Wind alignment process and programming are the very similar, so a "re-learning" process is not required by the technicians. The following process will work in a similar fashion.

THE "VERTI-ZONTAL" COMPOUND MOVE

First step in the alignment is to check for "soft foot." We need a flat plane for all four feet so that the generator won't twist. This is done by loosening one foot at a time and seeing if there is any movement with the shims under that foot. Since the generator is heavy, use a pry bar or channel lock to see if the shims slide or move. If the shims move, try a feeler gage or precut shim to determine the amount of soft foot. General industry specifications call for no more than 0.05mm as the maximum allowable soft foot. Place the proper amount of shim under the foot to eliminate the soft foot condition. If there is no movement, tighten the bolt and repeat for each of the four feet. With the GO Wind software, just pick from the list of proper turbines and coupling styles. This will load all the correct dimensions and alignment tolerances.

Now the setup is complete and ready to take readings to evaluate the alignment condition. Ro-

Fig. 2: Pre-alignment duties involve taking off the coupling guard, and in some cases installing a turning gear and a rotor lock so brake will remain disengaged.

Fig. 3: The sensor setup is quick, easy, and accurate.

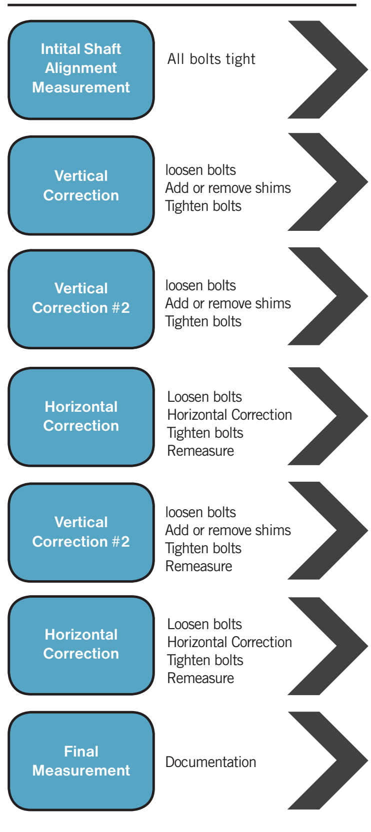


Fig. 4: A checklist for the traditional approach to performing shaft alignment duties.

tate the shafts so that the laser heads are somewhere near the 9:00 position, press OK, now rotate the shafts out of the shaded area just short of 12:00, press OK, and finally rotate to the 3:00 position and press OK. The result summary screen shows the current alignment condition, or "as found." If it's within tolerance, just save the alignment values in the GO Wind for your records; the file format is a bitmap/text file with no need for additional software.

If an adjustment is needed on the generator, a "Verti-Zontal" Compound move will be preformed. With true position sensing, the rotational center lines of each shaft relative to each other is always known at all times, no matter how much you move the generator and/or gearbox. In other words, the GO Wind knows where the generator and gearbox are sitting even when the generator is pushed, pulled, or lifted through the whole alignment. This technology allows for the vertical and horizontal move to be completed without having to re-measure, or more importantly having to loosen and tighten hold-down bolts over and over again.

Two rules about the first step in your Verti-Zontal Compound move: Always perform the vertical adjustment first. Never do the vertical adjustment live or in real-time mode, since the values will change as soon as the bolts are loosened. Because there can be only three bolts loose at any time, vertical values at the feet can jump and move around. Adjust the both back feet by the value the GO Wind displays in the summary screen, minus = too low, plus = too high. Here is where the 0.5mm shims can create a mathematical nightmare, so let's make it easy. The rule to follow is to adjust the feet so that both sets, front and back, will have the same sign, with the back feet a bit larger value than the front. An example would be if the back feet show that you are 0.8mm low (-0.8) and the front shows that you are 0.4mm high (0.4), the easiest solution would be to add 0.5mm to the back feet, making the value -0.3mm and removing 0.5mm from the front making the value -0.1. Now both sets of feet are the same sign, with both low and the back feet a bit lower than the front, and the alignment tolerances are met. However, if the proper shim variation of 0.05mm to 2.0mm are used this calculation can be eliminated.

Once we have corrected the vertical we now can complete the Verti-Zontal Compound move by selecting the correction key (shim icon) and moving the generator in a side-to-side or horizontal move. Do not tighten the bolts, since we are moving horizontally first. The GO Wind makes this simple by displaying arrows pointing in the direction you need to move. Adjust by using a jack bolt kit, and move the largest value slowly. Once in tolerance the arrows appear as arrowheads only, and the offset and angularity icons will have clear backgrounds. Now tighten the hold-down bolts in a criss-cross pattern in three passes—first snug, then tight, and now tightest. Since torque wrenches may not be used at all times, it's good practice to have the same technician loosen and tighten all four bolts.

Now measure for our final alignment condition. After the measurement is completed the summary screen will show that the alignment just completed has the correct tolerances, and the final condition can now be recorded. Save the measurement, and you are done with the alignment process. Using this Verti-Zontal Compound move process alignments now can be completed in under 30 minutes.

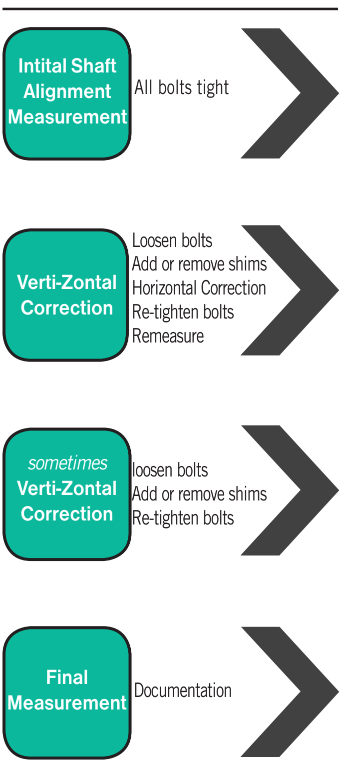
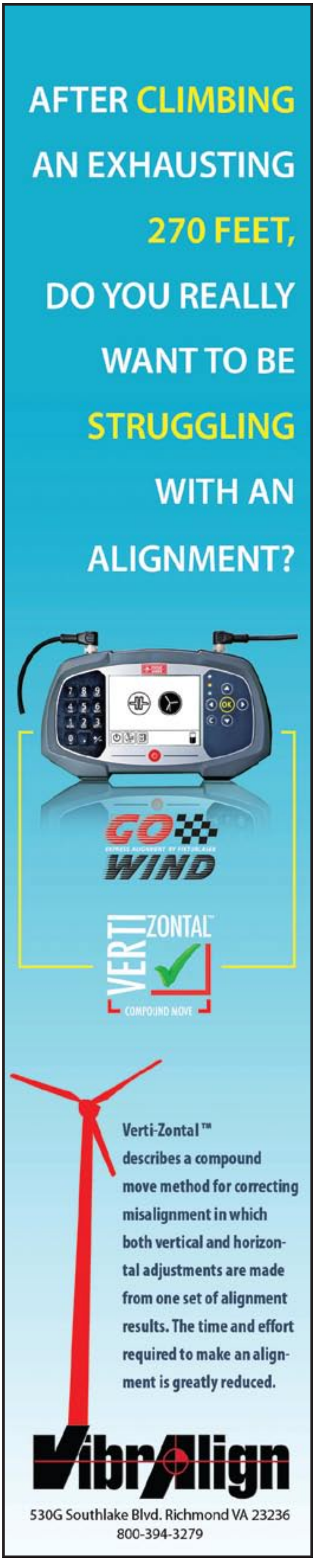


Fig. 5: VibrAlign's streamlined "Verti-Zontal" Compound move approach saves steps, and time.

CONCLUSION

Pretty easy, wouldn't you say? What makes the alignment process easier now for the wind industry is the Verti-Zontal Compound move, which eliminates two to three steps of the old aligning process, not to mention less wrench turning in the process. This is why aligning a wind turbine just got easier. So the next time you're performing this operation remember that taking a moment to choose the right tool will result in greater accuracy and fewer headaches!

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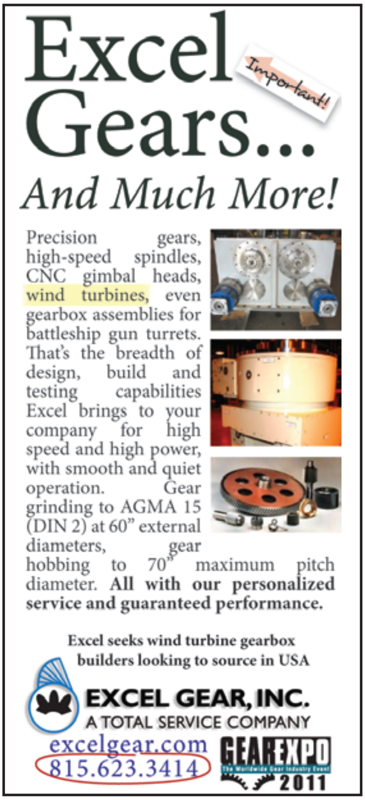
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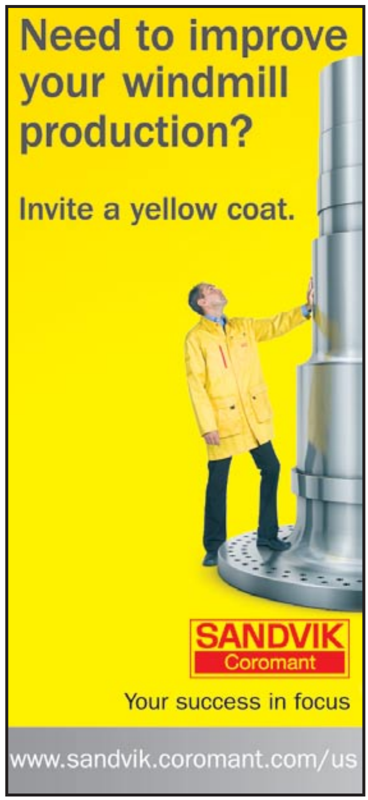
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Dan Janisch LEED AP
director/Wind Energy Technology Program, Mesabi Range College

TELL US HOW THIS PROGRAM CAME INTO BEING.

It all began about four years ago, when there was a legislative appropriation here in Minnesota that provided seed money for the program. We decided that we wanted to lay a foundation for a wind technology program that would be among the best in the country. We reached out to other colleges that already had wind programs in place such as Iowa Lakes Community College, who were very generous in providing input as we began developing our curriculum. But we wanted to make sure that we were teaching our students what their future employers would need them to know, so we approached major wind companies such as Clipper Windpower to get their point of view, and they've become a major supporter of our efforts. Not only did its executive management agree to sit on our educational advisory board, helping us to shape our curriculum and update it along the way, but the company has also donated $300,000 worth of equipment for our wind lab. We also received PI System software as a gift from OSIsoft, which allows us to manage real-time data and events and is valued at about $225,000. Other industry supporters include Minnesota Power, the Duluth Seaway Port Authority, LHB Engineering, Iron Range Resources, The Minnesota Center for Engineering & Manufacturing Excellence, B&K Trucking, Vic's Crane and Heavy Haul, Hytorc, Skidmore-Wilhelm, NRG, and Atmospheric Systems Corp., from which we purchased a sodar unit with a grant we'd applied for. In total we have received well over $1 million in value from support and donations. We have received guidance from the American Wind Energy Association since the inception of the program. The team worked with AWEA's Education Working Group to compile a list of job skills that are critical for a good technician to have. I'm now a member of its education working group in order to make sure that we are meeting the needs of the industry and to help keep our curriculum fresh. We'll be applying for AWEA's Seal of Approval this summer, as we have met the final requirement of graduating our first class of students this spring. So what we ended up with is a 72-credit AAS degree that takes two years to complete and is fairly rigorous. We want to produce employees that are highly qualified for the wealth of entry-level jobs that are out there, and we just graduated our first class of students. Clipper has already hired one of them, in fact.

DESCRIBE THE STUDENT'S COURSEWORK, AND THE HANDS-ON EXPERIENCE THEY RECEIVE.

We have open enrollment since this is a state college, and students take a placement test to gauge their strengths and weaknesses, but no one is turned away. We also make clear that there are a wide variety of jobs out there, and that you don't necessarily have to be able to climb a tower to take advantage of them. The wind industry is big enough now that there are many different professional avenues a person can take, whether that involves manufacturing or repairing and servicing equipment on the ground. Once they've been accepted into the program the students begin with the Introduction to Wind Energy course, and that same semester they take a class called Field Training and Project Operations, which focuses on the construction side of things and the actual responsibilities a wind technician would have. Then, after some general education classes such as Physical Science and Technical Writing they go into electronics hot and heavy in the second semester, studying subjects such as Digital Electronics, DC/AC Electronics and Electricity, and Electrical Safety. We close out that semester with OSHA 10 and Wind Turbine Safety, Wind Cranes and Rigging, and Tower Rescue. Students are then required to complete a six-credit Wind Energy Technology Internship, and although we help them polish their resumes and give them some job-interview coaching, they've got to land these internships themselves. Both Clipper Windpower and Minnesota Power have taken on our interns, along with other wind-related entities, and it's really exciting to see the students come back to class so energized from the experience. The remaining semesters are filled with courses like Programmable Logic Controllers, Industrial Motor Control, Wind Turbine Instrumentation and Communication, Wind Turbine Mechanical Systems, Composite Repair, Power Generation and Distribution, and more. Beyond the classroom students have ongoing opportunities to gain hands-on experience by taking trips to Minnesota Power to learn about the grid, to the nearby Taconite Ridge Wind Farm that's operated by Clipper Windpower, and they will also be responsible for operating the Vestas V27 turbine we've purchased that will be installed soon. We're also integrated with the college's Process Automation Systems Program, so we have programmable logic controllers, or PLCs, in our wind lab as well. So we feel that we have the relationships, equipment, and curriculum in place to help provide the wind industry with the well-trained employees they require, and that will give the students themselves the opportunity to get involved in this growing and dynamic field.

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