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JULY/AUGUST 2020
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July/August 2020 VOLUME 12 ◤ NUMBER 7

Wind Systems (ISSN 2327-2422) is published monthly by Media Solutions, Inc., 266D Yeager Parkway Pelham, AL 35124. Phone (205) 380-1573 Fax (205) 380-1580 International subscription rates: $72.00 per year. Periodicals Postage Paid at Pelham, AL and at additional mailing offices. Printed in the USA. POSTMASTER: Send address changes to Wind Systems magazine, P.O. Box 1210 Pelham AL 35124. Publications mail agreement No. 41395015 return undeliverable Canadian addresses to P.O. Box 503 RPO West Beaver Creek Richmond Hill, ON L4B4R6.

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FROM THE EDITOR

The future of wind is still going strong

The craziness that seems to be the driving force of 2020 has affected almost every part of our lives — from the tiniest things we may take for granted to the larger health concerns that keep us up at night.

As we try to make sense and adapt to what has become a new normal, *Wind Systems* has tried to adapt as well.

When we were putting together our July issue, we came to the realization that many of our readers were still working from home. That meant that our monthly print issue would be sitting in a mailroom or in a mailbox collecting dust.

Because of that, we decided to hold onto much of the content for July and publish it in this combined July/August issue in your hands right now.

Your main takeaway from that is you have a lot of exciting extra content to keep you informed about what's going on with the wind industry.

Our August issue has always been about bonus content featured in our annual Market Outlook report, and, despite the world's bigger concerns, this combined issue still boasts articles on various aspects of the future of wind, particularly in the U.S.

How the industry, as well as state and local governments, approaches wind is a big part of this issue.

The American Wind Energy Association is always a big help with our Market Outlook. Our bonus coverage begins with an article from AWEA's Celeste Wanner, where she discusses how wind is building a future for Fortune 1000 companies.

North Carolina is busy trying to get steel in the water for an offshore wind project. In an article from Elizabeth Ouzts, you'll learn how the Tar Heel State is taking its first step in developing an offshore wind study.

But that's not all to be found in this issue. In addition to our bonus content, the July/August issue also takes a look at lubrication, turbine foundations, and much more.

Safety in the face of COVID-19 is still very much a concern within all aspects of the industry, so be sure and check out our article from Simon Hayes, where he shares his insights about training in the face of the coronavirus pandemic. And in our Conversation, Pure Safety Group's Erica Cole discusses how her company approaches safety issues from fall protection to viral protection.

The Market Outlook issue is always one of my favorites because it really brings into sharp focus just how promising wind energy is and will continue to be. And this combined issue only serves to bring you more of what you need to know about wind.

Please enjoy, and, as always, thanks for reading!

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Giving Wind Direction
WIND SYSTEMS

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Corporate customers buying record amount of U.S. wind power

From AWEA

Commercial and industrial companies bought 4,447 MW of U.S. wind capacity last year, setting a new record for annual procurements and bringing total corporate agreements for wind power to 16,857 MW, according to the first Wind Powers American Business report from the American Wind Energy Association (AWEA).

The report reveals corporate customers across a variety of industry sectors now purchase 10 percent of all operating wind capacity in the country. The U.S. wind market is increasingly attractive as businesses strive to meet sustainability targets and improve their bottom lines, with total contracts rising from fewer than 800 MW at the end of 2013 to more than 16,800 MW at the end of 2019.

"Leading businesses are increasingly relying on wind energy to power their operations, reduce costs to their customers, and help achieve their sustainability goals," said Tom Kiernan, CEO of AWEA. "These companies are leaders in their industries, making sustainability commitments that are good for business and good for the environment."

More than 140 companies have purchased U.S. wind energy. Overall, Google is the top corporate wind energy customer in the U.S., with 2,397 MW contracted. Facebook is the second largest purchaser, with 1,459 MW, followed by Walmart, AT&T, and Microsoft.

Walmart purchased the most wind energy of any company in 2019, signing contracts for three wind projects totaling 541 MW. AT&T was the second largest corporate buyer of wind for the year, contracting 460 MW from two projects.

The breadth of the corporate and industrial market is growing alongside the depth, with 18 first-time buyers of wind entering the market last year. McDonald's, Sprint, Ford Motor Company, Crown Holdings, and Gap were the leading first-time buyers in 2019.

AWEA AMERICAN WIND ENERGY ASSOCIATION

The American Wind Energy Association (AWEA) is the premier national trade association that represents the interests of America's wind energy industry. For more information, go to www.awea.org

DIRECTION

THE FUTURE OF WIND

The ONYX Insight whitepaper reveals how effective O&M decisions need to be based on a combination of data analytics and real-world engineering experience. (Courtesy: Shutterstock)

Smart digitalization strategy can lead to O&M savings, according to whitepaper

Owners and operators who look to make "quick digitalization fixes" rather than investing in smart digitalization strategies are in danger of missing out on huge operations and maintenance (O&M) savings that are critical to wind-farm profitability. This is according to ONYX InSight, a leading provider of predictive maintenance solutions to the wind industry.

The emergence of COVID-19 has accelerated the adoption of digitalization practices. Some owners and operators who have previously overlooked digital technology in their operations now find themselves at a substantial disadvantage, struggling to deal with a wide range of market challenges. Even those who have previously invested are looking at ways to bolster the effects of their strategies as they look to take advantage of a predicted boost in renewable investments.

In its new whitepaper, *How smart digitalization will help you thrive in a post-pandemic world,* ONYX InSight warns how the industry is at a crossroads when it comes to digitalization adoption and how digitalization has the potential to bring its own costs and downsides to the industry if applied ineffectively.

The whitepaper highlights three common obstacles that owners and operators must avoid in order to prevent a poor return on their digitalization investment:

- Collecting data with no clear strategy.
- Over-reliance on artificial intelligence (AI) and machine learning (ML).
- Failure to recognize multiple data streams.

When owners and operators struggle to implement successful digitalization strategies, and expected returns do not materialize, disillusionment starts to set in. In the whitepaper, ONYX InSight warns that companies may begin rejecting advances in digitalization because they are not getting the returns promised by some service providers and they do not know how best to use the technology on offer.

"Some owners and operators invest in cheaper AI-only services because they receive assurances that these services will increase their profits," says Bruce Hall, CEO, ONYX InSight. "However, the issue with some of these services is they rely only on algorithms to identify the trends and anomalies that indicate operational issues and lack the engineering expertise to provide accurate interpretation of the data and draw out the trends. This is problematic because most ML and AI tools only look for indicators of anomalous behavior, rather than direct fault identification, and fail to spot or highlight the 'real' issues. This means owners and operators still need access to practical engineering skill sets or other tools if they are to extract useful insights. Without those skills the data — and therefore service — is of limited value. This has caused some operators to become disappointed in ML services."

"We are very optimistic about what ML can offer," he said. "Data analytics has a huge role to play in improving profits and production on wind farms through predictive maintenance ... but only if the technology is utilized in the right way."

The whitepaper reveals how effective O&M decisions need to be based on a combination of data analytics and real-world engineering experience, how combining data streams can transform the level of insights that can be drawn from wind-turbine data and how the industry needs to eliminate data silos and bring all data into one place.

"The future of predictive maintenance in the wind industry will see more data streams introduced into analysis to enable wind-farm owners and operators to realize maximum production and profits," Hall said. "However, the addition of extra data streams will only compound the issue created by ineffectual data services. This is why it is so important to ensure the right analysis and expertise are called upon. The best service providers in the industry will have experienced engineers who have not only seen most issues before but can also tackle new issues efficiently while delivering actionable advice that makes a real commercial difference to wind-farm owners and operators."

"The lessons of the pandemic must be combined with the lessons of the past few years," he said. "Advances in remote sensing and remote analytics are accelerating rapidly as part of our 'new normal,' and it is likely that this new way of working will continue. It is for this reason that digitalization needs to be approached systematically, ensuring that the technology is understood, expectations are realistic, and that best practice in data analysis becomes ingrained into O&M operations."

MORE INFO onyxinsight.com

GCube highlights growing cyber threat to energy companies

GCube Insurance, a leading provider of insurance services for renewable energy projects, has emphasized that renewable energy asset owners relying more heavily on digital systems during the current period of lockdown — and beyond — must adapt to increased exposure to cyber threats such as ransomware, denial-of-service, and human error.

Recent cyber-attacks on global renewable energy businesses have underlined the scale and nature of this previously under-reported threat and have added to the already significant demand for GCube's non-damage cyber risk insurance product as increasing numbers of firms seek to mitigate their potential exposure to business

The emergence of COVID-19 has led to an unprecedented lockdown worldwide, leading many renewable energy companies to take advantage of remote monitoring systems and working practices to try and ensure "business as usual" despite the disruption. (Courtesy: GCube)

Chad Marriott (Courtesy: Stoel Rives LLP)

interruption and other cyber losses.

The emergence of COVID-19 has led to an unprecedented lockdown worldwide, leading many renewable energy companies to take advantage of remote monitoring systems and working practices to try and ensure "business as usual" despite the disruption.

Though cyber-attacks such as ransomware and denial-of-service remain significantly under-reported in the renewable energy industry, recent high-profile examples in the U.K., the U.S., and Portugal have provided additional public demonstration of the need for asset owners to invest in cyber insurance products that can provide financial cover in these "non-physical damage" events.

"Digitalization, of course, drives significant efficiency gains for businesses and is now a necessity for renewable energy companies looking to maintain continuity during the COVID-19 pandemic," said Geoffrey Taunton-Collins, senior analyst at GCube. "But with portfolios now at greater risk of cyber-attacks, we are seeing even greater demand for our cyber insurance product as project owners are increasingly realizing the very real threat that cyber-attacks pose."

Numerous businesses have approached GCube seeking a means to mitigate their financial exposure to cyber-attack. These include wind projects owned by leading firms such as Eolenerg and Molly Wind Ltd, who have either procured the coverage outright or included the product as part of their insurance renewal.

GCube's research suggests that though cyber-attacks are estimated to be responsible for more than $3 trillion in losses annually — and are set to rise — the cyber insurance market last year was only worth about $5 billion, with many insurers not yet providing cyber cover.

MORE INFO www.gcube-insurance.com

Stoel Rives energy partner named to legal power list

Stoel Rives LLP recently announced Chad Marriott, energy development partner and head of the firm's wind energy subgroup, was named to *A Word About Wind's* Top 100 Legal Power List 2020, a list of the 100 most influential lawyers working globally on the financing of wind-energy projects. The list is based on industry input and independent research.

Marriott has a national practice in energy project finance and M&A. He serves as counsel to sponsors, owners, and investors in the development, sale, acquisition, and financing of renewable-energy projects, has led teams advising on the acquisition of historic wind assets for repowering and has served as lead counsel on the acquisition of both operational and development-stage wind, solar, and battery energy storage projects in the United States and Canada.

"Chad's extensive experience in finance, M&A, and state and federal utility regulation are invaluable to our clients at all stages of project development, operation, and repowering, and we are thrilled he received this industry recognition," said Jennifer Martin, Stoel Rives partner and co-chair of the Energy & Natural Resources Industry Group. "In addition to his knowledge and practice skill, he has the ability to manage diverse teams across practice areas and offices to the benefit of the firm's clients."

Marriott's selection follows an extensive, independent ranking process undertaken by *A Word About Wind's* editorial and insight teams in conjunction with its advisory board and panel of expert judges from the wind and finance sectors. The Legal Power List ranks and profiles the most important and influential legal professionals working in the global wind industry across in-house counsel and at law firms. Founded in 2012, *A Word About Wind* seeks to accelerate the growth of

The Åndberg wind farm is one of four current wind power investments managed by Ardian's new sustainable energy investment platform, eNordic. (Courtesy: KfW IPEX-Bank)

wind globally by informing and connecting key industry decision-makers.

MORE INFO www.stoel.com

Ardian signs 20-year financing agreement for Åndberg wind farm

Ardian, a world-leading private investment house, has signed a 20-year financing for its 286 MW "Åndberg" wind farm in Sweden. The financing is provided by KfW IPEX-Bank, which is the part of KfW Group responsible for project and export finance.

The long-term financing was secured on the back of a 10-year green power purchase agreement (PPA) with Skellefteå Kraft, one of Sweden's largest energy producers, agreed in October 2019. The financing allows Ardian and eNordic to further optimize and secure more revenue streams for the wind farm.

Ardian Infrastructure acquired the Åndberg wind farm from OX2 in February 2019 as part of its Nordic sustainable energy investment platform, eNordic. The wind farm is relying on the latest technology, having upgraded its Nordex turbines to the 5MW class earlier this year. Following its completion in 2021, Åndberg will each year provide clean electricity in excess of 800 GWh, making it one of the largest wind farms in Sweden.

The Åndberg wind farm is one of four current wind power investments managed by Ardian's new sustainable energy investment platform, eNordic. Earlier this year, Ardian made its first investment in Finland with the acquisition of the Lakiakangas 1 wind farm from German-based wind-power company, CPC Finland Oy.

"This agreement is the latest step in our strategy to build a leading independent sustainable energy group in the Nordic region," said Thomas Linnard, managing director, eNordic. "The long-term financing was secured at very attractive terms despite current market conditions and high level of complexity involved, highlighting the strength of the project and our approach."

"This project is a great example of our asset management capabilities and ability to improve our investments' performance including financing, hedging, build-ups, and technical optimization," said Simo Santavirta, head of asset management, Ardian Infrastructure.

"This operation highlights our continued commitment to sustainability and relentless activity as we continue to look for investment opportunities to support the sustainable energy transition in the Nordic region," said Amir Sharifi, managing director, Ardian Infrastructure.

"KfW IPEX-Bank is firmly committed to finance innovative energy and environmental projects, and we're pleased to support Ardian and eNordic's Åndberg wind farm as they continue to support the sustainable energy transition in the Nordics," said Markus Scheer, member of the management board of KfW IPEX-Bank. "It has been a real pleasure to work with their highly competent teams, and we look forward to a long-term partnership."

MORE INFO www.ardian.com

WIND BUILDS THE FUTURE FOR FORTUNE 1000 COMPANIES

Wind-friendly states are attracting the attention of companies that want access to renewable energy, with corporations more likely to sign contracts with projects in states that have high-quality wind resources.

By CELESTE WANNER

Companies in nearly every sector of the economy are building a new future for how to do business —they're powering their stores, factories, and data centers using wind power. Corporate and industrial customers bought 4,447 MW of U.S. wind capacity last year, setting a new record for annual procurements, according to the first Wind Powers American Business report from the American Wind Energy Association (AWEA). This brings the total corporate agreements for wind power to 16,857 MW, enough to power 5.2 million average American homes.

The report found that corporate customers across an array of sectors are investing in wind, now purchasing 10 percent of all operating wind capacity in the country. Doing so helps companies improve their bottom line — especially vital while recovering from the coronavirus pandemic — while meeting sustainability targets. Investing in renewables is also a smart move in a market where consumers are increasingly concerned about what powers the brands they are loyal to.

2019 SAW INCREASE IN VOLUME OF WIND PURCHASES

In the last six years, corporate purchasing has skyrocketed from less than 800 MW at the end of 2013 to more than

The cost of wind has dropped nearly 70 percent since 2009 and is now an affordable and sustainable power source for businesses. (Courtesy: AWEA)

16,800 MW at the end of 2019. The 2019 total of 4,447 MW was well above the average yearly contracted amount of 2,660 MW. The surge in demand for wind is driven primarily by its increasing economic feasibility. The cost of wind has dropped nearly 70 percent since 2009 and is now an affordable and sustainable power source for businesses. This demand is projected to continue to grow; Wood Mackenzie estimates that Fortune 1000 companies will foster the growth of 85,000 MW of renewable energy through 2030 [1].

Of the 140-plus companies that have purchased wind power to date, Google holds the spot as the top corporate wind customer. The tech giant has contracted 2,397 MW from wind projects across six states. Facebook is the second largest purchaser with 1,459 MW of wind energy, and Walmart comes in third with 1,333 MW. Walmart was the largest purchaser of 2019, with three contracts for wind totaling 541 MW.

"Wind energy is a core component in the mix to meet Walmart's goal of powering 50 percent of our operations with renewable sources by 2025," said Mark Vanderhelm, vice president of Energy for Walmart, Inc. "Over the past two years, Walmart has entered into a number of wind-power agreements. These investments represent an important leap forward in our company's renewable energy journey and reinforce Walmart's broader mission to advance sustainability across global supply chains."

Seeing the nation's largest corporations supporting wind is driving others to follow suit. Eighteen companies became first time buyers last year, including McDonald's, Sprint, Ford Motor Company, Crown Holdings, and Gap Inc. McDonald's is the first fast food company to purchase wind energy. The quick service restaurant company bought 220 MW last year, which is the equivalent of more than 1,300 restaurants-worth of electricity. This purchase made McDonald's the sixth biggest wind purchaser for the year and in the top 20 for overall capacity. The fast food chain has no plans of slowing down its investment in wind energy.

"McDonald's is just getting started on our renewable energy journey in the U.S.," said Emma Cox, renewable energy lead for McDonald's. "Building on years of sourcing renewable energy in many of our European markets, our first ever large-scale wind project in the U.S. represents a significant next step in our continuing work to address climate change using our Scale for Good. We want to keep this momentum going and are excited about the impact this will have on the environment and the communities we serve."

TYPES OF COMPANIES BUYING WIND ENERGY ARE DIVERSIFYING

Before 2015, wind purchases were made primarily by technology and retail companies, with those sectors making up nearly 80 percent of corporate wind purchases. Today, tech and retail make up 53 percent of customers, as other companies have discovered the advantages of being pow-

Over half of all corporate deals are connected to projects in Texas, Oklahoma, and Kansas, which respectively rank first, third, and fourth in the country for installed wind capacity. (Courtesy: AWEA)

ered by wind. Purchases made in the food and beverage, telecommunications, and retail sectors increased notably in recent years. The end of 2019 saw the technology sector accounting for 41 percent of total corporate wind-energy purchases, while telecommunications and food and beverage represented 9 percent each. Other corporations purchasing wind include healthcare, automotive, industrial, and consumer goods.

HELPING STATES SEE MORE BUSINESS

The report also highlighted that corporations are more likely to sign contracts with projects in states that have high-quality wind resources and a wholesale electricity market, retail choice, or green tariff program. Over half of all corporate deals are connected to projects in Texas, Oklahoma, and Kansas, which respectively rank first, third, and fourth in the country for installed wind capacity. Nebraska and South Dakota have both seen an increase in corporate wind deals as well along with more wind development in the past two years.

Wind-friendly states also are attracting the attention of companies that want access to renewable energy. Companies such as Facebook, Google, and Apple have chosen to site new data centers or expand data centers in states where they are able to purchase wind energy. For example, Apple's decision to move some of its operations to Iowa was motivated by the presence of wind energy: In announcing plans to build a 400,000 square foot, $1.3 billion data center, Apple CEO Tim Cook said Iowa's renewable energy resource was "paramount for us" and "if we couldn't (procure renewables), we would not be here."

HUGE OPPORTUNITIES FOR GROWTH

Though corporate wind purchasing has grown significantly in recent years, it is still a relatively new market that only a portion of U.S. companies have entered. Fortune 1000 companies use approximately 1,192 TW/h of electricity annually; only 1 percent of which is met via direct procurement of wind or solar power.

However, in order to satisfy customers, corporations will need to continue investing in wind energy. A poll showed that more than 80 percent of the nation's voters say that company commitment to combating climate change is important to them, and 87 percent say it is important that companies use renewables as a way to keep costs low and pass on those savings to consumers.

As the demand for renewable energy continues to grow and roadblocks to corporate purchases continue to fall, many of the world's largest companies will continue turning to wind energy to build a clean, reliable, affordable future.

REFERENCES

[1] Wood Mackenzie. Analysis of Commercial and Industrial Wind Energy Demand in the United States. May 2019.

ABOUT THE AUTHOR

Celeste Wanner is Research and Analytics Manager for AWEA.

'AN EXCITING MILESTONE' FOR NORTH CAROLINA

North Carolina has some of the nation's best potential for ocean-based wind turbines, with the technical potential to meet the state's electricity needs many times over. (Courtesy: Shutterstock)

The Tar Heel State takes its first step in developing an offshore wind study.

By ELIZABETH OUZTS

North Carolina has taken the first step toward what observers say is a crucial study of offshore wind — issuing a request for proposals to analyze the state's ports and manufacturing supply chain.

Other states that have conducted similar analyses have created a virtuous cycle of more local jobs, lower costs, and more activity in an offshore wind sector still in its nascent stages in the United States. Advocates say the request for proposals issued recently sets that same cycle in motion for North Carolina.

"Not only will this provide key insights to the state's unique industry qualifications and opportunity areas, but it sends an important signal to the offshore wind industry that North Carolina is open for business," said Katharine Kollins, president of the Southeastern Wind Coalition.

MASSIVE POTENTIAL

The Tar Heel State has some of the nation's best potential for ocean-based wind turbines, with the technical potential to meet the state's electricity needs many times over.

In the near term, federal officials have identified two patches of sea near Wilmington that could host wind farms, and an area just beyond the Kitty Hawk horizon is already in the early stages of development. Turbines in the three sites combined could create enough electricity to power more than 1.5 million homes.

But most of the U.S. activity on offshore wind so far has been concentrated in the Northeast, where states are upgrading ports — to enable shipment of tremendous blades, towers, and other specialized components — and creating a network of local manufacturers and installers. Virginia has also begun similar steps.

Officials want North Carolina to follow suit, seeking not only to boost clean-energy production within the state, but to maximize job creation in a supply chain servicing the entire region.

The request for proposals "marks an exciting milestone in North Carolina's efforts to seize on the economic development potential of the offshore wind industry," said Chris Chung, executive director of the Economic Development Partnership of North Carolina.

IDENTIFYING UPGRADES

The study is to identify what upgrades are necessary at ports in Wilmington and Morehead City and pinpoint job needs within the state, already home to a robust energy-related manufacturing sector, including 28 wind-related manufacturing facilities that employ more than 1,000 people.

The request for proposals came after Gov. Roy Cooper, a Democrat, promised in November the study would move

Block Island wind farm off the coast of Rhode Island was the first U.S. offshore wind facility constructed. Most of the U.S. activity on offshore wind so far has been concentrated in the Northeast, where states are upgrading ports. (Courtesy: AWEA)

forward despite an impasse with the Republican-led Legislature over the 2019-20 budget. Cooper had originally proposed $300,000 for the research, an idea that won bipartisan support.

How much the state will end up spending on this analysis, housed under the Department of Commerce, isn't clear.

"Our procurement method is a competitive process, and we believe many organizations will seek to help us conduct this study," said department communications director David Rhoades. "The quality, depth, and efficiency of those proposals will determine the ultimate scale of the engagement."

Asked where the department would find the money for the study, Rhoades said the department reallocated funds from elsewhere in its operating budget.

"We're confident we have the resources on hand to develop and publish a useful report that will help the state further develop the wind-energy industry in North Carolina," he said.

PLANNED COMPLETION AT YEAR'S END

Proposals were due June 15, and the state hopes the work can be completed by the end of the year. The study is a piece the state's Clean Energy Plan issued last year, part of Cooper's executive order on climate calling for greenhouse gas reductions of 40 percent by 2025 compared to 2005 levels.

Action items under the 144-page plan have proceeded full steam ahead even as the state grapples with the coronavirus pandemic, with a web of stakeholder groups meeting virtually for hours and even days on end.

The plan, spearheaded by the Department of Environmental Quality, notes that other states have conducted port and supply chain studies, set procurement goals and requirements, and enacted other incentives that send friendly market signals to the industry.

"Capital flows toward certainty," according to the plan.

The plan assigns DEQ the task of recommending what policy incentives North Carolina should enact to attract the industry, but spokesperson Sharon Martin didn't say when to expect those recommendations. She said an offshore wind goal and other measures were being considered as part of a "larger stakeholder process" over how to reduce emissions and modernize the state's utility regime.

Cassie Gavin, the chief lobbyist for the North Carolina Sierra Club, said her group wants an offshore wind target to be one of those recommendations. She was thrilled to see the study move forward on its own terms, but also wished it would set the stage for more aggressive policy action.

"Hopefully," she said, "the study will help us get to a goal."

ABOUT THE AUTHOR

Elizabeth Ouzts is based in Raleigh, North Carolina, and has reported on the state's clean energy transition for the Energy News Network since 2016. A former director of communications for the nonprofit Environment America, Ouzts brings nearly two decades of experience in environmental and energy policy to her reporting. This article was originally published by the Energy News Network, a nonprofit news organization that covers the nation's transition to clean energy.

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NON-DESTRUCTIVE TESTING OF TURBINE FOUNDATIONS

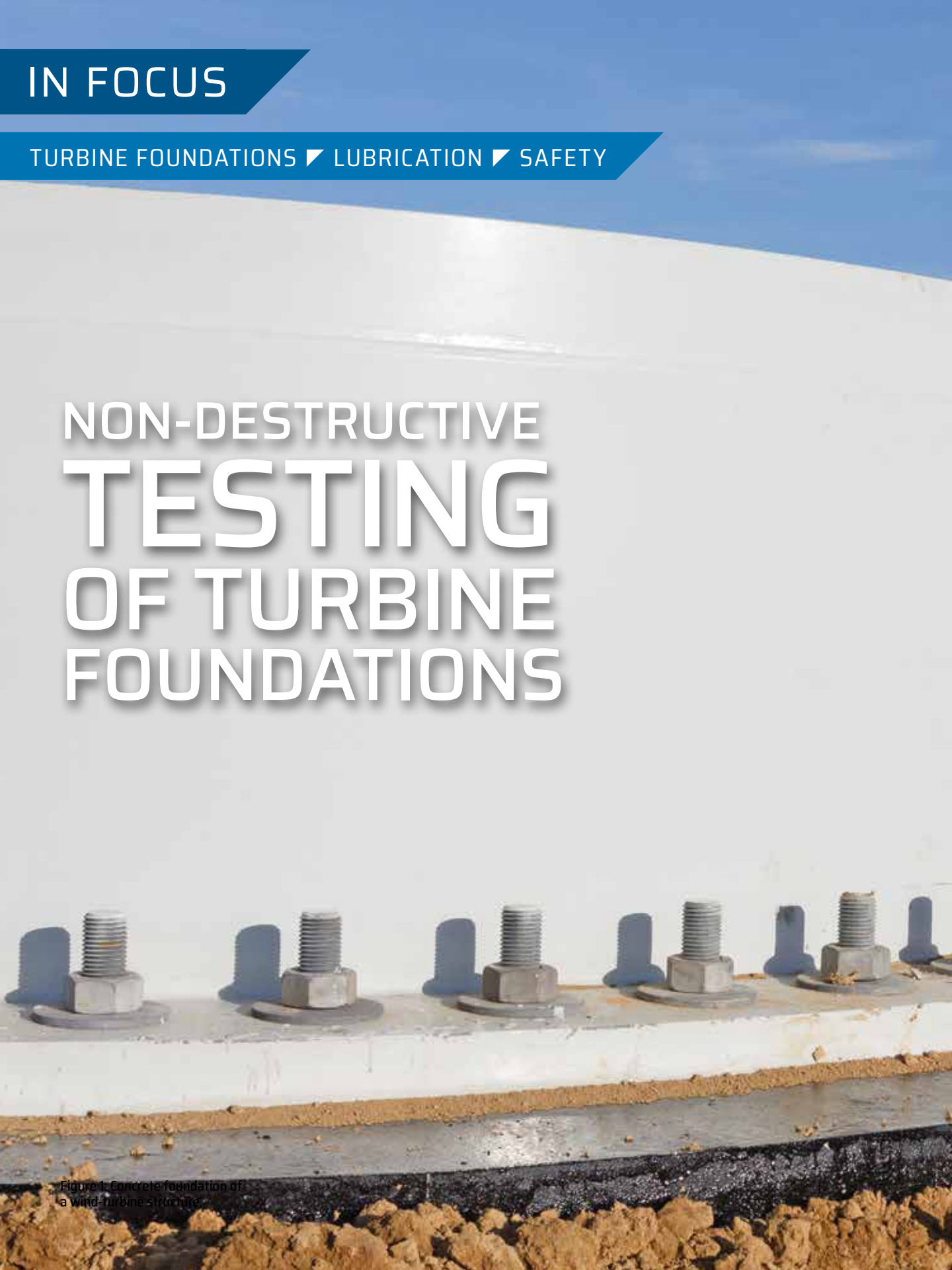

Figure 1: Concrete foundation of a wind-turbine structure

A combination of non-destructive testing solutions and structural health monitoring systems can be used to enhance the quality control and quality assurance of new wind-turbine foundations.

By HAMED LAYSSI, FARID MORADI, and VAHID SHAHSAVARI

Proper quality control and quality assurance procedures are necessary to ensure safe and reliable performance of wind turbines. Various inspection tools and procedures have been developed to assess the safety and reliability of the mechanical components of the turbine, shaft, and blades. However, the concrete foundations are often overlooked. The dynamic and cyclic loads from wind, shaft vibration due to wind, and rotation of blades can expedite cracking in concrete, which might, in turn, affect the mechanical performance of the foundation, its stiffness, dynamic response, and overall structural performance. Cracks and other defects can happen as a result of construction procedure, curing, or simply excessive dynamic loads. It is important to verify these cracks in advance to avoid major structural deficiencies in the future. This article provides a brief review on some of the most common non-destructive tests and structural health monitoring solutions that can be used in the quality control and quality assurance of the wind-turbine foundations. Some of these methods have previously been used for other types of mass concrete elements (such as dams, gas-turbine foundations, etc.), and can be customized for different types of wind-turbine foundations.

INTRODUCTION

Over the past decade, Canada has heavily invested in wind energy, increasing its annual capacity from nearly 2,000 MW in 2008, to nearly 13,000 MW in 2019. That is enough to power approximately 3.3 million homes – 6 percent of the country's electricity demand (Canadian Wind Energy Association, 2019).

There are 299 wind farms operating from coast to coast, including projects in two of the three northern territories. While the quality control, routine inspection, and performance monitoring of the turbine and the blades have significantly developed over the past few decades, the quality control and monitoring of the foundation elements is often overlooked (Charles Nmai, 2010). This is essential in keeping these massive towers grounded and secure. In this article,

Figure 1: Concrete foundation of a wind-turbine structure.

we will review how non-destructive testing of wind turbine foundations and using real-time structural health monitoring systems can help engineers in the process of quality control, quality assurance, and maintenance.

Wind turbines are often supported on massive concrete foundations:

- The wind-turbine foundation can be as large as 10-15 meters in diameter.
- The foundation block can be as thick as one to two meters, depending on the tower size and soil characteristics.

Due to the relatively large dimensions of wind-turbine foundations, these structures are often considered mass concrete. According to ACI 301 (2016), a mass concrete is referred to any volume of structural concrete in which a combination of dimensions of the member being cast and the condition and characteristics of boundaries can lead to undesirable thermal stresses and cracking as a result of elevated concrete temperature due to heat of hydration. Elevated heat in mass concrete components can develop massive temperature gradients in the foundation block. This may result in thermal contraction cracking shortly after the concrete hardens — compromising the structural integrity and durability of the foundation. (See Figure 1).

Wind-turbine foundations have sophisticated congested steel reinforcement to provide stability against dynamic loads. This will make the placement of concrete challenging, and it may result in poor quality patches in the foundation. The congested rebar mesh might contribute to segregation of concrete. Congested rebar complicates the debris/dust removal from the foundation prior to placement of concrete, increasing the chances of poor patches and voids on or around anchors.

While the use of self-consolidating concrete (SCC) and steel fibers can help address some of these challenges by reducing the amount of steel bars, the quality of foundation components needs to be evaluated ahead of installing the tower and the turbine.

The cracking also arises very easily in mass concrete foundations because of thermal cracking as a result of inadequate temperature monitoring, post-tensioning forces (i.e. where anchors are used to connect foundations to the bedrock), and creep. Hence, any interruptions in work or change in work order should be fully recorded.

Another issue that can affect the quality of concrete foundations could be durability issue such as alkali-silica reactions (ASR). Since these foundations are normally exposed to moisture, the risk of ASR will be high wherever reactive aggregates are used in the concrete mix design. This can be addressed during the selection of construction materials.

QUALITY CONTROL OF WIND TURBINE FOUNDATIONS

The quality of concrete is an important task during the construction on a mass foundation. It is often necessary to examine these mass foundations for any signs of premature cracking, voids, or other types of anomalies. Ideally, such testing should be done without damaging the concrete.

A combination of intrusive testing and non-destructive (or minimally destructive) tests are available to assess the quality and integrity of concrete foundations. The range of properties that can be assessed using non-destructive tests and partially destructive tests is quite large and includes such fundamental parameters as density, elastic modulus and strength as well as surface hardness, reinforcement location, reinforcement size, and cover thickness.

Routine quality control tests are necessary to monitor the strength development in mass concrete foundations. The quality control is one of the most important aspects taken into account during the construction and placement of concrete. Proper curing of concrete is also very important.

A range of in-situ and laboratory tests can be performed for enhanced assessment of concrete quality:

- **A:** Fresh concrete tests such as air content, slump, compressive strength, flow test.
- **B:** Non-destructive tests for quality control and quality assurance.
- **C:** Real-time inspection and monitoring (during and post construction).

A. FRESH CONCRETE TESTS

Traditional sampling and on-site concrete testing have been the market standard for the past few decades. The slump

test is often used to assess the consistency and workability of concrete. Air content measurement is another effective method in evaluating the properties of fresh concrete. When concrete is placed over dense rebar mesh, a flow test can help engineers assess the workability and flow of concrete. Another major test is sampling concrete specimens and testing them for compressive strength evaluation; rapid chloride permeability test (RCPT) is recommended for durability assessment.

Figure 2: Ground-penetrating radar for rebar scanning.

B. NON-DESTRUCTIVE TESTING FOR QUALITY CONTROL AND QUALITY ASSURANCE

Certain construction issues can result in defects in mass concrete elements. Poor quality concrete with low workability may lead to voids and honeycombs. Moreover, the congested steel reinforcement increases the chances of segregation in concrete. Since most foundation elements are relatively large and considered mass concrete, improper heat control (resulting from cement hydration) can result in significant cracking.

Non-destructive testing (NDT) methods are increasingly applied for inspection and condition assessment of concrete structures and foundations. According to ACI 228 (2013), the increasing trend in use of NDT methods is because of: 1) technical improvement (i.e. software and hardware improvement) in collecting, storing, and analysis of data; 2) economic considerations in assessing larger areas/volumes when compared to intrusive methods; 3) speed of NDT methods in assessing of concrete structure; and 4) ability to repeat the test.

Among different NDT methods, ultrasonic pulse echo (UPE) tomography, impact-echo (IE), and ground-penetrating radar (GPR) are three commonly used NDT methods for subsurface scanning and imaging. This section describes application of these NDT for condition assessment of concrete structures and mass foundations.

ULTRASONIC PULSE ECHO TOMOGRAPHY

Ultrasonic Pulse Echo (UPE) is a non-destructive testing (NDT) method for scanning sub-surface targets in concrete elements. UPE methods use acoustic stress waves to study the properties of sub-surface layers, and locate defects by identifying any anomaly of acoustical impedance that is different from concrete. Ultrasonic tomography can be used to evaluate the shallow depth deficiencies in the foundations. Depending on the reinforcement pattern, this technique provides a reliable and cost-effective tool to scan concrete for potential defects.

The main concept behind UPE is measuring the transit time of ultrasonic waves in concrete. A modern UPE instrument (called "ultrasonic pulse echo tomography") consists of an array of piezoelectric transducers capable of exciting the concrete surface through short-burst high amplitude and voltage pulses (see SHRP2, 2013). As the pulse propagates within the concrete, it gets reflected and refracted at the interface of voids or other internal targets. The reflected stress waves are monitored at the receiving transducer. Eventually the tomography concept is used to convert received stress waves to 2D or 3D images. This technique can also be used to image subsurface defects and objects, and show the boundaries of the test area.

GROUND-PENETRATING RADAR

Ground-penetrating radar (GPR) provides a reliable, cost-effective, and non-intrusive tool for scanning and imaging of sub-surface features, such as rebar location, rebar depth, and spacing. (See Figure 2)

A general use GPR device works based on the transmission of electromagnetic waves into concrete and detecting discontinuities of dielectric properties within the concrete area under investigation. When electromagnetic waves arrive at internal objects, such a steel reinforcement, conduits, pipes, or other anomalies such as large air pockets, they partially get reflected in all directions. The reflections moving toward the concrete surface are detected by the receiving antenna. The test is generally performed over single or multiple parallel or perpendicular paths. At any point along the test path, location information and the reflected electromagnetic response are recorded and used for

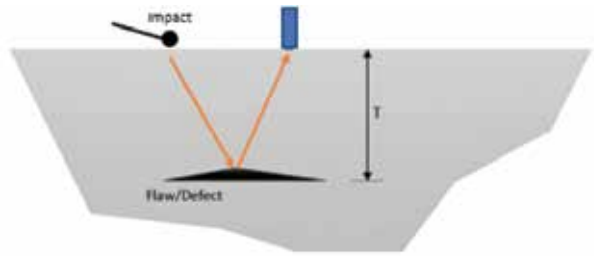

Figure 3: Impact-echo testing for evaluating concrete foundations.

analysis. While GPR can be extremely useful in structure inspection, there are certain limitations to its applications in the field. GPR does not provide any information on the characteristics of concrete materials, or any precise information on rebar size.

IMPACT-ECHO

Impact-echo (IE) is an acoustic, non-destructive test method for the structural integrity testing of concrete structural members such as foundations, walls, slabs, and bridge decks. Develop by Sansalone and Carino (1986), the impact-echo test is based on the generation of stress waves through a short-duration mechanical impact on the surface of concrete element. The test can be used to assess the depth of structural member, and locate potential sub-surface voids, objects (e.g. shield for post-tensioning tendons) and discontinuities.

An impact-echo test device is mainly composed of three main components including an impactor (i.e. small steel balls), a transducer (i.e. piezoelectric accelerometer or geophone), and a data acquisition system. During an impact-echo reading, an impulse (a short duration impact) is applied by a proper impactor at one-single point on the surface of the concrete element. The resulting stress waves propagate into the concrete medium in all directions and reflected between all the existing boundaries and interfaces. When the reflection is arrived to the surface, displacement is induced on the surface of the concrete. The transducer records the surface movement, converting the measured movement into an analog signal of amplitude vs. time, called "waveform." The waveform is recorded by a data acquisition system. This waveform is then proceeded for data analysis in either time-domain or frequency-domain. The test method was adapted as a standard test procedure by the American Society of Testing Materials (ASTM C 1383, 2015), "Standard Test Method for Measuring the P-Wave Speed and the Thickness of Concrete Plates Using the Impact-Echo Method." Figure 3 shows a schematic of an impact-echo test.

C. REAL-TIME INSPECTION AND MONITORING

Smart monitoring systems can help engineers by collecting accurate and high-quality real-time measurements of foundation element conditions, communicating this information with the control system and signaling warnings should an irregular pattern be observed.

Sensors for structural health monitoring are designed to facilitate the monitoring process and to enable maintenance engineers with decision-making tools, which will ensure the safety and serviceability of these foundations.

CRACK MONITORING

Wind-turbine foundations can experience substantial cracking for various reasons: Construction procedures can result in early shrinkage and thermal cracks. Foundations are subject to moisture, which might increase the likelihood of rebar corrosion over the service life. Moreover, the foundation block is subject to vibration and tensile stresses as a result of dynamic wind loading on the tower and turbine. Assessment of these cracks is performed using above-ground methods or through excavation, which tends to be labor intensive and time consuming and might require removing the turbine from the power grid (Perry et al. 2017). Fiber-optic sensors can be used to monitor abrupt changes in stress and strains on concrete and steel bars. Moreover, a relationship between strains in the tower and strains in the foundation can be developed and used as a basis for inspection and monitoring of cracks in foundation blocks.

TILT MONITORING

Cyclic and dynamic wind loads on the turbine blades and the shaft are transferred to the foundation block resulting in excessive stresses (compressive and tensile) and tilt. Excessive tilt may result in the malfunctioning of the turbines, expensive repairs, and even complete shutdown of wind turbines. Structural health monitoring systems involving tiltmeters can be used to assess the foundation tilting in real-time. The tiltmeters can measure angles of slope (or tilt), elevation, or depression of wind-turbine foundations with respect to gravity's direction and create early warning of potential structural damage (Bhattacharya. 2019).

VIBRATION MONITORING

Wind-turbine foundations are subject to different types of dynamic loads, including: wind, wave, and the rotational effects of the rotor (i.e. rotor frequency and the blade passing frequency). The stiffness of operational wind-turbine foundations can change with the loads imparted on the superstructure, which in turn can result in a change in the modal parameters (i.e. natural frequency, mode shape) of the turbine foundation (Adhikari, 2012).

Dynamic response of the foundation block is critical given the fact that these components are subject to rapidly changing wind loads and turbine/blade vibrations. This is critical for the stability and reliable performance of the structure. Vibration-based structural health monitoring solutions use data obtained from an array of accelerometers and measure vertical and/or horizontal accelerations at specific locations. These sensors are deployed for real-time performance evaluation of wind-turbine foundations under variable cyclic and dynamic loads.

CONCLUSIONS

Concrete foundations of wind-turbine elements are subject to complex loading conditions during construction, and while the structure is at service. Cracks and defects can happen as a result of construction practice or due to excessive dynamic loads from the wind or vibration of the tower and the turbine blades. Development and progress of cracks in the foundation can affect the stiffness of the foundation, resulting in premature structural deficiencies, and durability related issues.

A combination of non-destructive testing solutions and structural health monitoring systems can be used to enhance the quality control and quality assurance of new wind-turbine foundations. Moreover, these testing solutions can be used to assess the performance of the existing foundation blocks in real-time and trigger necessary warnings to help the asset owners and maintenance managers prioritize their repair and maintenance needs.

REFERENCES

[1] ACI 228 Committee (2013) "Report on Nondestructive Test Methods for Evaluation of Concrete in Structures," American Concrete Institute.

[2] ACI 301 Committee (2016) "Specifications for Structural Concrete," American Concrete Institute.

[3] ASTM C1383-15, Standard Test Method for Measuring the P-Wave Speed and the Thickness of Concrete Plates Using the Impact-Echo Method, ASTM International, West Conshohocken, PA, 2015.

[4] Canadian Wind Association (2019) "canwea.ca/wind-energy/installed-capacity/" Last visited 15 July 2020.

[5] Charles Nmai (2010) "Support Systems: What to Consider when Concreting Wind Turbine Foundations" Alternative Power Construction.

[6] Perry M, McAlorum J, Fusiek G, Niewczas P, McKeeman I, Rubert T. Crack Monitoring of Operational Wind Turbine Foundations. Sensors (Basel). 2017;17(8):1925. Published 2017 Aug 21. doi:10.3390/s17081925.

[7] Sansalone, M., and Carino, N.J., 1986, "Impact-Echo: A Method for Flaw Detection in Concrete Using Transient Stress Waves," NBSIR 86-3452, National Bureau of Standards, Sept., 222 p. (Available from NTIS, Springfield, VA, 22161, PB #87-104444/AS).

[8] S. Bhattacharya, Design of Foundations For Offshore Wind Turbines, Wiley and Sons Ltd., 2019, pp. 202–210.

[9] Strategic Highway Research Program-SHPR2, 2013 "Nondestructive Testing to Identify Concrete Bridge Deck Deterioration", Transportation Research Board.

[10] Adhikari, Sondipon & Bhattacharya, Subhamoy. (2012). Dynamic Analysis of Wind Turbine Towers on Flexible Foundations. Shock and Vibration. 19. 37-56. 10.1155/2012/408493.

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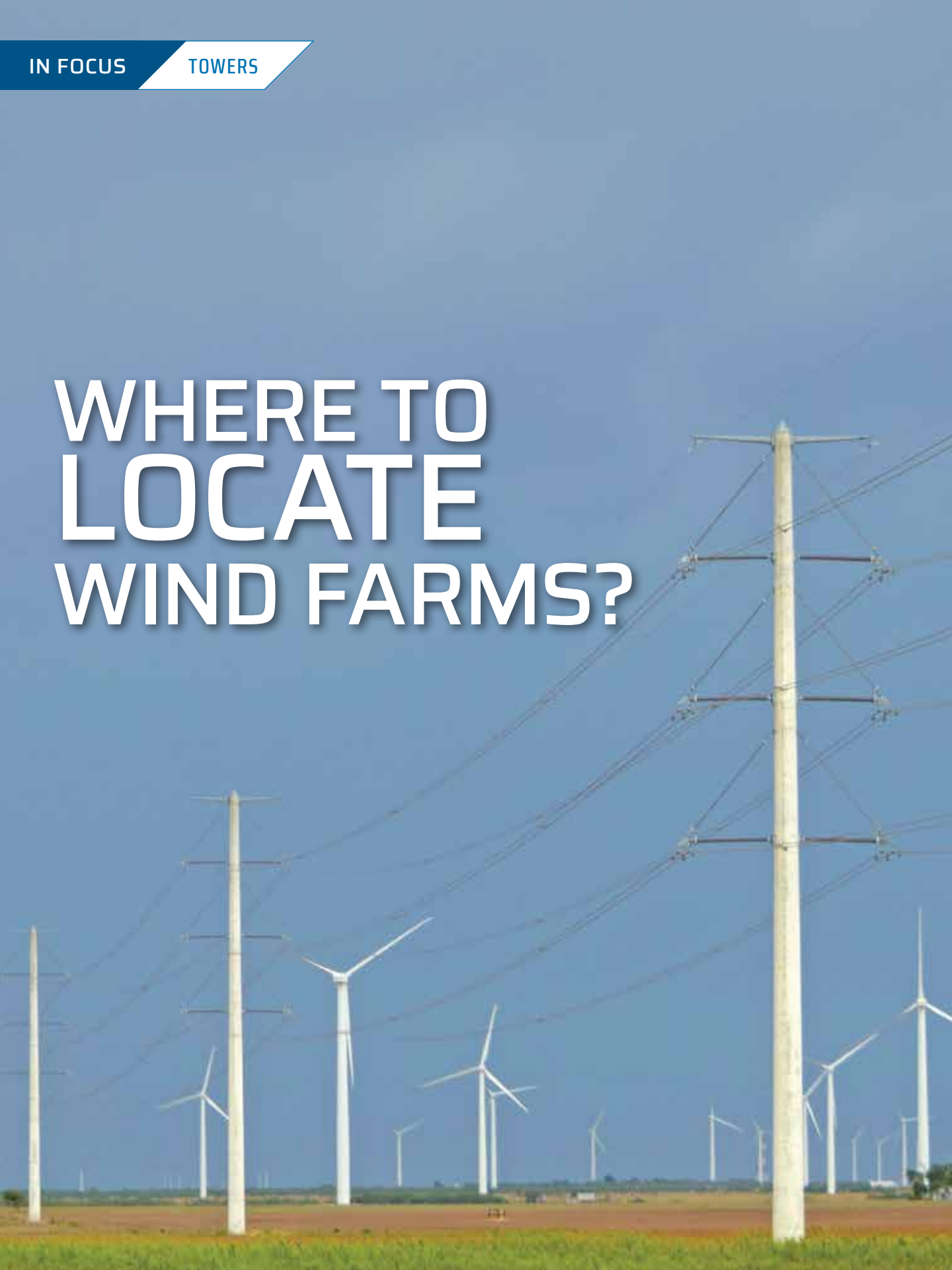
WHERE TO LOCATE WIND FARMS?



From a lubricant standpoint, wind turbines operating under fairly consistent conditions will lead to extending the durability of gear oils.

By DR. NEIL CANTER

Wind power is emerging as a sustainable source of electricity. As we know, finding solutions for improving the reliability and durability of gearboxes is a long-standing objective for the lubricant industry.

Wind farms tend to be in remote locations, whether on land or offshore. In a Tribology and Lubrication Technology article [1], a study that complemented a 2015 report on offshore wind energy by the U.S. Department of Energy (DOE) was discussed. The authors of the follow-up study indicated that the DOE should have factored in the availability of the rare earth metal neodymium because it is needed for direct drive systems, which are preferred for use offshore. As part of this work, the authors divided the U.S. into five distinct regions and developed what-if scenarios to predict the potential use of neodymium for the next 30 years in each region.

Besides the challenges just discussed, optimizing the electricity generated is difficult to do because of regional differences in the magnitude of the wind power. Predicting the wind speed in any specific location even 24 hours ahead is difficult to forecast.

"A power company, reliant on wind power, must plan on a daily basis how much energy will be provided," said Guido Cervone, professor of geography, meteorology, and atmospheric pressure at Penn State. "The answer will prompt the power company to determine how much energy they may need to buy or sell on any given day. Costs will rise if the power company must continue to buy electricity from other sources if they cannot secure the anticipated amount from wind power."

There are several methods available to predict wind speed that have been organized into the following categories: numerical weather prediction models, statistical models, artificial neural network models, and hybrid models. Some of these models are better at short-term forecasting (30 minutes to six hours ahead), while others contribute better to long-term forecasting (one day to one week ahead).

"Each of these models has inaccuracies that are analogous to the cone of uncertainty and spaghetti models seen in weather forecasting," Cervone said. "One crucial factor for the operational use of renewable energy is to estimate how well models are able to predict future outcomes. This predictability parameter now proves to be useful in using past wind data to predict the future."

Cervone, Dr. L. Delle Monache of Center of Western Water Extremes, Scripps Institution of Oceanography at the University of California-San Diego, and his colleagues used predictability in a new technique to prepare a probability curve for wind speed across the U.S.

THE ANALOG ENSEMBLE APPROACH

The researchers used a model known as the Analog Ensemble approach to determine wind speeds at specific locations.

"The Analog Ensemble is the brainchild of Dr. Delle Monache, and it was first developed at the U.S. National Center for Atmospheric Research," Cervone said. "It generates probabilistic forecasts for future outcomes by analyzing past performance of forecasts. A two-dimensional grid determines the probability distribution of wind speeds using variables such as temperature and pressure over space and time."

The forecasting was done for wind that is 80 meters above sea level.

"We used this altitude because it is the height of the hub of the turbine, which is the component connecting the blades to the main shaft," Cervone said.

For a specific location, data from the past is used that matches as closely as possible the location's time of year in order to predict the future.

"In our efforts to predict wind speed 24 hours in advance, the model selected specific dates from the past (such as January 1, 2016, March 15, 2016, and November 10, 2016) that have the same weather as is predicted at the time of forecasting," Cervone said. "The database of past weather we used extended from January 15, 2015, through January 14, 2017. We used six-hour intervals in using the model to predict wind speeds."

The challenge for the researchers is dealing with extreme weather events.

"Weather events that do not necessarily occur routinely at a specific location are more difficult to factor into the Analog Ensemble model," Cervone said.

Extreme weather is more likely to be found in regions where the average wind speed is higher.

"An operator can use this model to place a wind farm in a specific region with a fair chance that the electricity generated will meet the specific demands of a utility," Cervone said. "Some measure of uncertainty will always be present, leading to the fact that locating a wind farm anywhere always has a certain degree of risk."

The researchers are determining how to use this model to account more accurately for extreme and rare weather events.

"We also are evaluating every grid in the U.S. to determine how to better improve the accuracy of the model," Cervone said.

Recognition exists that wind farms operate optimally when the wind blows at a low rate of speed and is fairly consistent. Cervone is fairly confident that the model produced in this study will be useful for assisting the wind-turbine industry with situating turbines in locations that can gen-

Wind farms tend to be in remote locations, whether on land or offshore. (Courtesy:STLE)

A new model to predict wind speeds in a particular location has been developed to help operators indentify locations where wind farms can be placed to maximize electricity output. (Courtesy: Penn State University)

erate electricity at an optimum rate to meet current and future demand.

"Our model will not tell operators where to place a wind farm but, rather, assist them with understanding the probability of having the proper wind conditions to produce electricity successfully in any specific location," he said.

From the lubricant standpoint, wind turbines operating under fairly consistent conditions will lead to extending the durability of gear oils. Additional information on this research can be found in a recent article [2] or by contacting Cervone at cervone@psu.edu.

REFERENCES

[1] Canter, N. (2019), "Challenges in implementing offshore wind power," TLT, 75 (10), pp. 14-15.

[2] Shahriari, M., Cervone, G., Harding, L. and Monache, L. (2020), "Using the analog ensemble method as a proxy measurement for wind power predictability," Renewable Energy, 146, pp. 789-801.

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TRAINING IN THE WAKE OF CORONA

Advance rescue training — The GWO safety standard enables successful transport of a co-worker, who cannot self-evacuate, to an assembly point until professional emergency responders arrive. (Courtesy: GWO and High Plains Technology Center)

Wind turbines haven't stopped turning, which means they still need servicing, so practices have been redefined for training safely post-COVID-19.

By SIMON HAYES

At the height of the global pandemic, as little as 24 percent of the usual amount of safety training was available for the world's wind-power workforce.

Government lockdowns almost everywhere rendered schools, colleges, and specialist training centers unable to provide courses, despite the fact our workforce had a continuing obligation to keep wind turbines spinning.

Now, as centers in the United States are reopening for safety training and refresher courses, which keep workers' skills in life saving or working at height up to speed, several trends and best practices have emerged.

Global Wind Organisation (GWO) has maintained close contact with its network of more than 350 training providers, 17 of which operate in the U.S. and Canada. The objective has been to share best practice and innovation among this global community. We've held weekly webinars with GWO providers in Taiwan who shared their experience dealing with SARS in 2003; a large center in Poland which was the only country in Europe to continue training during the Pandemic; and Siemens Gamesa Renewable Energy's Orlando, Florida, training center, which has used techniques borrowed from nuclear decontamination processes to reopen its operations safely for all concerned.

We held conversations with three GWO certified training providers to listen to details of their reopening action plans at locations at the center of the wind industry in the United States:

- **ENSA North America, Amarillo, Texas:** Opened April 6.
- **High Plains Technology Center (HPTC), Woodward, Oklahoma:** Opened May 4.
- **Safety Technology, Sweet Water, Texas:** Opened May 22.

It is important to point out that the wind industry is expanding rapidly, and all three of these training centers have a healthy backlog of companies and individuals who want and need safety training.

BEGINNING WITH A LOOK AT BEHAVIORS

"The whole approach to reopening starts with the understanding that people and everything at a training center poses a risk of infection," said Nick Jones, training product manager for ENSA. "There is a need to do the homework and build plans that protect everyone. That is why ENSA partnered with a pandemic expert throughout the planning process."

Ben Dickens, vice president, sales & marketing North America for Safety Technology, emphasized what is expected of instructors and trainees for personal protective equipment (PPE) and sanitizing through the training experience, and everything starts with building new practices.

Over at HPTC, the challenge every day is doing what is possible to protect instructors and trainees, according to Taylor Burnett, business and industry services, assistant superintendent.

"Taken together, these insights indicate that even before reopening, the mindset of commitment to changing operations and processes for the protection of all is essential," Burnett said. "The bottom line is that there is no room for complacency."

STARTING BEFORE TRAINING EVEN BEGINS

Doing things differently begins with understanding local mandates, guidelines from the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO), and other standards including OSHA 3990 in preparing to reopen.

At HPTC, there is a distinct and separate entrance, as well as exit to the facilities located on a technical school campus.

"Planning included identifying two separate buildings so courses and instructors can be staggered, allowing time for sanitizing before and after classes," Burnett said.

Similarly, at Safety Technology, the training center is on a technical school campus that allowed for simplified and controlled access to the facility by trainees as well as for sanitizing.

Jones at ENSA explained that a spirit of collaboration is essential for everyone. That is why they partnered with the hotel near the training facility where trainees stay to make sure the cleaning and disinfecting protocols met their standards, including a thorough disinfection of every room after a guest checks out, making sure the employees wear masks or face coverings, and the disinfection of all common areas at least three times a day.

All three training providers also track trainees coming to their facilities 14 days before arrival. This means that all trainees fill out forms that cover potential COVID-19 symptoms, contact with individuals who have had symptoms, any travel by air, participation in gatherings of 10 or more people, and visiting any hot spot for cases identified by the CDC.

Because the instructors at Safety Technology have led courses offsite with clients, they took the initiative to maintain similar records for their instructors, and the documents are updated every two weeks.

ARRIVING AT THE CENTERS AND TRAINING BEGINS

Nearly all trainees drive to the centers, which alleviates concerns with air travel. Upon arrival, they bring their signed form, which is reviewed for exceptions before training be-

A student administers a temperature check upon entering the training facility. (Courtesy: GWO and High Plains Technology Center)

gins. That is followed by a temperature check for everyone.

It is essential that trainees are provided with PPE including helmets, masks and gloves. At High Plains Technology Center, trainees also bring their own harnesses and lanyards. Expectations for use of PPE and sanitizers are explained in detail by all three training providers. Instructors also have a key role in demonstrating the expectations for PPE as well as social distancing.

The ratio of trainees to instructors is reduced by all three training providers to allow for social distancing. For example, at Safety Technology, the ratio of trainees to instructors is four-to-one as compared to six-to-one.

Stations for trainees in the classrooms are at least six feet part in all cases to allow for distancing and maintaining a safe environment.

There is a natural tendency for people to want to move closer together during the training so that is why it is vital for instructors to be able to maintain social distancing. At ENSA, they have gone a step further to include a floor monitor in each classroom to oversee social distancing for a safe environment.

In all cases, training providers can lead the full GWO content of basic safety standards, which includes first aid, manual handling, fire awareness, and working at heights. The only significant change is use of mannequins in some of the hands-on training for the first aid and working at heights modules.

SANITIZING, SANITIZING, SANITIZING

When it comes to sanitizing, two areas of focus are the individuals and the equipment.

Sanitizing stations are part of the reception areas and in the classrooms for the trainees, and breaks are taken solely for sanitizing. Each of the centers also operates an extremely detailed cleaning plan.

At Safety Technology, when a trainee uses a climbing tower, it is cleaned after each use; it is cleaned after the end of each day again, and the equipment is cleaned between courses, too. A detailed cleaning plan is in place for training rooms that are sanitized multiple times each day. Records are kept to ensure all are sanitized appropriately.

Because HPTC staggers its classes, the climbing tower is used first in one session and last in the second course. This allows for cleaning before and after. In addition, the facilities' surfaces are cleansed with a sanitizing gun twice each week. This technique has a proven past in that it was used during flu seasons and reduced cases, according to Burnett.

ENSA started by evaluating the training center for low- and high-touch locations. Examples of high-touch locations are door handles and counters, which are disinfected four times a day. Low-touch locations are sanitized daily. When it comes to equipment such as lanyards, trainees are the only ones who handle the gear over the course of a week, storing it in a locker after each day. After training is completed, the equipment is sanitized and stored for at least 48 hours.

LOOKING OPTIMISTICALLY TO THE FUTURE

Each of the training providers reflects what is going on in the growing wind-turbine industry where hiring technicians continues to be very strong. Furthermore, these training providers noted that they are hiring instructors.

At ENSA, Jones observed, "We're at capacity, and this is

A student and instructor use a moulage kit for first aid training. A moulage kit is used to replicate injuries for first aid training. (Courtesy: GWO and High Plains Technology Center)

because of a collaborative effort, where everybody came up with ideas for the benefit of all."

"High Plains Technology will have its largest numbers for year ending in June," Burnett said. "I see an even better year ahead."

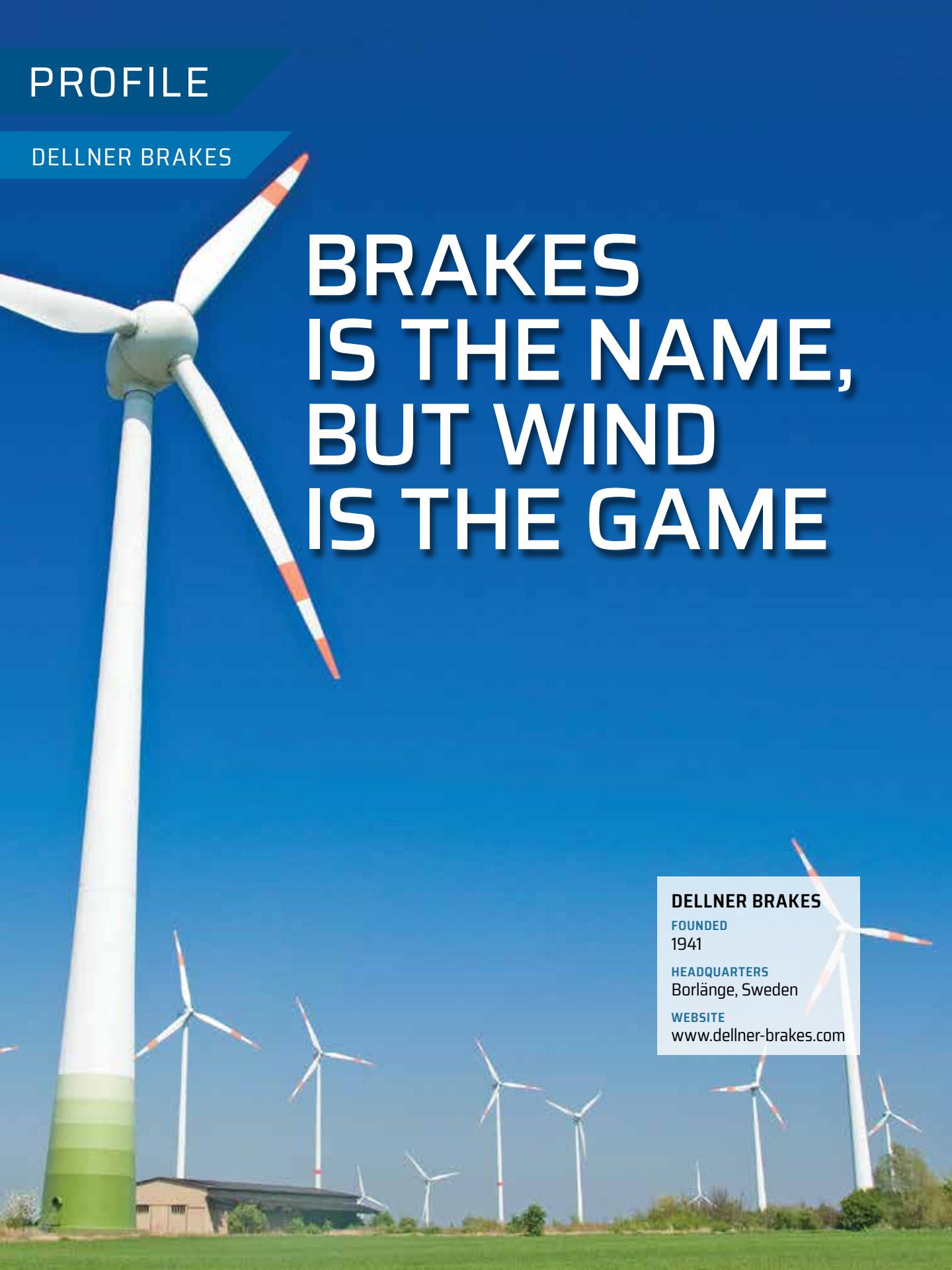
"Our pipeline is filled at Safety Technology," Dickens said. "We could exceed our numbers because the market is solid."

As Jones pointed out, the key is to make sure trends are followed, watched, and understood to build forward in the right way ... safely.

ABOUT THE AUTHOR

Simon Hayes, vice chairman of the North America committee of GWO, is head of Health, Safety and Environment (HSE) for Ørsted and the offshore business in North America, located in Providence, Rhode Island. He previously was lead project HSE manager for the company. Hayes also gained experience at DONG Energy, the predecessor company to Ørsted, where he was team lead — site HSE, site HSE manager for the construction phase of the GODE 01 & 02 offshore wind farm, and site HSE manager and project HSE manager for the construction phase of the Borkum Riffgrund 01 offshore wind farm. The Global Wind Organisation is a non-profit group of wind turbine owners and wind turbine manufacturers, committed to the creation and adoption of standardized safety training and emergency procedures.

BRAKES IS THE NAME, BUT WIND IS THE GAME



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By approaching customers with a full-service mentality, Dellner Brakes works to supply the industry with a range of lightweight, noise-free systems for braking and gliding processes in wind turbines.

By KENNETH CARTER ◤ Wind Systems editor

When watching a wind turbine slowly spin from a distance, it's easy to forget just how massive the blades actually are — as well as how fast they really are turning.

And sometimes, whether it's for scheduled maintenance or an emergency, those blades have to stop.

To perform that task, turbines are equipped with braking systems — and many of those braking systems are manufactured by Dellner Brakes.

Through Dellner's JHS product line, the company offers a range of lightweight, noise-free systems for braking and gliding processes in wind turbines, with an emphasis on noise reduction, which can play a big role in the overall acceptance of wind energy.

"What we offer is a complete braking system," said Dellner Brakes CEO Marcus Aberg. "That could be a yaw brake or a sliding bearing for the yaw brake, a rotor brake that slows and stops the rotor or a rotor lock that fixes the hub in place — right through to hydraulic power units and advanced friction materials, in line with our full system approach."

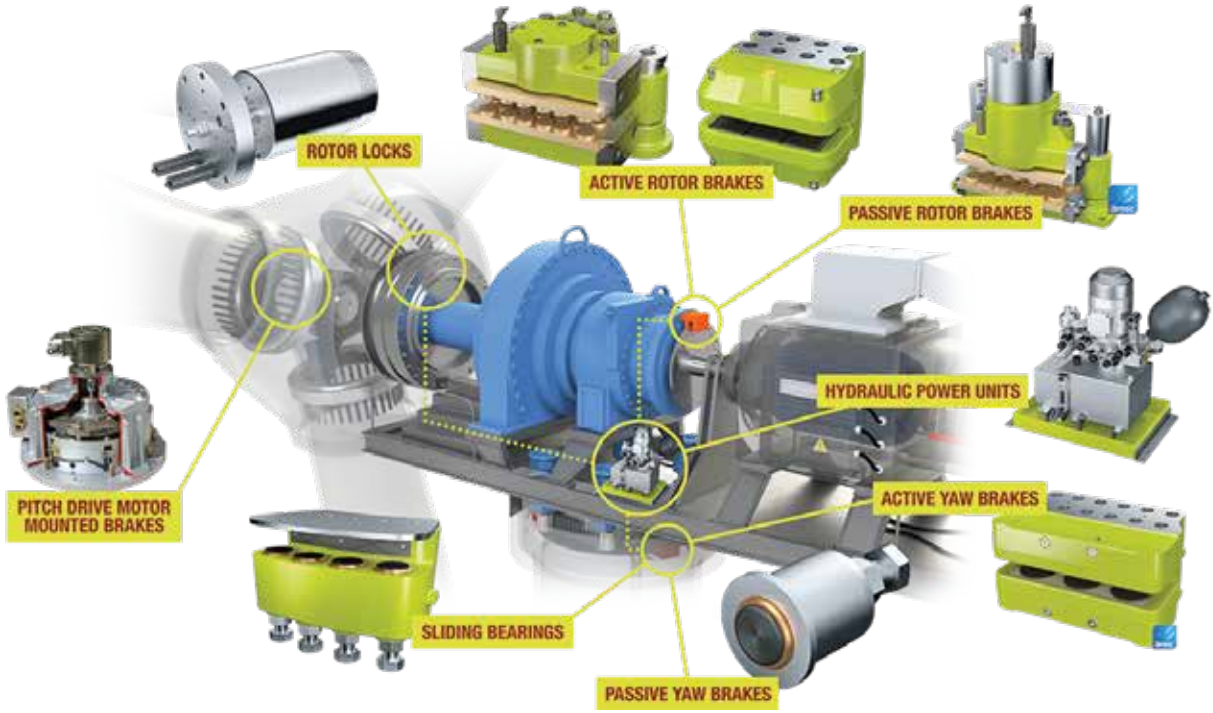
FULL BRAKING SYSTEM

Dellner is able to supply a full system that includes the power source, the brake and friction materials, as well as the locking devices.

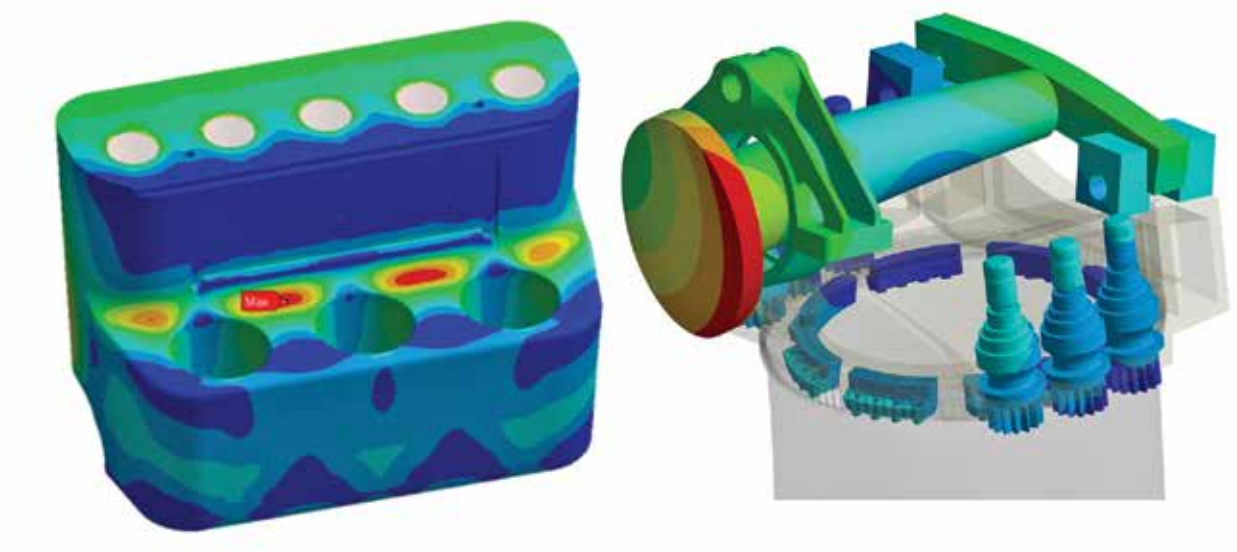
Some of the components that make up Dellner's full braking system include yaw brakes used to stop and hold the rotating nacelle in position once the rotors have been turned to face into the wind, hydraulic rotor locks that fix the hub of a wind turbine so maintenance can be carried out in safety, and rotor brakes used for slowing, stopping, and holding the turbine's rotors, including emergency stops.

Even with Dellner's wide range of braking hardware, Aberg is keen to emphasize that their business is not just about the brakes.

"It's a hard task, but our ultimate goal is to be part of the wind industry, and not just be 'the brake people,'" he said. "We would like to understand as much as possible about the full turbine, how it works, and how it's manufactured. If we can understand the turbine better, then we are in a much better position to develop the right braking system for our customers."



This look inside a wind turbine shows Dellner Brakes' products at work. (Courtesy: Dellner Brakes)



Dellner Brakes provides engineering services for manufacturers' own product design. (Courtesy: Dellner Brakes)

And Aberg says Dellner likes to be hands-on with a project from start to finish.

"We like to be hands-on and be there to help our customers out wherever we can," he said. "When we're closely involved with manufacturers and their projects, I think that makes it easier for us to see things in the round and then use our experience to support development."

UNDERSTANDING THE FULL PICTURE

Part of the reason Dellner wants to be more than just a brake supplier is the simple reality that a wind turbine is made up of so many parts with the common goal of creating clean energy.

"When a customer comes to us, we try to understand the full picture," Aberg said. "If we can understand how the turbine works, we are then in a stronger position to develop solutions on how to control it with the brakes. Development of a wind turbine is always ongoing, and we are at our best when we are invited to be part of that development as part of the OEM's team. I would say the last year and a half have been really busy for us in regards of being a partner for a lot of OEMs, working together to create new turbines and new ways to control them with our brake systems."

To that end, Dellner is able to offer engineering services so its customers have a strong platform from which to start manufacturing braking systems. Those services include engineering and 3D construction of components, assemblies, tools, and special parts; optimization of existing solutions, technical documents, customized testing, and development of prototypes.

And since wind turbines are being built all over the world, it becomes paramount that the parts are tested to endure in a wide variety of climates. Dellner has a climate chamber available to make sure parts can pass that critical requirement.

NEW TO WIND

Dellner Brakes, based in Sweden, is a family-owned business that has been developing, manufacturing, marketing, and maintaining brake solutions for industrial, marine, and oil and gas since the 1950s.

But in September 2018, Dellner Brakes acquired German wind-brake specialist JHS and has been making prominent headway in the wind sector as a result.

"We are building a worldwide organization," Aberg said. "Right now, we are established in China, in India, in Europe, and in the U.S., and we are also starting up in South America. These business units are 100-percent focused on the wind market."

STEADY, STRONG, PROUD

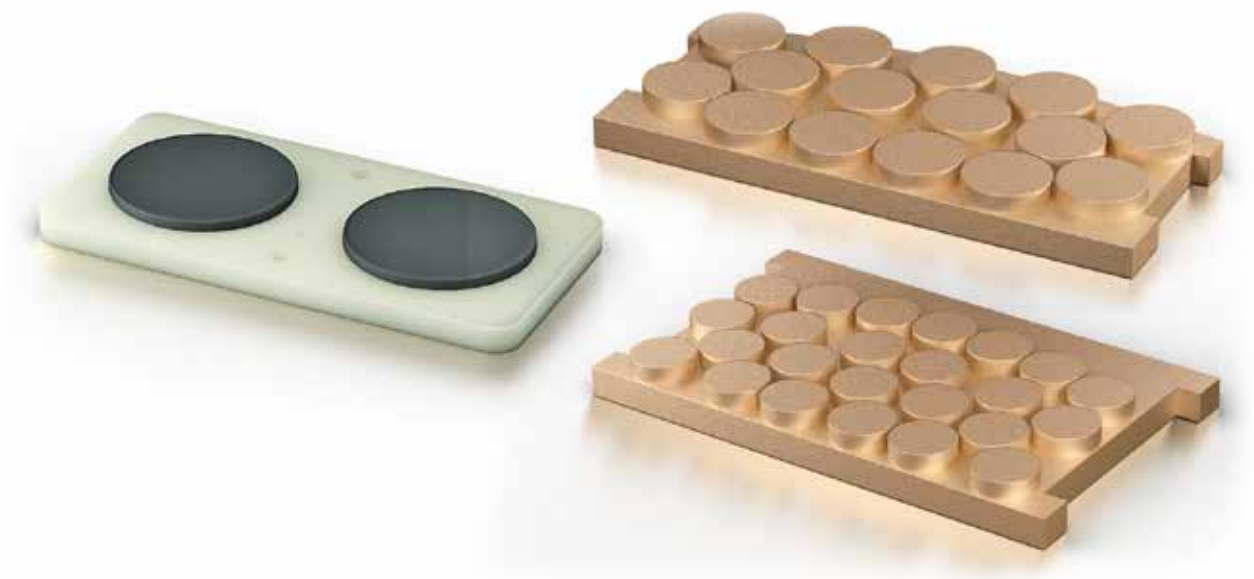
Hard work and hard-won partnerships are Dellner's core strengths, and it is something Aberg is particularly proud of — when he is spurred into admitting it.

"I'm from Sweden, and we are quite practical, down-to-earth people," he said. "But I do have lots of good memories through the years where we have worked in partnership with our OEM manufacturers. Where we have succeeded the most is when we've been able to work together with a customer and help them develop their product to be more competitive in the market. We are pleased to have been here with Dellner Brakes during the past 20 years and, having entered the wind market, to be a part of that development."

STRONG GROWTH AHEAD

And Aberg said Dellner's wind division is hoping to continue making strides in the constantly growing industry.

"I see the industry developing quite strongly," he said. "If



High quality spares and accessories including brake pads, side linings, and service tools. (Courtesy: Dellner Brakes)

you look into 2020 with everything that's happening, it feels like wind is standing tall."

Even though wind as an industry is still quite young compared to, for example, the automated train industry and power plants, unlike those industries, wind is working toward a cleaner future.

"It's one of the most developed green energies that we have," Aberg said. "It feels like it's constantly being developed, and the development of getting more efficiency out of the wind turbines will most likely continue. The wind is constant, giving us a good opportunity to create green, substantial energy for society. It feels like it will be steady for a long time."

Erica Cole

Product manager of mechanical goods ◤ Pure Safety Group

"We're experts in the products that we design and, on top of that, you have full compliance covered in a range of different countries."

◤ What's a typical day like for you at PSG?

I'm a product manager for Pure Safety Group, managing hard goods and metal goods categories, which include self-retracting lifelines, horizontal lifelines, ladders, anchors, and guardrails.

I'm like a mini-CEO for these categories. I make sure that these areas of the business are running smoothly and are profitable.

To be honest, there really isn't a typical day. It's varied. Some days I may be sitting in a meeting all day, other days I may be out with customers. I may be looking at a design or talking with compliance. I'm running steady and fast the entire time, but that's one of the things that I like about this job. It keeps me on my toes.

◤ What types of safety products do you offer the wind industry?

Pure Safety Group is made up of three different brands.

We have the Guardian Fall Protection brand, which is a brand that's really well-known in general industry and construction, but we also service other industries. Guardian was originally founded just outside of Seattle in Kent, Washington. The brand is very well-known for its anchorage products and self-retracting lifelines, which are used throughout several industries.

The second brand that's under the Pure Safety Group header is actually a company that's based in the U.K. — Checkmate Lifting & Safety.

It originally started out as a company that did lifting, rigging equipment, gear, and things of that nature. The head of this business for Pure Safety Group grew up in the business. His father started the company, and so he knows fall protection in and out. If you think about it, if you've been around fall protection since you were 5 or 6 years old, how well does this man know the products, so he can solve any fall protection problem?

His name is Oliver Austin and, if you're familiar with our industry, you'll know Oliver's name. He's done committee work. He's very into design. I would say that Checkmate is the innovation powerhouse of the business.

The Checkmate brand of PSG is responsible for a lot of proprietary products and patents — very high-tech products — using advanced materials, and it's looking at bringing in new technologies and solving really big nuances of the business, while making products inherently safe. That's the branch of the business that really gives us the new and exciting products.

The third brand that we have under our business is Stronghold. The Stronghold brand is a dropped-object prevention company. They also make products for the nuclear industry. And they are one of the best at it. There are other companies and competitors of that nature that have a similar product offering, but Stronghold was the original innovator and creator, and it still continues to innovate dropped object prevention; they're continually developing the newest and the latest, and they're really thinking about: How do we make people who are working at height even safer?

That being said about all of the three brands, the products that we have to offer for the wind and safety industry are positioning lanyards and the most comfortable climbing and tower harnesses, as well as products for rescue and descent. I think about the wind industry in three different areas: assembly, maintenance, and rescue.

If you think about assembly, you may have somebody who's putting a tower up or working around assembling a wind turbine.

They need to be in fall protection all day. If you're in fall protection all day, it's critical to you that you're able to move around and perform your job. The equipment you're wearing and using needs to be comfortable, and it needs to

be lightweight. If you look at products from Checkmate, a lot of innovative harnesses — like the latest harness from Checkmate, the Xplorer Harness — are designed to be extremely lightweight. The way the harness is made actually contours to the curves of your body.

If you're up working on a turbine or a tower, there's actually a sub-pelvic assembly in the harness that makes it extremely comfortable so you can work in an almost semi-seated position.

The connection on that harness is actually a ring connection, so if you think about climbing, moving up and down, or even just range of motion, it fully allows your hip and your leg to move with a full range of motion so you don't get that restricted feeling you may get in a standard harness.

I think people who are actually wearing that equipment and using it day in, day out, all day, those are the things that really matter to them, because if you have to be in something all day, it needs to be something that's not distracting you from doing your job. You don't want to be like, oh, I have a cramp in my leg. You just want to be able to get the job done.

With positioning lanyards, the No. 1 issue with the wind industry is the weight, because it's on your person, or you're tied off to it.

Things like offering aluminum connectors, which use innovative material that's safe and compliant. PSG products are OSHA compliant, ANSI compliant, CSA compliant, and EN compliant, so the nice thing about Pure Safety Group and our products is that, because we have companies in various locations across the globe and fall protection is all that we do, we know what's required everywhere for fall protection. We're not manufacturing gloves or safety glasses or gas detectors. It's just fall protection.

We're really experts in the products that we design, and, on top of that, have full compliance covered in a range of different countries.

On the rescue side of things, I would definitely highlight another Checkmate product, which would be our MAX Descender.

When a turbine is being assembled, God forbid you need to rescue somebody. And with the wind industry, height is going to be one of the major factors you need to be concerned with, as well as speed.

If you have someone who has fallen, or they're in a position that they need to be rescued, they're incapacitated. You want to get to that person as quickly as possible. If they're 300 feet up in the air, you really want to get to them fast, and you want to be able to get them safely down to the ground quickly.

Looking at the MAX Descender, one of the nicer components about this unit is it does have a stainless steel and aluminum construction, so it's a lightweight product for the industry, but also can be used with a drill or as a wheel, which allows you to ascend or descend at a faster pace to get that person to safety. You can use it upright, or you can also use it in an inverted mode if needed.

Also, weight requirements need to be considered. When you're rescuing somebody, you may have at least two people, maybe more, on this one line. You want to make sure that you're able to get them down safely, so our product can handle up to 660 pounds. And it comes in custom lengths.

What other methods does PSG use to keep wind technicians safer?

We have a full training program we offer in-house. We do training through our HART training program and offer classes. You can come into our facilities either in the U.K., which is about an hour or so outside of London, or you can come to Kent, Washington, which is just 30 minutes outside of Seattle, or to Pasadena, Texas, near Houston.

We also do online training, and we do training where we will come into your facility. We have a list of training courses that are already preset, but we also do customized training through the HART program.

It's a full offering, and it's kind of nice if you think about it for the wind industry. In your industry, because at-height technicians need training on those specific products because they are a bit more complex than your standard fall protection. They're a lot more involved.

How has the COVID-19 pandemic affected how PSG works with the wind industry, or has it?

It's definitely had an effect. It's not just with wind. It's affected how we work with everyone. A lot of the training has moved to online vs. in-person and, even when we're doing in-person training, the class sizes are different, or we need to make sure we're in an outdoor environment.

We've also had a lot of recent requests and questions as far as just cleaning the products: How do I clean my harness? What chemicals are allowed? How is it that I need to be cleaning my lanyards? We've had a lot of requests from customers who are actually looking at replacing their equipment just due to COVID. It's been a time I think about where the focus in the global economy has really been on keeping people safe, putting the focus back on families, and the person, and if you think about your colleagues irrespective of the industry, they truly are your family.

With wind specifically, it's an industry where safety is the utmost concern, and we have a lot of well-versed people on the products who are professionals. I've also seen a lot of companies investing in their workers more during this time, and I think Pure Safety Group has done a good job of pairing our people with our customers, looking at their existing equipment, and making recommendations on how they can continue to keep their workers safe during COVID — making sure they have each worker outfitted with the tools they need.

So, when they do get back on the job full-time, everybody is fully trained and ready to go. There's been a large focus on training during this time.

MORE INFO www.puresafetygroup.com

The 12-MW Coastal Virginia Offshore Wind (CVOW) pilot project is 27 miles off Virginia Beach. (Courtesy: Dominion Energy)

CONSTRUCTION

Dominion completes first offshore project in U.S. federal waters

Dominion Energy recently announced the successful installation of the two turbine, 12-MW Coastal Virginia Offshore Wind (CVOW) pilot project 27 miles off Virginia Beach. The first offshore wind farm to be approved by the Bureau of Ocean Energy Management (BOEM) and installed in federal waters and second constructed in the United States was built safely and on schedule despite the worldwide impact from the coronavirus pandemic. The turbines will now undergo acceptance testing before being energized later this summer and will produce enough clean, renewable energy, at peak output, to power 3,000 Virginia homes.

Dominion Energy will apply the valuable permitting, design, installation, and operations experience from the pilot project to its proposed 2,600-MW commercial project. That project, which is the largest announced offshore wind project in North America, is on track to commence construction in 2024, and upon completion, will provide enough renewable electricity to power up to 650,000 homes.

Several Virginia-based companies contributed to the CVOW pilot project, and Dominion Energy remains committed to creating the expertise to position Hampton Roads to be a supply chain hub for U.S. offshore wind efforts.

Offshore wind generation is a vital part of Dominion Energy's comprehensive clean energy strategy to meet standards outlined in the Virginia Clean Economy Act and to achieve the company's net zero carbon dioxide and methane emissions commitment by 2050. Ørsted is serving as the offshore engineering, procurement, and construction lead for the project.

MORE INFO DominionEnergy.com

CONSTRUCTION

Global Wind Service finishes installation of Harvest Ridge

Global Wind Service recently finished installation at Harvest Ridge in Doug-

las County, Illinois. Vestas-American Wind Technology (Vestas) has contracted wind-turbine installation and service company Global Wind Service (GWS) to deliver crane and installation for the project. The C&I scope award included unloading, pre-assembly, erection, and mechanical completion of all turbines at the site, as well as delivery of all needed cranes and machinery for the work.

The wind farm consists of 48 wind turbines: 37 V150-4.3MW and 11 V136-3.78MW. The total capacity of the wind farm is 200 MW and is enough to power about 73,000 average households in Illinois with clean energy. The project ran over the winter and faced some challenging weather conditions as well as having to cope with the COVID-19 pandemic. But the project team and partners finished the project in safe manner.

MORE INFO www.globalwindservice.com

CONSTRUCTION

Valley Forge & Bolt hires Rick Bailey as chief metallurgist

Valley Forge & Bolt, manufacturer of hot-forged industrial fasteners, recently welcomed Rick Bailey to the company as chief metallurgist. Throughout his more than four-decade career, he has specialized in steel, the core component of Valley Forge products. Bailey will apply his scientific and technical knowledge, as well as his leadership abilities, to Valley Forge's continued growth as the top supplier of fasteners and custom critical joint solutions.

Bailey will be involved in numerous levels of the organization, with an eye on maintaining efficient, high-quality processes. His responsibilities include creating product formulations and purchasing steel, production planning, advising on forging and heat-treating, expanding employee understanding

Rick Bailey. (Courtesy: Valley Forge & Bolt)

of product functions, and assisting with quality controls.

"My strength is in treating product creation holistically — taking raw materials and carrying them through forming, machining, and heat treating to get quality levels that customers need," Bailey said. "My role is to turn science into practice, applying the technical side of metallurgy to improve processes. And to embrace continuous improvement so we're always learning and better serving our customers."

MORE INFO www.vfbolts.com

INNOVATION

Ventient teams with ONYX to advance its digital strategy

Ventient Energy, one of the largest European renewable power producers, and ONYX InSight, a leading provider of predictive maintenance solutions to the wind industry, are partnering to optimize output and extend the life of a large fleet of the U.K.'s onshore turbines with new technology.

As a fast advancing company with wide operational expertise and strong merger and acquisition capability, Ventient is acquiring onshore wind assets to achieve sustainable portfolio growth and deliver greater rewards for investors. As part of a strategy to improve the reliability of its fleet, more than 300 turbines across 17 wind farms will be retrofitted with ONYX InSight's condition monitoring system (ecoCMS) advanced sensing technology and cloud-based predictive analytics, fleetMONITOR. This will enable a transition to proactive maintenance, aiming to reduce downtime and major component refurbishment costs.

With the retrofit, the turbines will be "data-rich," enabling predictive analytics and optimized repair planning.

"Once we get the equipment installed, we can identify bearing failures routinely six to 24 months in advance of repair," said Dr. Evgenia Golysheva, head of engineering at ONYX InSight. "To ensure efficient installation, we've streamlined the process and have a strong quality assurance and control process. We have piloted on several sites already to iron out any potential technical challenges and make the scale-up easy."

MORE INFO www.onyxinsight.com

INNOVATION

Machine learning approach produces more accurate data

Researchers at the U.S. Department of Energy's (DOE's) National Renewable Energy Laboratory (NREL) have developed a novel machine learning approach to quickly enhance the resolution of wind velocity data by 50 times and solar irradiance data by 25 times — an enhancement that has never been achieved before with climate data.

The researchers took an alternative approach by using adversarial training, in which the model produces physically realistic details by observing entire fields at a time, providing high-resolution climate data at a much

faster rate. This approach will enable scientists to complete renewable energy studies in future climate scenarios faster and with more accuracy.

"To be able to enhance the spatial and temporal resolution of climate forecasts hugely impacts not only energy planning, but agriculture, transportation, and so much more," said Ryan King, a senior computational scientist at NREL who specializes in physics-informed deep learning.

King and NREL colleagues Karen Stengel, Andrew Glaws, and Dylan Hettinger authored a new article detailing their approach, titled "Adversarial super-resolution of climatological wind and solar data," which appears in the journal Proceedings of the National Academy of Sciences of the United States of America.

Accurate, high-resolution climate forecasts are important for predicting variations in wind, clouds, rain, and sea currents that fuel renewable energies. Short-term forecasts drive operational decision-making, medium-term weather forecasts guide scheduling and resource allocations, and long-term climate forecasts inform infrastructure planning and policymaking

MORE INFO www.nrel.gov

INNOVATION

GRTC proves concept of spiral turbine

Fort Myers, Florida-based Golden Ratio Turbine Concepts, LLC (GRTC), a Golden Ratio wind and hydro rotary apparatus developer, has successfully wind tested its newest Golden Spiral vertical axis wind turbine (VAWT) prototype.

GRTC stated the new Golden Spiral VAWT design conforms to its patented extended spiral leverage arm technology that increases torque. The design is based on Golden Ratio geometry and elements that create a wind turbine of superb balance in motion.

"The new VAWT is graceful, quiet, and begins spinning in only a breath of air flow," said inventor and GRTC founder James Walker. "The new Golden Spiral VAWT prototype has repeatedly proven the design concept."

The new rotor configuration differs in its elements and appearance from previous GRTC models, but it is deeply rooted in the inventor's patented concept, which creates more torque than a traditional radial rotor due to its Golden Ratio Spiral.

"Popular small wind horizontal axis wind turbine (HAWT) devices are often rated at 12.5 m/s or 28 mph, but average wind speeds are only 10-12 mph (or less) and their rated power outputs are rare," Walker said.

MORE INFO www.goldenratioturbineconcepts.com

The new hybrid Chartwell 24 design has a unique hybrid propulsion system that incorporates an electric motor alongside a diesel engine, which drive a high-performance changeable pitch propeller (CPP) system. (Courtesy: Chartwell Marine)

MAINTENANCE

Chartwell, Diverse to build hybrid CTV for High Speed Transfers

Chartwell Marine, a pioneer in next-generation vessel design, has signed a contract to design and deliver a new hybrid Chartwell 24 crew transfer vessel (CTV) for High Speed Transfers (HST), an innovative CTV operator that supports the offshore wind energy and oil and gas industries worldwide. The vessel, which will provide dedicated support for the offshore wind sector, is set to be built locally in the U.K. by Isle of Wight yard Diverse Marine, which was awarded the build contract following a competitive global tender process.

HST's order marks a milestone in the collaboration between these three British firms, which has seen a number of adaptations made to the proven Chartwell 24 design to meet the demands of hybrid operation.

The international expansion of the offshore wind sector is creating significant opportunities for the maritime supply chain and simultaneously driving substantial innovation in vessel design as operators respond to new and emerging legislative requirements. Reducing vessel emissions and fuel consumption is a key target for the industry to ensure compliance with air quality legislation and reduce the overall carbon footprint of building and operating offshore wind farms.

MORE INFO www.chartwellmarine.com

MAINTENANCE

New leadership takes the helm at GWO North America

Global Wind Organisation (GWO), the industry group responsible for safety training standards for more than 90,000 of the world's wind-energy workers, recently announced its leaders for its North America committee.

Wesley Witt, Head of Quality Management and Health, Safety and Environment for the Americas region of Siemens Gamesa Renewable Energy (SGRE) has been elected chairman of the GWO North America committee, and Simon Hayes, Head of Health, Safety and Environment for Ørsted and the offshore business in North America, has been elected vice chairman.

The GWO North America Committee is establishing standards for safety and technical training across the continent, and is encouraging training centers, community colleges, trade union, and others to deliver GWO standards for the wind-energy workforce.

Seventeen GWO training sites have now opened across North America, and the committee will focus its efforts on supporting the standards' adoption to help create a safer and more productive workforce.

MORE INFO www.globalwindsafety.org

MANUFACTURING

Siemens Gamesa launches next-gen turbine in India

Siemens Gamesa Renewable Energy continues to lead the way in India, one of the largest onshore markets in the world, with the introduction of its next generation wind turbine, the SG 3.4-145. The new wind turbine is specifically designed and optimized for wind conditions in the country and has a clear objective to deliver the lowest possible levelized cost of energy (LCOE) with high reliability. The turbine is strongly positioned to cater to the needs of the auction market and aims to further drive the growth of wind power in India.

The SG 3.4-145 is 127.5 meters tall with a blade-tip height of 200 meters, which helps it to maximize wind potential at every site. (Courtesy: Siemens Gamesa)

"The Indian market is evolving fast, and so adapting to the new market dynamics is key to our success and long-term competitiveness," said Alfonso Faubel, Siemens Gamesa Onshore CEO. "The SG 3.4-145 — an incremental innovation — is a step forward in that direction. The long-term fundamentals of the wind industry remain strong, and this new turbine means Siemens Gamesa is uniquely positioned to help our customers achieve their renewable energy goals, reinforce our leading position in the market and accelerate the cause for renewables,"

The new wind turbine is an extension of the Siemens Gamesa 3.X platform, of which the company has installed more than 3 GW globally and will be manufactured in its facilities in India starting in early 2021.

MORE INFO www.siemensgamesa.com

MANUFACTURING

TÜV NORD to certify largest offshore wind turbine

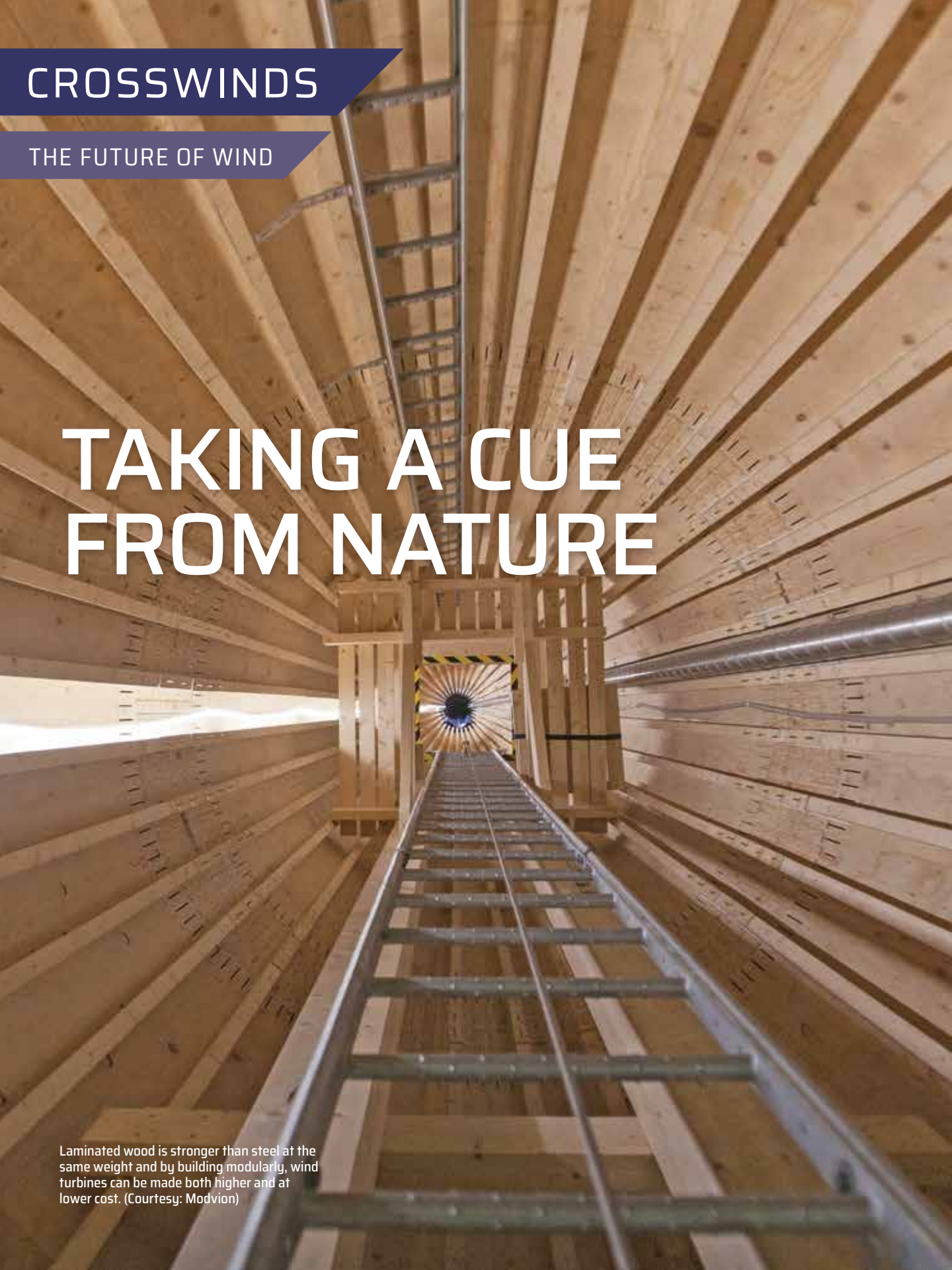
TÜV NORD recently certified the world's largest offshore wind turbine. With a capacity of up to 15 MW and a rotor diameter of 222 meters, the newest turbine from Siemens Gamesa will raise the bar and be a milestone in the generation of clean energy. Following TÜV NORD's assignment with various predecessor models, the wind-energy experts will support the SG 14-222 DD on its way to market maturity. The order covers prototype and type certification.

"We are very proud that Siemens Gamesa is relying on our expertise for this extraordinary project," said Silvio Konrad, TÜV NORD managing director.

The TÜV NORD wind experts are commissioned to certify the turbine in accordance with the internationally recognized IECRE scheme OD 501.

MORE INFO www.tuv-nord-group.com

TAKING A CUE FROM NATURE



Laminated wood is stronger than steel at the same weight and by building modularly, wind turbines can be made both higher and at lower cost. (Courtesy: Modvion)

Using wood instead of steel, Modvion AB has successfully erected a wooden wind tower in Sweden, making the turbine climate neutral before it even begins creating energy.

By WIND SYSTEMS STAFF

Sweden's first wooden wind tower has been constructed on the island of Björkö outside Gothenburg. The tower is 30 meters high and recently was erected by the development company Modvion. The wood construction is as strong as steel and makes the wind turbine climate neutral from the start. As early as 2022, the first wooden towers will be built on a commercial scale.

"This is a major breakthrough that paves the way for the next generation of wind turbines," said Otto Lundman, CEO of Modvion AB. "Laminated wood is stronger than steel at the same weight, and by building in modules, the wind turbines can be taller. By building in wood, we also reduce carbon dioxide emissions in manufacturing and instead store carbon dioxide in the design."

The wind tower now erected on Björkö is 30 meters high and will be used for research purposes. But the first wooden towers will be built on a commercial scale by 2022.

Modvion has signed declarations of intent with Varberg Energi for a 110-meter-high tower and with Rabbalshede Kraft for 10 towers, at least 150 meters high.

RESEARCH GRANT

A few months after the wind tower was constructed, Modvion was granted 6.5 million euros from the EU EIC Accelerator program. The European Commission specifically highlighted the contribution that Modvion's technology can make to restarting the post-coronavirus economy.

The call proved to be the toughest yet within the EIC Accelerator program, with only 72 of 3,696 applicants granted financing. Half of the companies offer solutions for slowing the spread of the coronavirus, while half will contribute to the EU's recovery plan for rapidly getting the economy up and running again after the pandemic.

"That we are one of the few companies to receive grants in such fierce competition is a seal of quality," Lundman said. "This financing creates security for us, our partners, and potential investors. We can now focus on increasing the workforce, building a new development facility, and constructing the first full-scale wooden wind turbine tower."

MODULAR CONCEPT

The 30-meter tower was built together with Moelven at the gluewood factory in Töreboda. The lower weight of the wood and the modular concept make it possible to build taller towers, the sections of which can be transported on public roads.

"Wood has fantastic properties, and we need to build much more in wood if we are to meet the climate goals," said Johan Åhlén, CEO of Moelven Töreboda. "For us, it is hugely inspiring to participate in this pilot project where we have been able to use renewable wood in a design for the production of renewable energy."

Wind towers in wood can be built at a significantly lower cost than steel, which lowers the production cost of the wind-generated electricity. The carbon dioxide absorbed by trees as they grow is stored in the wooden towers, which means that the wind turbines are climate neutral right from the start.

The wooden wind tower on Björkö is 30 meters high and will be used for research purposes. (Courtesy: Modvion)

Wind towers in wood can be built at a significantly lower cost than steel, which lowers the production cost of the wind-generated electricity. (Courtesy: Modvion)

The Swedish Wind Power Technology Centre at Chalmers is the client for the wooden tower in Björkö.

"Wind power is expected to be the EU's largest power source as early as 2027," said Ola Carlson, director of the Swedish Wind Power Technology Centre and assistant professor of renewable power generation. "With wind towers in wood, we get even more climate-smarter renewable electricity to face the climate crisis."

'ENORMOUS DEMAND'

The intention is that manufacturing will continue to take

> Wood has fantastic properties, and we need to build much more in wood if we are to meet the climate goals. For us, it is hugely inspiring to participate in this pilot project where we have been able to use renewable wood in a design for the production of renewable energy.

AD INDEX

The first wooden towers will be built on a commercial scale by 2022. (Courtesy: Modvion)

place in cooperation with Moelven Töreboda AB. The activities are financed by the Swedish Energy Agency, the Västra Götaland Region, and the EU program Horizon 2020 SME Instruments Phase 1.

"We are seeing an enormous demand for our wooden wind turbine towers," Lundman said. "Laminated wood is stronger than steel at the same weight and by building modularly, wind turbines can be made both higher and at lower cost. Building in wood also radically reduces carbon dioxide emissions, allowing us to offer climate-neutral wind energy."

Among other things, the EU grant will be used to build a development facility in the Gothenburg area. This is where the first tower on a commercial scale will be constructed for Varberg Energi.

"This support from the EU is clear proof of the enormous potential of wooden wind turbine towers, and it will help us develop as a company at an even faster pace," Lundman said. "We are now one step closer to being able to offer commercial, climate-neutral wind turbine towers."

ABOUT THE COMPANY

Modvion is a Gothenburg company that develops demanding designs in laminated wood, nature's carbon fiber, for large-scale construction. Wooden structures enable radical emission reductions by replacing emission-intensive materials such as steel and concrete. For more information, go to www.modvion.com