Giving Wind Direction

WIND SYSTEMS

IN FOCUS

Condition Monitoring ◤ O&M: Maintenance

PREDICTING THE UNPREDICTABLE

PROFILE

InEight

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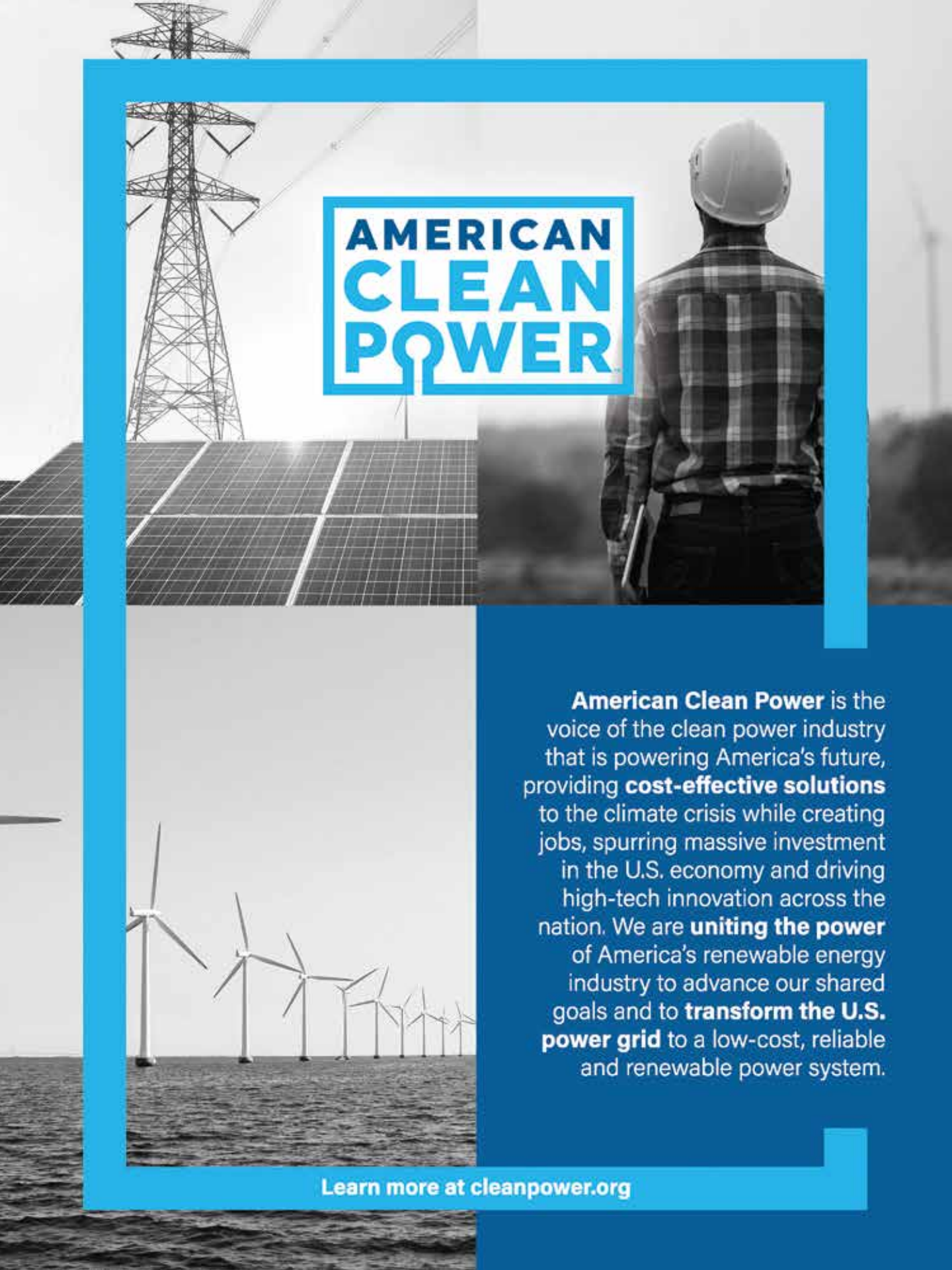

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THE COVER SHUTTERSTOCK

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◤ THE FUTURE OF WIND

Avangrid Oregon wind farm begins operations, will power 60,000 homes ◤ Study: Wind could power more than half of U.S. ◤ Interior Department announces Carolina Long Bay wind sale

NAVIGATING EARLY WIND'S MIDLIFE CRISIS

Even for turbines reaching middle-age, there is usually more than enough underutilized data to extend asset life, increase efficiency, produce more renewable energy, and bolster the balance sheet.

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FROM THE EDITOR

Signs of normalcy continue

The last two years have been a wild ride not just for the wind industry, but for the world at large.

Wind Systems was not immune to the challenges that the pandemic forced on us, but now that millions are vaccinated, it really appears that much of the world is returning to some semblance of normalcy.

Case in point: The CLEANPOWER show in San Antonio, Texas, actually happened. And not only did it happen, it was considered a huge success with more than 7,000 attendees browsing the show floor May 17-18.

I am working on a more complete show breakdown for our July issue, but I came away from the show feeling very good about the industry. I heard a lot of amazing development plans, and I suspect that can only be a positive for the future of wind, both onshore and off.

In the meantime, allow me to share this month's *Wind Systems*, which takes a look at a couple of important issues for owner-operators to consider for their wind farms: condition monitoring and proper maintenance.

Our cover article from Emerson's Thomas Andersen looks at how operating wind turbines with a condition monitoring solution equipped with the latest technologies and software enables non-visible existing and emerging faults to be identified earlier in the failure curve.

Also, on the subject of condition monitoring, John Eastman, president of ZTZ Services International, shares his insights on how a reliable condition monitoring system can ensure that the electrical bushings and other key elements are closely watched to avoid transformer deterioration.

Maintenance is also an ever-present necessity for keeping up a wind asset. Our final article from Snap-on's Mark Edmunds discusses the need to add intelligence to tool boxes and cribs in an effort to reduce tool loss on wind farms.

You'll find that and much more in this month's issue. I hope you find it as interesting as I did.

Stay cool out there, and, as always, thanks for reading!

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WIND SYSTEMS

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Carolina Long Bay lease sale shows momentum of U.S. offshore sector

From ACP

The American Clean Power Association (ACP) applauded the Department of Interior and the Bureau of Ocean Energy Management (BOEM) for holding a lease sale in the Carolina Long Bay wind-energy area that will create thousands of high-skilled U.S. jobs, strengthen coastal economies, and deliver vast amounts of reliable, clean energy to America's largest population centers.

The offshore wind-energy lease sale conducted by BOEM generated $300 million in revenue that will go to the U.S. Treasury. The two lease areas that were bid upon include 110,091 acres offshore North Carolina and South Carolina in the Wilmington East Wind Energy Area. Once fully developed, these leases could generate at least 1.3 GW of offshore wind energy, enough to power nearly 500,000 homes with carbon-free, domestically produced electricity.

The lease sale is a critical step to meeting the U.S. goal of deploying 30 GW of offshore wind energy by 2030, which could create up to 83,000 jobs and $25 billion in annual economic output. The U.S. offshore wind industry is investing billions of dollars in a domestic supply chain, including investments in fabrication facilities, port upgrades, vessels, and workforce training.

"This lease sale shows the strong demand for clean energy, and it should also be a sign to Congress to repeal the 10-year moratorium on offshore wind leasing off the coasts of North Carolina, South Carolina, Georgia, and Florida," said Heather Zichal, ACP's CEO. "Creating a stable policy platform for offshore wind development and facilitating the first wave of significant projects will provide certainty for the industry, strengthen the workforce, and bolster domestic supply chains up and down the coasts and across the country."

Development of these offshore leases will bring jobs and investment to the region. The existing Atlantic offshore projects under development draw on a supply and vendor chain stretching into Western North Carolina, the Gulf Coast and Midwest.

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DIRECTION

THE FUTURE OF WIND

Avangrid's 200 Golden Hills wind farm in Sherman County, Oregon, will provide enough clean, renewable electricity to Puget Sound Energy to power more than 60,000 homes annually. (Courtesy: Avangrid Renewables)

Avangrid Oregon wind farm begins operations, will power 60,000 homes

Avangrid Renewables recently announced that it began operations April 29 at its 200 MW Golden Hills wind farm in Sherman County, Oregon. The facility will provide enough clean, renewable electricity to Puget Sound Energy (PSE) to power more than 60,000 homes annually.

"Delivering on this project represents an important milestone for Avangrid Renewables as we continue to build on our robust portfolio of projects in the Pacific Northwest region and advance our position as a leading renewable energy developer in the U.S.," said Jose Antonio Miranda, Avangrid Renewables' president and CEO, Onshore. "We are pleased to work with Puget Sound Energy to help it meet its ambitious goals to reduce emissions and provide clean, reliable power to its customers."

The project will help PSE meet its goals to reduce carbon dioxide emissions while providing additional capacity to serve customers, particularly during winter periods of high electricity demand. The project is Avangrid Renewables' seventh wind project in Sherman County, 11th in Oregon, and 14th in the Pacific Northwest.

"We are excited for this next step and what this partnership with Avangrid Renewables means as we continue to build on our history of championing renewable energy in the Pacific Northwest," said Ron Roberts, PSE vice president of energy supply. "This new wind project will enable us to expand our efforts toward providing clean, reliable electric service to all of our customers as we work together to create a clean energy future for all."

The addition of the Golden Hills wind project increases PSE's owned and contracted wind fleet to more than 1,150 MW.

The Golden Hills Wind Farm is near the town of Wasco, Oregon. The project includes 41 Vestas V150 4.3 MW turbines and 10 GE 116 2.5 MW turbines. The farm is spread across about 28,000 acres of grazing and dry-land wheat farmland held by 37 landowners. Avangrid Renewables started construction on the project in May 2020.

The project will employ about 13 full-time employees and is expected to deliver more than $220 million in landowner payments and local taxes over the lifetime of the project.

MORE INFO www.avangridrenewables.com

Many industry leaders expected for solar, wind North America

Reuters Events recently announced senior representatives from Avangrid Renewables, Longroad Energy, EDF Renewables, ENGIE, Invenergy, EDP Renewables, and Arevon Energy have confirmed to speak at Reuters Events: Utility Scale Solar and Wind North America 2022 Conference and Exhibition, June 21-22 in Dallas, Texas.

The executive lead event will connect 400-plus representatives from the U.S. solar and wind value chain including asset managers, operators, developers, utilities, OEMs, and service providers to optimize their asset operation and management for maximum revenue.

Over two days, the conference agenda will address cross wind and solar challenges such as grid constraints, PPAs, supply chain, and then, with two dedicated wind and solar tracks, to deep dive into the technical O&M and asset management strategies.

Backed by the industry, speakers sharing their solar and wind strategy include:

- Dana Herrera, General Manager, Asset Management, Renewables, Shell.
- Jorge Pedron, COO, Avangrid Renewables.
- Dan Summa, EVP, Asset Optimization, EDF Renewables.
- John Windsor, SVP, Renewable Generation, Liberty Power.
- Laura Caspari, VP, Head of Power Marketing and Commercial Strategy, ENGIE.
- Gabriel Yamal, Director of Development - Western Region (US) and Mexico, EDP Renewables.
- Meghan Semiao, Director, Asset Management, Longroad Energy.
- Anand Narayanan, VP, Asset Management, Arevon Energy.
- Cristina Drivas, Director, Power Marketing, C&I, Lightsource bp.
- Mike Deggendorf, SVP, Regulated Infrastructure Development, American Electric Power.
- Leigh Zanone, Senior Director, Operation and Asset Management, 8minute Solar Energy.
- Brad Purtell, VP, Services Business Development, Invenergy.
- Martin Mugica, President & CEO, Skyline Renewables.

"With U.S. wind and solar having just triumphed at another record, generating 20 percent of all U.S. electricity for the first time, we look forward to welcoming the community to Dallas this summer to tackle the growing pains of deploying and operating assets at scale, and facilitate the establishment of solar and wind as the backbone of U.S. energy generation," said Leo Lam Reis, Project Director, Utility Scale Solar and Wind, Reuters Events.

MORE INFO events.reutersevents.com/renewable-energy

Interior Department announces Carolina Long Bay wind sale

The Department of the Interior recently announced the results of the Bureau of Ocean Energy Management's (BOEM) offshore wind sale off the coast of North Carolina in the Carolina Long Bay area.

The lease sale offered two lease areas totaling 110,091 acres in the Caro-

lina Long Bay area about 20 miles off the coast of Bald Head Island, North Carolina. The two lease areas have the potential to support at least 1.3 GW of offshore wind — enough wind energy to power about 500,000 homes.

The results are a milestone toward achieving the Biden-Harris administration's goal of reaching 30 GW of offshore wind by 2030, and North Carolina's goal of reaching 2.8 GW of offshore wind by 2030.

The lease sale drew winning bids from two companies totaling about $315 million.

According to The Special Initiative for Offshore Wind's 2021 Supply Chain Contracting Forecast, offshore wind is projected to create more than $109 billion in economic output, with approximately $90 billion of that output focused in the manufacturing supply chain.

"We are incredibly excited to work with Total Energies Renewables USA and Duke Energy Renewables Wind to bring offshore wind development to the Carolinas," said Southeastern Wind Coalition's Katharine Kollins. "The announcement of two provisional lease winners increases the opportunity for economic development to support the offshore wind industry in North Carolina and across the East Coast."

"Investments from two developers means increased supply-chain investment and recruitment, workforce development and thousands of good-paying jobs, and infrastructure development that will support other North Carolina industries," Kollins said.

MORE INFO www.sewind.org

Study: Wind could power more than half of U.S.

The U.S. Department of Energy's (DOE) National Renewable Energy Laboratory recently released the Distributed Wind Energy Futures Study, which details the high potential to profitably deploy nearly 1,400 GW of distributed wind capacity across the United States. This equates to more than half of the nation's current annual electricity consumption.

"As this study illustrates, distributed wind energy could bring clean power to millions of American households," said Kelly Speakes-Backman, principal deputy assistant secretary for Energy Efficiency and Renewable Energy. "By realizing this potential, we can help local communities drive their own paths to a clean energy future and support national progress toward our climate goals."

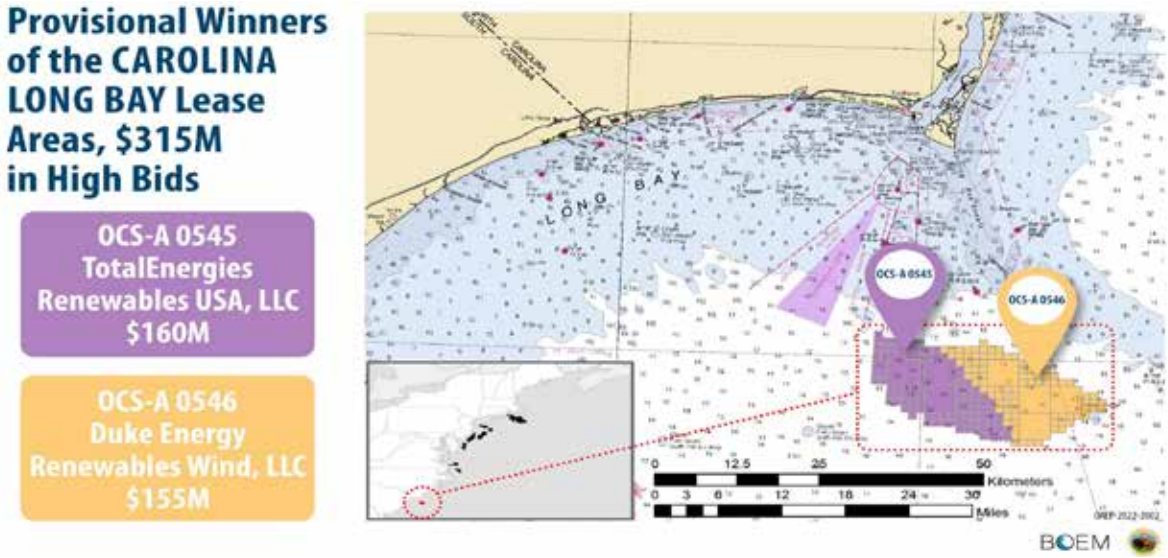
Distributed wind energy is connected to local electricity distribution networks and can provide onsite energy to businesses, farms, homes, and other users. About 1.1 GW of distributed wind capacity is installed in the United States today.

The study identifies states in the nation's Midwest and Heartland regions as having the largest potential for distributed wind due to the combination of high wind speeds and sufficiently high retail electricity rates. The Pacific and Northeast regions also have significant potential for expansion of behind-the-meter distributed wind deployments, where the distributed wind system directly offsets a specific end-user's consumption of retail electricity supply.

There are also significant opportunities to expand distributed wind in disadvantaged communities, identified as census areas with a high risk for environmental hazards and/or areas that include high proportions of low-income households.

This is particularly true in the coming decade for behind-the-meter deployments in states such as Texas, Montana, Michigan, and New Mexico, potentially creating a means to reduce energy burden in these communities.

MORE INFO www.energy.gov



Two lease areas have the potential to support at least 1.3 GW of offshore wind. (Courtesy: Southeastern Wind Coalition)

Aerones startup raises $9M for wind-turbine inspection robots

Aerones, a company that builds robots to automate and scale wind-turbine inspection and maintenance, raised a $9 million seed round to scale production, expand services, and meet fast-growing demand.

With its suite of proprietary robots, Aerones inspects and maintains turbines up to six times faster and up to 40 percent more cost efficiently than humans.

Aerones' core technology is a patented computerized winch system that controls a high-precision robotic arm. The company provides services such as leading-edge repair, detailed external inspections, data analysis, lightning protection system tests, NDT ultrasound inspections, drainage hole cleaning as well as blade cleaning, de-icing, and coating applications—all of which can be controlled remotely.

As opposed to conventional inspections and maintenance operations (where humans rappel down turbines in sometimes dangerous weather conditions), Aerones' robots deliver results without any safety risks to individuals, and in a broader range of weather conditions.

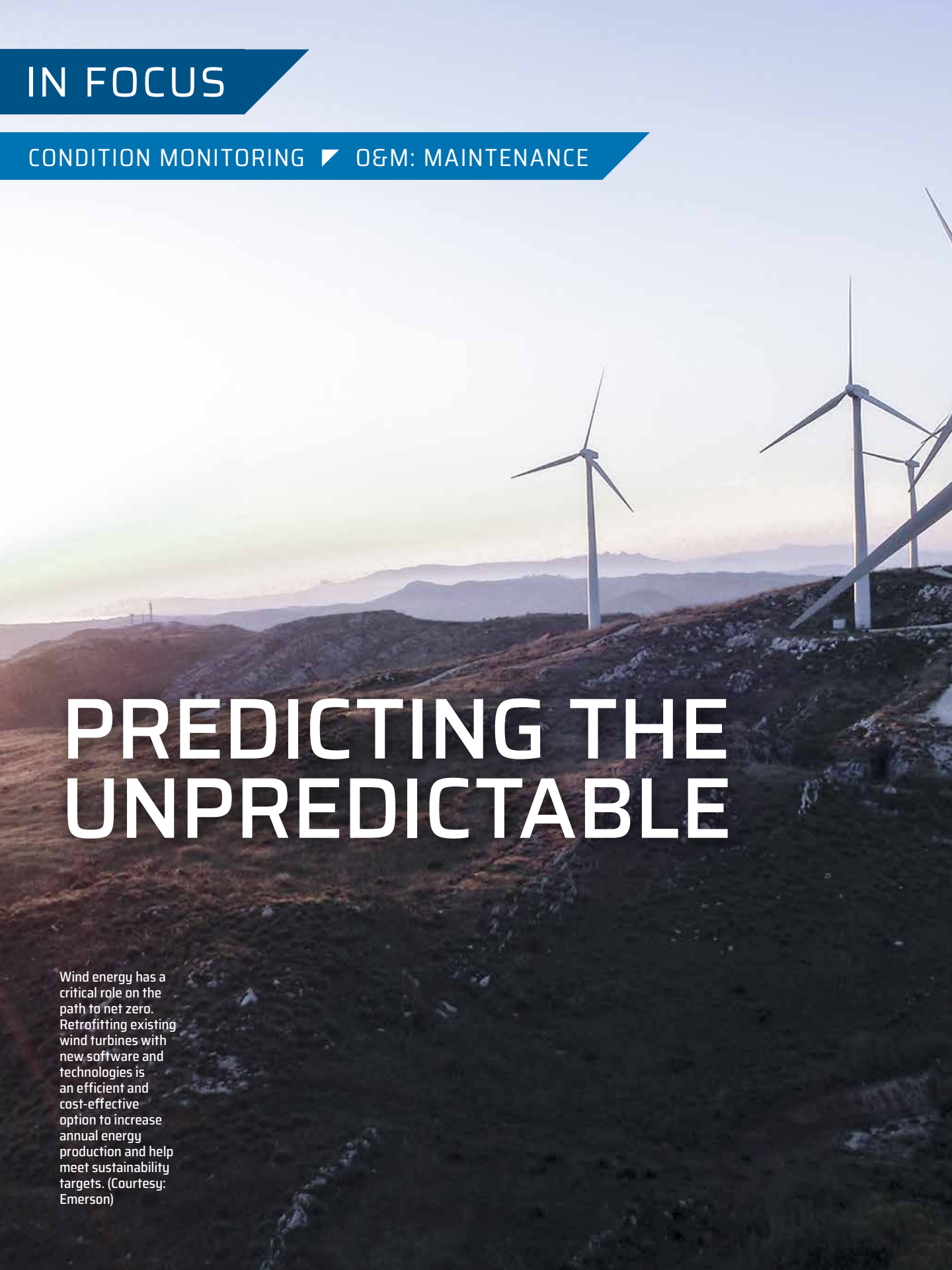
"Aerones is the first full-stack player in the industry," said Sofia Hmich, founder of Future Positive Capital, "as opposed to companies that merely use remote sensing to capture data or focus on analytics, Aerones automates complex operations. They are becoming the one-stop shop for O&Ms to streamline operations and help accelerate the scale-up of renewable energy to reach Net Zero emissions."

Aerones already works with nine of the world's 10 largest wind companies, including Siemens Gamesa, Enel, GE, and Vestas, and has now serviced more than 3,000 wind turbines in 17 countries across North and South America as well as Europe.

MORE INFO aerones.com

Aerones's CEO and co-founder Dainis Kruze (left) and co-founder and CTO Janis Putrams (right.) (Courtesy: Aerones)

PREDICTING THE UNPREDICTABLE



Wind energy has a critical role on the path to net zero. Retrofitting existing wind turbines with new software and technologies is an efficient and cost-effective option to increase annual energy production and help meet sustainability targets. (Courtesy: Emerson)

Operating wind turbines with a condition monitoring solution equipped with the latest technologies and software enables non-visible existing and emerging faults to be identified earlier in the failure curve.

By THOMAS ANDERSEN

While the demand for cleaner energy and falling prices has increased the supply of wind power, the growth rate for new wind capacity is falling short of what's needed to meet the world's climate targets. One strategy to help bolster capacity is to enhance the operations of existing wind farms by extending turbine lifespan, enhancing performance, and reducing downtime.

The estimated life expectancy of wind turbines is roughly 20 years. Due to their remote locations and exposure to harsh conditions, wind turbines are often subject to extremely high and varying torque loads that result in fatigue wear on rotating equipment such as gearboxes or bearings. Even though these components are designed to withstand severe environments, as the turbines age, they will experience a sharp increase in operations and maintenance costs and their operational life will likely fall short of 20-years.

Unpredictable, variable conditions such as wind speed, wind direction, temperature, and humidity amplify the stress placed on turbine components, which can introduce premature component wear. If left undetected, misalignment, imbalance, looseness, cracks, or other mechanical wear problems can escalate and eventually cause significant equipment damage, machine failure, or even an unplanned outage.

The National Renewable Energy Laboratory's (NREL) Gearbox Reliability Database (GRD) shows that 76 percent of wind-turbine gearboxes failed due to bearings, while 17 percent of failures were caused by gears. Additionally, a member of STLE notes bearing failures in wind turbines can be expensive due to lost production and costs associated with component replacement and maintenance.

The total cost of wind-turbine gearbox replacement varies depending on the turbine location, turbine type, gearbox type, etc.; however, gearbox failures on land-based turbines are assumed "to cost about $250,000 to $300,000 per failure event."

INCREASE RELIABILITY AND AVAILABILITY

Today, most new wind turbines are equipped with an integrated condition monitoring system, while many older turbines are still operating without a view into the health of the turbine components and related systems.

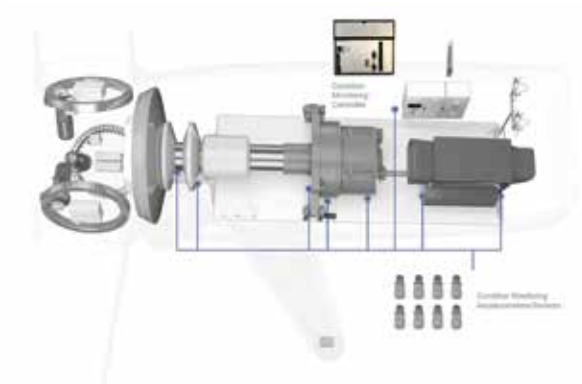
Implementing a retrofit strategy that includes software and technologies tailored to individual wind turbines, their location, surrounding environment, and how they are operated helps to extend lifespan, increase availability, enhance performance and reduce O&M costs. Including condition monitoring with vibration analysis as a key part of that strategy delivers those results by enabling faster, more informed decisions.

For many operators and owners, it's difficult to predict upcoming maintenance needs because they lack newer control systems with condition-monitoring capability or their current monitoring system doesn't use the entire dataset collected from the turbine.

Furthermore, they are operating with "black box" control or software systems that do not provide access to the detailed data needed to customize turbine-specific maintenance plans. Oftentimes, a reliability expert is needed to interpret the limited data that is available and recommend a course of action, which adds cost and prolongs fixing the problem.

State-of-the-art condition monitoring systems that cover all aspects of wind-turbine operations with a focus on vibration analysis can help to quickly pinpoint the root cause of an issue before it escalates. Modern reliability monitoring solutions are designed to simplify operations and maintenance actions by quickly providing recommendations that optimize operating and maintenance choices.

Condition monitoring upgrades should begin with a comprehensive wind-turbine survey to predetermine critical vibration levels and frequency ranges. Proven baseline values from the appropriate International Organization for Standardization (ISO) and The Association of German Engineers (VDI) standards should be used to monitor changes in turbine conditions, comparing key parameters against thresholds. Operational turbine data from the main controller enables accurate analysis of vibrations based on component loads and performance.



Operating with a modern condition monitoring and predictive maintenance strategy that uses state-of-the-art sensors and algorithms helps to minimize unplanned outages and maximize energy output and revenue generation. (Courtesy: Emerson)

Supplement resource-strained staff by subscribing to 24/7 surveillance services with wind turbine, condition monitoring, and vibration experts that survey, analyze, and report on the health of wind turbines and wind farms. (Courtesy: Emerson)

A few features and functions to consider when evaluating condition monitoring systems include:

- Strategically placed external sensors that provide accurate monitoring of tower and drivetrain components, including the gearbox, generator, and main bearings.
- Synchronous vibration data sampling for all connected sensors or modules.
- Real-time vibration signal processing based on accelerometer inputs.
- Advanced algorithms for signal processing and data analysis.
- A maintenance-free design without fans and replaceable batteries.
- Easy integration with turbine control and SCADA systems as well as turbine and farm networks.
- Secure data flow, storage, and multi-user access.
- Self-diagnostic capabilities with status indication.
- Scalable software and hardware architecture.
- Flexible configuration and installation options.
- Scheduled or event-based data acquisition.
- Web access to online and offline data.

Not all wind turbines or farms are the same, and no two starting points are exactly alike. Therefore, the applied condition monitoring system must be adaptable and tailored to meet unique needs with a comprehensive strategy that can be applied to individual turbines or across a fleet of wind assets.

For wind farms comprised of multi-OEM turbines and turbine types, the use of high-performance, vendor-independent condition monitoring software that embraces open standards and protocols enables connectivity to a wide range of devices. Implementing a unified solution streamlines operations and reduces costs.

FOCUS WITH A CLEAR VIEW OF OPERATIONS

When evaluating condition monitoring solutions, it is important to consider flexible implementation options to meet schedule and budget constraints. These include:

- Installing a standalone system.
- Interfacing with existing turbine controls and SCADA systems.
- Including condition monitoring as part of a comprehensive wind turbine retrofit project.

Tightly integrated condition monitoring and SCADA systems provide owners and operators with accurate, real-time data and actionable insights to help with decision-making.

As a natural extension of condition monitoring, an intuitive and common SCADA system applied across a wide variety of turbine models and control platforms provides a clear visual indication of turbine health. An intuitive dashboard displaying key production, availability, alarm, and weather-condition information enables users to rapidly identify and mitigate emerging issues, reducing run-to-failure incidents and associated unplanned outages.

SUPPLEMENT YOUR TEAM WITH EXPERT SUPPORT

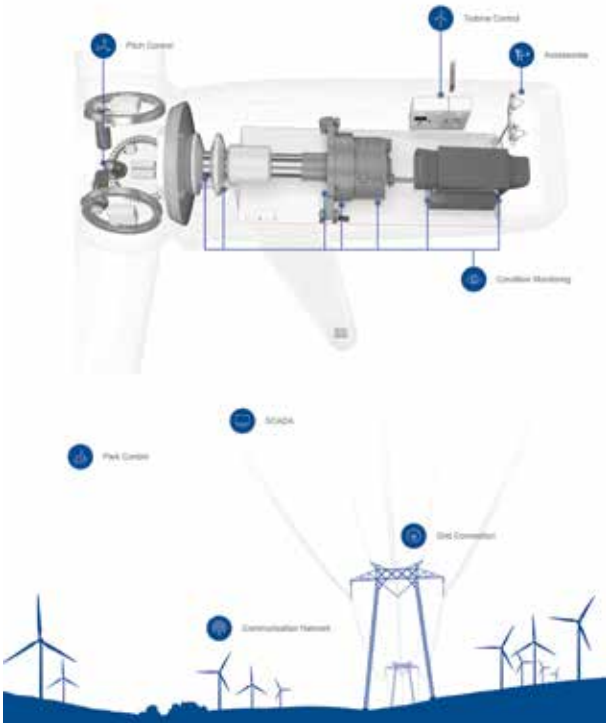
Installing and operating a modern condition monitoring solution addresses many wind-turbine health issues. But in today's fast-moving, resource-constrained environment, owners and operators may not have the bandwidth to carefully monitor the increase in data generated by new software and technology.

Partnering with a trusted adviser who possesses extensive wind industry and certified vibration analysis expertise can supplement an organization's current workforce, providing 24/7 visibility into the status of turbine operations. Implementing a thorough program of surveillance, alarm management, and diagnostic reporting services ensures optimal turbine drive train performance and operational longevity. Adding reliability consulting services to a condition monitoring or retrofit program can create a complete, proactive asset management strategy to reduce the frequency, duration, and impact of planned and unplanned events.

SEE, SAVE, AND PRODUCE MORE

Operating wind turbines with a condition monitoring solution equipped with the latest technologies and software enables non-visible existing and emerging faults to be identified earlier in the failure curve. Instead of reacting to the consequences of an accelerating issue, wind-farm owners and operators can proactively apply predictive maintenance strategies to extend the lifespan of their turbines.

Applying flexible deployment options, such as centralized remote operation center systems and cloud-based or mobile applications, provides the right information to the right person at the right time, regardless of location. Using real-time condition data from wind-turbine equipment, impending issues are recognized, diagnosed, and resolved more efficiently. Automated, continuous extensive monitoring of rotating components reduces unplanned service, risk, and costs while increasing turbine availability and performance.



Implementing a comprehensive retrofit strategy that includes condition monitoring introduces a uniform platform to an older wind turbine or across a fleet of multi-vendor wind assets, which can extend turbine life, increase availability, and reduce operating and maintenance costs. (Courtesy: Emerson)

Investing in a wind-retrofit program with a holistic approach provides wind owners and operators with full visibility into their data and a vivid view of wind-turbine operations, regardless of OEM or equipment type. Adding modern condition monitoring solutions that provide greater insight into equipment health is a practical and cost-efficient way to anticipate maintenance needs before they become more costly, produce more renewable low-cost wind energy, and take an important step toward a more sustainable world.

ABOUT THE AUTHOR

Thomas Andersen is vice president of Renewable Energy Technologies for Emerson. In this position, Andersen leads Emerson's expansion into the renewable sector with innovative software and technologies that increase reliability and annual energy production while reducing operations and maintenance costs. Andersen's extensive experience will help customers to accelerate their digital transformation journey to smarter, more sustainable operations. Andersen has more than 30 years of renewable control and optimization experience with a keen focus on wind generation.

KEEPING TABS ON THE TRANSFORMER

A NextEra site in West Texas shows a bushing monitor installed next to a transformer (in white outline). (Courtesy: ZTZ Services International)

A reliable condition monitoring system can ensure that the electrical bushings – which are at a high risk of exposure – and other key elements are closely watched to avoid the sudden failure of the transformer.

By JOHN EASTMAN

Of all the components in a utility-scale wind or solar project, the Main Step-Up Transformer is probably the most important. The good health of this asset is of the utmost importance as it transfers the power from the field of harvest to the grid.

In the present supply climate, failure of the transformer spells doom for the revenue stream even if, for only one month, a large site loses more than $6 million.

Of all the things that can potentially go wrong with a large power transformer, the electrical bushings account for the largest risk exposure. This means that it is a good idea to place an on-line monitor system to keep watch over the performance of the bushings — both the high side and low side.

DGA MONITORING SYSTEMS

Beyond the bushings, internal problems with windings, internal connections, core grounding, and other things can also introduce problems that will deteriorate the transformer. These incipient conditions will provide clues in the form of flammable gases formed inside the transformer. The various hydrocarbon gases (caused essentially by "cracking" of the oil) and hydrogen will be produced in amounts that can be measured by condition monitors called dissolved gas analysis, or DGA, monitoring systems.

By applying bushing monitoring along with an online DGA system, the renewables operator is well protected against most transformer problems that can fester and eventually cause a catastrophic failure. The operator will be able to know, well in advance, that a transformer is in trouble and needs maintenance attention.

The addition of on-line monitoring for bushings and dissolved gases in the insulating oil should be part of every repowering project, especially if the original transformer will continue in service.

A bushing monitor will include a sensor that replaces the C1 test tap grounding cover. Each sensor maintains the ground but also provides very accurate measurement of the small AC leakage current and its phase angle.

For most main step-up applications, both the high-side and low-side bushings are monitored for a total of six sensors. Installing the sensors requires a brief transformer outage of four hours to install the conduit runs, the sensors, and marshal the cables into the monitor control box. The system is then configured and started when the transformer is re-energized.

From the signals the sensors provide, the power factor, capacitance, and other attributes are calculated. The various resultants are then cross-compared with test methods applied. The most recent off-line power factor test results for each bushing can be used as a starting value. If these are not available, the system will take the first measurements and use them as starting points.

EYE ON SAFETY

From the safety perspective, the bushing sensor must limit the voltage-potential output to a safe level in case of contact with personnel from accidental damage of the cabling. This limiting circuitry must be within the bushing sensor, built with the finest electronic parts, and be twice-redundant.

From the overall reliability perspective, all unnecessary removeable electrical connectors must be deleted. The bushing sensor cable must be continuous from the sensor internal circuitry all the way to the shorting switches in the monitor cabinet.

Precision engineered bushing sensors replace the grounding cover at the bushing base. (Courtesy: ZTZ Services International)

Three bushing sensors on the main step up transformer at Walla Walla Washington NextEra Site. (Courtesy: ZTZ Services International)

The installation of the sensors to the bushings will need to be done by experienced field personnel. Extreme care must be exercised when working with older bushings so as not to cause any damage to them and to ensure a perfect weather-tight seal is attained for each sensor. Turnkey installation by trained and experienced factory field engineers is the best way to ensure long-term reliability with all the other requirements being met.

The health information can be transmitted to stakeholders by usual protocols and also inspected for "drill-down" analysis using included software. Deluxe systems can also include partial discharge analysis of the bushings and internal transformer parts using PRPD techniques.

Transformers used for solar sites between the inverters and the utility transmission line see rough service. Daily full-on, full-off along with the effects of transients and harmonics is not normal substation transformer duty. Since the power factor of a bushing is affected by heat, the daily cycle shows in the power-factor plot. A monitor recently logged this data at a large solar facility in California. It clearly shows the effect of temperature as a saw-tooth pattern but also that two of three bushings on the low side are developing internal problems, causing the overall power factor to trend higher, X3 rising to alarm level with X1 not far behind.

The addition of an on-line DGA system adds to an operator's situational awareness for these critical assets.

As a retrofit device, the DGA is simply mounted directly onto the drain valve. DGA systems are available from "early warning," which look for hydrogen, moisture, and a composite value of hydrocarbons, to a full-range of 10 distinct dissolved gases, which give very precise and repeatable results.

DGA INSTALLATION

Online DGA systems are available from a few reputable vendors, but the best ones do not require any consumable gases for operation — helium for instance. These maintenance items are expensive and should be avoided.

Ease-of-installation means it can be installed with the transformer in-service. There should also be a provision for easy access to draw a manual oil sample if desired. Other important attributes include test repeatability, warranty, and support.

A 10-year warranty is available on some systems and should be included. A service proven life in excess of 15 years is also a desireable feature. The online DGA should have the necessary analysis features built-in, such as Duval Triangle and Roger's ratio test methods and hot-spot calculated temperature that takes load into consideration. It also should be capable of network connection by cellular modem.

A failed bushing is a "bad day" for any utility. The debris can certainly damage other nearby components such as adjacent bushing sheds, surge arrestors, and flying porcelain can ruin nearby solar panels. Of course, a sudden failure is also a risk to personnel. A transformer fire gives bad public relations and environmental cleanup. The preservation of the transformer is the hard benefit, and there are many soft benefits. A proactive approach to condition monitoring is favored by insurance companies covering the assets. Online condition monitoring of the main step-up transformer

One-year plot of low-side bushing power factor shows dangerous trend toward failure. (Courtesy: ZTZ Services International)

should be a strong consideration for any repowering project, especially when the existing transformer is being kept and is 10 years old or older.

TAKING ADVANTAGE OF EXPERIENCE

Transformer condition monitoring has come a long way, and most of the heavy lifting for trials, beta tests, and proving was done by the investor-owned utilities during the past 40 years. The renewables sector can now enjoy the fruits of this past and should embrace the systems as a way to maximize up-time and preserve the precious step-up transformer.

Even the best transformer condition monitor is helpless to make decisions related to taking the transformer out of service. If alarms are asserted, then the stakeholders must heed them.

At a power plant in Eastern Europe, bushing monitoring was added to the high-side bushings of a 17-year-old 270 MVA GSU in December of 2015. The data shows power factor of H2 peaking at 1.5 percent in May 2016, when it was advised that the transformer be taken immediately out of service for testing.

Because an outage was planned within five weeks, the owner decided to wait until then. Two days before the outage, the bushing exploded. The final C1 measurement of H2 was 114 percent and 8 percent power factor. In the last moment before failure, the big increase of C1 can be observed, caused by a break of insulation layers between metal foils in the bushing condenser core.

The failure was recorded by a surveillance camera. It can be seen here: tinyurl.com/bushing-failure

A monitoring system giving asset condition guidance with very high confidence is something that is continually improved over decades in thousands of field installations. Sensors and other hardware are required to be made with high precision and material quality with no system calibration requirement for the life of the system. Of course, most commercial monitoring systems can be made to work well at the time of commissioning, but only the highly developed system, well installed, will last for decades.

An on-line DGA system installed at Hornsea II offshore wind. (Courtesy: ZTZ Services International)

ABOUT THE AUTHOR

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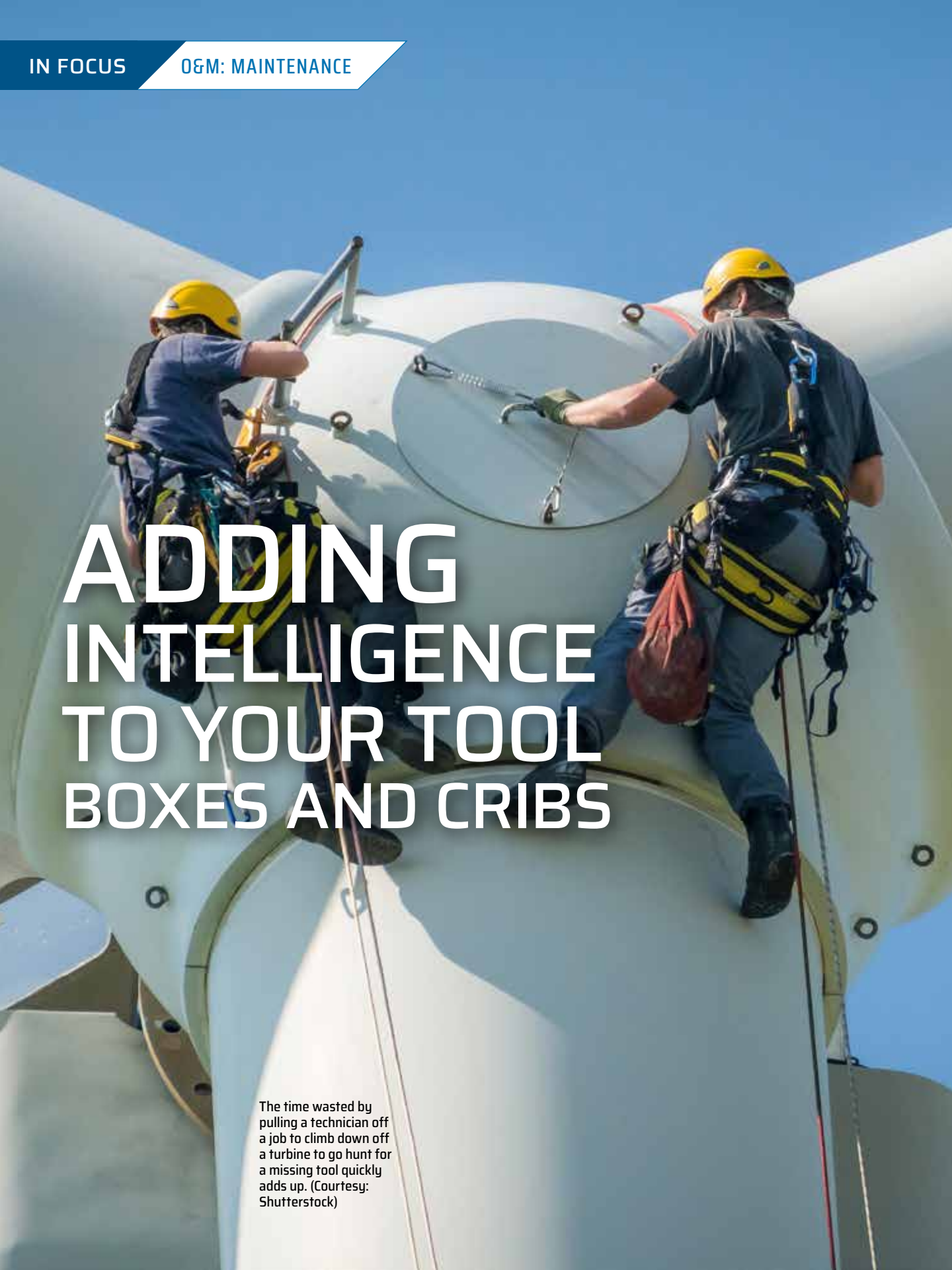

ADDING INTELLIGENCE TO YOUR TOOL BOXES AND CRIBS

The time wasted by pulling a technician off a job to climb down off a turbine to go hunt for a missing tool quickly adds up. (Courtesy: Shutterstock)

Talking tool boxes that alert you when a tool hasn't been properly returned – tool boxes and cribs are doing this, and much more, all in an effort to reduce tool loss on wind farms.

By MARK EDMUNDS

Tool control comes in all shapes and sizes. While there is no one-size-fits-all, there are plenty of options available to wind farms when it comes to getting a better handle on their tool control.

Lost or missing tools cost the renewable energy industry hundreds of thousands of dollars each year, not only in lost revenue, but in productivity as well. The time wasted by pulling a technician off the job to climb down off a turbine to go hunt for a missing tool quickly adds up. However, there is a solution.

Technology today allows tool control to become a reality rather than just a concept. Innovations in the industry have taken tool control to the next level resulting in improved technician performance and productivity, saving utilities money while greatly reducing the chance of tools walking away from job sites. These advances are driving the industry to develop more efficient maintenance practices and, in turn, allow utilities to become proactive in trimming costs.

IMPLEMENTING A TOOL CONTROL PROGRAM

Some people still do not associate technology with tool control, and past perceptions may have something to do with that. Not that long ago, foam cutouts in a box constituted adequate oversight; it gave technicians a quick visual check that tools were in their proper spot, and it certainly was a better option than a box with no foam where tools were scattered throughout drawers.

However, a proactive tool control program has become a much more interactive endeavor. Technology and tool control are linking together, and the level of functionality it provides to users surpasses previous options.

The goal of a credible tool control program is to minimize lost or misplaced tools. To realize that goal, any credible system should meet five criteria: organization, visibility, access control, asset management, and automation. These factors, when added together, work to provide a detailed process of tool inspection and accountability, both before and after a job is completed, as well as a process that is repeatable.

Questions you should ask yourself in designing a tool control program include:

- What is the goal of a tool control program for your department?
- How extensive will the program be?
- What materials will be monitored?
- Who can perform a general inspection of the area?
- What forms, if any, should be required?
- Will all the tools be monitored?

The answers to these questions will help you begin evaluating the scope of your tooling needs and get you started correctly on the path to success.

AUTOMATION IN THE BOXES

Digital imaging technology is one way to bring standardization and accountability to tool boxes. This technology provides the ability to monitor and track tools as they are removed from tool boxes and then returned throughout the day — all in real time. It works by scanning each tool in the drawer to determine its status. If tool status is questionable, an interactive monitor affixed to the box can display the

With a quick scan, tools and equipment checked out from a tool crib can be tracked, enabling administrators to know which technician has possession of that particular item. (Courtesy: Snap-on)

Digital imaging technology offers several advantages to utilities, including reducing lost or misplaced tool concerns. (Courtesy: Snap-on)

disputed tool transaction, or it can be identified in the audit image at the administrator's PC. User log and data time/date information is available for every transaction.

Digital imaging technology offers several advantages to utilities. For starters, it reduces lost or misplaced tool concerns. If a technician checks out 15 tools and later returns 14 tools, the system announces not only that a tool is missing, but identifies the missing tool, and the technician now knows to go back and find that tool.

Additionally, the digital imaging software allows the tool box's designated administrator to track individual tool usages, add or delete users, and assign various levels of user access. The system can be synchronized to individual or multiple boxes and can pull data and images from each selected tool box. Data logs and audit image files are available for inspection in the administrator's program following synchronization with the tool box. It also allows people who are connected to the box throughout the network to know the status of all controlled tools and equipment. This means technicians will know the tool they need is on hand and available immediately and supervisors have an extra measure of confidence that tools and other critical assets are being well supervised.

LINKING TOOL BOXES TO TOOL CRIBS

The level of accountability is now extending to the tool crib as well. This provides tremendous value. In the past, utilities did not have an efficient way to move tools and equipment within their inventory or accurately keep track of them. While tool boxes were being monitored with a system like digital imaging, an effective complementary program for the tool crib did not exist. More importantly, there was not an efficient network linking the tool crib to toolboxes and lockers. Innovations are making this happen today, and the benefits are plentiful.

With a quick scan, tools and equipment checked out from a tool crib can be tracked, enabling administrators to know which technician has possession of that particular item. Other capabilities include setting up calibration schedules for tools such as torque wrenches to ensure compliance dates are not missed, and administrators can be alerted when consumable items, such as drill bits, fasteners, PPE, and other products are running low and need reordering.

This enables utilities to connect the tool cribs with the boxes and lockers — linking all critical components of tool control under one central platform. Administrators can see everything happening with their tooling program through a synchronized network. Tools and assets can be viewed and tracked in real time from mobile devices anywhere in the world.

Deploying a well-designed tool control system will work toward consolidating tools on wind farms. It's also going to reduce lost or misplaced tools, improve accountability, as well as promote an atmosphere for crib attendants and technicians to be more productive. Tool control is fast becoming an area that works for you — all thanks to automation and connectivity.

ABOUT THE AUTHOR

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‘A DISCIPLINED, CONNECTED APPROACH’

By coordinating multiple projects, InEight is able to track what went right and what went wrong while learning from that and setting expectations while better understanding the risks so the next project can improve from that experience. (Courtesy: InEight)

As a wind project begins its journey to reality, InEight uses its ability to track and coordinate real-time data to ensure the multi-faceted endeavor is a success from start to finish.

By KENNETH CARTER ◤ Wind Systems editor

Planning, designing, and constructing a wind farm can be a daunting task, to say the least. Hundreds of constantly moving and shifting parts can make or break a plan, and if that plan fails, millions of dollars can be on the line.

When it comes to ensuring all those moving parts are executed successfully, the experts at InEight have 30 years of experience in making that happen.

"InEight's focus has always been on taking complex construction projects and applying a disciplined, connected approach to those," said Brad Barth, chief product officer at InEight. "And that has attracted both owners, who are having to build things, and the contractors that build them. Over the years, some of those customers — which may have started with InEight for more traditional energy projects, like oil and gas — have taken our solution with them as they've evolved and transitioned towards renewable energy projects such as wind."

MANAGING TASKS

To get a wind farm up and running, there's an extensive laundry list of tasks that must be performed and managed including the approval process, permitting, environmental assessments, and more, according to Barth.

"It's tough to get road projects approved, but it's really tough to get wind farms approved," he said. "Our solution comes into play in the wind sector early on. We have a risk management solution that incorporates artificial intelligence, human intelligence, and risk intelligence to build confidence that risks have been accounted for prior to the project starting, which provides an added layer of confidence in the project approval process."

Once a project has been approved, InEight's solutions offer an array of project management capabilities, which allow owners to build schedules and budgets, manage design work, all the way through to issuing contracts for engineering and construction work, which involve multiple stakeholders. According to Barth, the solution offers a collaborative framework for all parties working together, offering all stakeholders increased visibility of project changes. Juggling all the pieces means things often change, so it's important that InEight's team is there to make any and all adjustments to keep the project's momentum going.

'A SYMPHONY CONDUCTOR'

"You're almost like a symphony conductor," he said. "Somebody's got to conduct all these different parties. You're doing the design work; you're doing the construction work. Another big aspect in wind is the specialized equipment that has to be engineered and procured. You're not buying concrete pipe or asphalt from an asphalt plant. These things are expensive. You're buying turbines, for example, and you might buy hundreds of them on a project. And if it's offshore, then how are we going to get that stuff offshore? We've got helicopters and other things. There's a lot of detail in making sure these projects stay on track."

By coordinating multiple projects, Barth said there's an advantage by being able to track what went right and what went wrong while learning from that and setting expectations while better understanding the risks so the next project can improve from that experience.

"Nobody wants to be that project that ends up in the news that's three years behind schedule and a hundred million dollars over budget," he said. "Nobody wants to be that, so our system helps make sure that doesn't happen, frankly. That's how that works."

MULTIPLE PLANS AVAILABLE

With supply chain issues being a constant concern, Barth emphasized that his team makes sure there are many different scenarios available to tackle any challenges that might show up.

"You have to have a plan B, because oftentimes your plan A is not working out — whether it's shortages, logistical challenges, or supply chain challenges," he said. "You've got to have a plan A and a plan B and maybe even a plan C. And sometimes, you execute on both because you can't take the risk of having one that doesn't work. It's a very collaborative approach that we enable, as opposed to, traditionally in construction, it's a very arm's length kind of relationship between the owners, engineers, and contractors. With our technology, if there's a change, your teams go through a change-order process. It's a very dogmatic approach, but on these wind-farm projects, what we see is you've got to react fast. It's more collaborative, and it's more iterative, and it's more transparent."

With more angles than the sides of a Dungeons and Dragons' die, InEight handles these plans within plans by dealing with areas Barth calls "siloes."

"We use the term 'siloes,'" he said. "That's where we see these stakeholders, and sometimes even within a stakeholder, there are different roles inside there, and they'll have their own kind of siloes of data. For example, let's just take the budget for a project. The owner might have a budget for the project that maybe is fairly high level. And then as they engage different contractors, suppliers, and engineers, they'll have a more detailed version of their budget that they're bringing to the table for their scope, and the same goes with the schedule."

The challenge comes when, for example, a design choice is needed during the engineering work, according to Barth. This could be the nature of the energy collection or maybe

Once a project has been approved, InEight's solutions offer an array of project management capabilities. (Courtesy: InEight)

even a change in the types of turbines or the number of turbines needed.

"That decision has a ripple effect on everything else," he said. "What often happens is if you don't have that visibility and if everybody's working in their own siloes, you may not realize you're impacting your construction schedule based on certain design assumptions when those designs change. That does two things: It means that the schedule probably just slipped, because now we have more design work to do, but it also means there are probably different quantities of work that are going to have to be installed and constructed."

With supply chain issues being a constant concern, InEight makes sure there are many different scenarios available to tackle any challenges that might show up. (Courtesy: InEight)

ELIMINATING DELAYS

If those factors remain unknown to the project at large, it could mean delays and rising construction costs, according to Barth.

"By bringing all that stuff together, everybody can have their view of their scope and their details, but we bring it together into this one unified view, not only so that you can react easily to changes, but you can also run 'what if's,'" he said. "You could say: What if we start to run behind schedule? What if we went to a six-day-a-week schedule instead of five days a week, what would that do? We're going to pay some overtime, but that shortens the schedule, so the benefit of that might be worth it. Those kinds of 'what if's,' when you're operating in siloes, that's hard to do. You can't do those 'what if's' and see the connections. But in our solution, you can very easily do those 'what if' scenarios."

An important aspect to making sure these projects move as efficiently as possible is being able to gather and track data-driven insights, according to Barth.

"Particularly in the wind sector, it's really important just because things are changing so rapidly," he said. "I mean the procurement costs, construction costs, logistical challenges, all that stuff is just in flux partially due to the pandemic and the changes that has brought on the industry. But it's not just that. Part of it is, but it's relatively new, and people are reacting and sort of wobbling into best practice and things like that. This data-driven approach allows you to capture lessons learned on every project, so that you get smarter on the next one. And that's key to setting realistic expectations in the first place. A data-driven approach allows you to, even within a project, as you repeat the work, you get

To get a wind farm up and running, there's an extensive laundry list of tasks that must be performed and managed including the approval process, permitting, environmental assessments, and more. (Courtesy: InEight)

smarter and smarter as you go. So, you can set reasonable expectations, and you can understand risks."

Being able to track different projects across geographically — and sometimes, geopolitically — diverse areas is an important factor to consider when getting a project up and running, according to Barth.

"And that's all about the details," he said. "It's tracking the assumptions, not just the result of the assumption. Imagine if you're putting an estimate together or a schedule together, it's one thing to know that this chunk of the work, let's say this scope of the work, is going to cost $10 million, and it's going to take 365 days. What you want to be able to track is: What were the assumptions that led to that? It's the procurement cost; it's the logistical cost; it's the construction cost; it's the engineering cost, and it's breaking that even down to the discipline.

How much of that is based on civil work, mechanical work, electrical work, instrumentation, components, all that kind of stuff? So, by breaking it down to a detail level, when the next project comes along, some of those details are going to be different. Maybe this is an offshore project, just like the other one, but we're going to freight the stuff out, not helicopter it. You can make those changes, but still have a nice template and proven list of assumptions. We're not having to reinvent the wheel every time."

CONTINUOUS INNOVATION

Barth said he sees InEight's involvement in wind increasing both on the owner side and the contractor side, which are key customer segments for the company.

"As we always do, when we get feedback from customers in that sector, in terms of what's working or what's not working, we will continually innovate on our solutions," he said. "We do new releases of the software, and we add hundreds of new features into the software every nine weeks. So, we've got a large R&D organization that's continuing to add to the solution, add enhancements, make it better, and deal with some of these real-world issues that are coming up on these projects. We try to be very reactive to that. We've been involved in some massive wind projects, and, coming out of that, there has been some great enhancement ideas for the product, and that'll continue. That's really our commitment: to continually improve the solution that the owners and the contractors use to manage these wind projects."

MORE INFO ineight.com

Jason Heitman

Wind O&M Director ◤ Enel Green Power

"Renewable energy in Oklahoma continues its upward trajectory, and we're happy to contribute to its workforce growth."

◤ What has been involved in getting the 300-MW Seven Cowboy wind project in Oklahoma started?

The Seven Cowboy Wind Project is the result of a decade worth of development activities. The adjacent project, Rocky Ridge, was built in 2012, and then Little Elk completed construction in 2015. Acreage that was not used for those two projects was then combined with additional leasing efforts to secure acreage to form the 300-MW Seven Cowboy Wind Project. Many years of environmental surveys were completed in addition to coordinating with the USFWS and ODWC. Transmission studies began taking place in 2016 to determine the project's impact to the transmission system where the project would be interconnecting. Meteorological towers have been collecting wind data during that period, which helped to guide the design of the project currently under construction. The project has supported local organizations during the development and kept local officials aware of the project's development status.

During the later stages of development, geotechnical investigation, ALTA surveys, and Phase I Environment Site Assessments were completed to ensure the project could feasibly be built in the areas selected for facilities to be located. Equipment was procured and contractors were selected to build the project while coordination was ongoing with landowners about where the facilities would be best located on their property to create minimal disturbance. This information was all used to further the engineering design to produce the most efficient project with the least impact to the land.

◤ Did the project face any special challenges?

Every project is unique and faces different challenges. This project has extremely supportive local communities and landowners, which aids in the company being able to develop a project that provides the most positive benefit for all of those local stakeholders. A unique challenge this project had the opportunity to successfully work through were the transmission studies. Enel's transmission team analyzed each milestone of results and had to be progressive and creative when providing guidance on what would be the best way to continue development of this project so that it has the greatest chance of reaching success.

◤ The wind project will boast a nearby training center. Is that a unique arrangement?

Yes, it is. Enel operates 11 wind farms in Oklahoma and is invested in developing Oklahoma's clean-energy workforce. We have a history of supporting Oklahoma and that includes the creation of over 130 long-term jobs and over $2 million in support for community initiatives. The training facility will help train new hires in-house to equip them for our open positions in Oklahoma and beyond.

For clarification, the office and training center are not specifically linked to the wind project aside from the fact that they are being built in the same state at the same time. Workers across Enel's entire wind fleet — including Seven Cowboy — will train in Oklahoma City. The office and wind

The training facility will help train new hires in-house to equip them for Enel Green Power's open positions in Oklahoma and beyond. (Courtesy: Enel Green Power)

New wind workers can experience climbing and maintaining wind turbines through training simulations held year-round. (Courtesy: Enel Green Power)

project will be located approximately 100 miles apart.

Will training at the center be just for the Seven Cowboy project, or will it be a more generalized training center for any wind job?

No, training at this center will support Enel Green Power North America's entire wind fleet.

The classroom and meeting space in the new Midtown office will allow Enel to welcome school groups and other community organizations to learn about renewable energy and STEM concepts first-hand. (Courtesy: Enel Green Power)

What types of courses will be available at the training center?

Courses will include topics such as safety, professional development, working at heights, ladder rescues, turbine repair, and troubleshooting. Trainees will learn in multiple settings including classroom discussion, hands-on simulation, and virtual reality. New wind workers can experience climbing and maintaining wind turbines through training simulations held year-round.

What has been the local reaction to the wind project and training center?

Local reaction has been positive so far. Oklahoma City is a growing city that has historically been dependent on the oil and gas industry, so our growth downtown is evidence of the diversification of the local economy. Renewable energy in Oklahoma continues its upward trajectory, and we're happy to contribute to its workforce growth. Additionally, the classroom and meeting space in the new Midtown office will allow us to welcome school groups and other community organizations to learn about renewable energy and STEM concepts first-hand from our experts and education partners.

What's the timetable for the Seven Cowboy wind project and the training center?

The Seven Cowboy project is still under construction and is expected to be in operation by the end of 2022. The training center is expected to be in operation by this summer.

MORE INFO www.enelgreenpower.com

Phase 1 of the Kennoxhead Wind Farm is now completed. (Courtesy: Collett)

CONSTRUCTION

Collett completes phase 1 of Scotland wind farm

Collett completed the delivery of 13 Nordex N133 turbines to Kennoxhead Wind Farm in South Lanarkshire, Scotland.

Located south of the A70 near the village of Glespin on the Douglas Estate, the site features Nordex N133 onshore wind turbines with an individual blade length of 64 meters and a tip height of no more than 180 meters.

Phase 1 of the Kennoxhead Wind Farm is now completed with the 133.2-meter diameter turbines featuring a 13,935-square-meter rotor sweep expected to enter commercial operation later in 2022.

Phase 2 of the project is still in development with 14 proposed additional turbines expected to enter commercial operation in 2024.

Beginning with a test drive of the 46-mile route from King George V Dock to South Lanarkshire, the Collett team simulated the 68-meter loaded vehicle to ensure that the 64-meter blades could safely traverse the route. Data gathered during the test drive, coupled with preliminary planning reports, allowed the team to determine the suitability of the route, identifying any modifications ahead of the commencement of deliveries. This included the removal of street furniture at King George V Dock and required civil work on site to prevent the loaded trailers grounding on the wind farm access roads.

Using King George V Dock's 32.6 hectares of storage, all components were imported to the Glasgow facility for onward transport. The team used specialist wind-turbine trailers for deliveries, including clamp trailers for the base and middle-tower sections, six-axle step-frames for the top towers, nacelle, hubs and drive trains, and Faymonville quadruple extendable wing max trailers for the 64-meter blades.

MORE INFO collett.co.uk

INNOVATION

BladeBUG robot saves inspection time

A robot called BladeBUG can be deployed to inspect areas of concern on a turbine blade, about half the time it

The processes required to rig and operate the BladeBUG can be managed by operations technicians with basic GWO Working at Height training. (Courtesy: BladeBug)

would take to deploy a human rope-access technician.

Rope-access techs traditionally have the job of inspection and repair on wind-turbine blades. However, prep time for a team is more than an hour, and the costly teams must manage safety risks at great height and sometimes in harsh weather.

"We designed the BladeBUG to reduce costly turbine shutdowns for our wind-energy clients. As the U.K. focuses its energy supply on renewable sources such as wind farms, it is imperative these projects operate as efficiently as possible," said Chris Cieslak, BladeBug director and founder. "Once our team has arrived on site, unloaded the BladeBUG, and carried out our safety checks, the robot will be attached to a blade and carrying out inspections in a little over half an hour. While vacuumed onto a turbine blade, the BladeBUG is able to walk around to any areas of interest."

For onshore turbines, a ground-up approach for deployment is used. The robot is attached at ground level to a rope lowered by a technician from the top of the turbine, then hoisted into place to inspect the blade. One end of the rope is attached to a power descender on the ground, then goes up to the top to a pulley and back down to the robot. A top-down approach to deployment works best for offshore turbines.

The processes required to rig and

operate the BladeBUG can be managed by operations technicians with basic GWO Working at Height training. The technicians on the tag lines communicate via radios with those operating the power descender to hoist the robot to the correct part of the blade.

The latest round of testing was successfully carried out at the Offshore Renewable Energy (ORE) Catapult's National Renewable Energy Centre in Blyth.

"It has been a privilege to be a part of the BladeBUG journey and watch Chris and the team develop such a vital piece of technology for the industry," said Andrew Stormonth-Darling of ORE Catapult. "The BladeBUG continues to go from strength to strength, and this latest test in Blyth is another tick in the box for the future of innovative wind turbine inspections."

MORE INFO www.bladebug.co.uk

With the Point Tupper Clean Energy Project, EverWind Fuels is embarking on a journey that will create Nova Scotia's first green hydrogen production facility and unlock the potential of Nova Scotia's green economy. (Courtesy: EverWind)

INNOVATION

EverWind to begin green H2 production in Nova Scotia

EverWind Fuels LLC, a developer of green hydrogen and ammonia production, storage facilities, and transportation assets, will begin production of green hydrogen in 2025 in Point Tupper, Nova Scotia.

EverWind has acquired the NuStar storage terminal in Point Tupper and plans to expand and develop the Point Tupper site to be the location of a regional green hydrogen hub for eastern Canada, including new green hydrogen and ammonia production facilities. These facilities will create new clean-energy jobs and support Nova Scotia's carbon emissions reduction targets.

"As part of the clean-energy transition, we are proud to invest in Nova Scotia and support the province in unlocking the immense opportunity presented by green hydrogen," said Trent Vichie, CEO of EverWind Fuels.

"The development of green hydrogen is an essential tool in the fight against climate change," Vichie said. "Expansion of the Point Tupper site will support significant economic development in the region that can attract billions of dollars in new investment, create new jobs, and help make Nova Scotia and Canada global leaders in this exciting industry."

By 2030, the project could reduce domestic and international carbon emissions by more than 4 million tons a year through the production of green hydrogen.

The Point Tupper site is positioned to produce green hydrogen as early as 2025, supported by existing in-place infrastructure. Point Tupper has an ice-free, deep-water port with 27-meter depth and two berths that can accommodate large vessels. The port is the deepest in Nova Scotia and the surrounding region.

The site has rail loading facilities and is adjacent to pipeline networks to support domestic and regional markets. Electricity transmission is available at the site as well as 7.7 million barrels of liquids storage and abundant freshwater, which is adjacent to the site.

The site is operated by a 70-person team trained to protect the surrounding environment and deliver safe operations.

EverWind Fuels also intends to partner with offshore wind developers to expand production over time, which aligns with the joint announcement by the Canadian and Nova Scotia governments in April 2022 to expand the mandate of Nova Scotia's offshore energy regime to support the transition to a clean economy and to create sustainable jobs.

"Onshore facilities, like Point Tupper, will be key to unlocking this important industry, and we are excited to play our part," Vichie said. "We are confident that this is both the right place and the right time to pursue this development. Governments across Canada are embracing green hydrogen and green ammonia as key parts of Canada's clean-energy future and, with this investment, we are excited to support the development of a regional hydrogen hub in Eastern Canada."

EverWind Fuels is committed to en-

ZX TM is a nacelle-mounted Lidar that uses continuous wave technology to measure the full shear and veer wind profile of a wind turbine. (Courtesy: NRG Systems)

gagement with Indigenous and local communities, governments and local business, and planning organizations to ensure feedback is incorporated throughout the development of the project.

"We have been engaging with communities, businesses and local organizations, and governments at every level early on in this project because we know it is a critical part of the process," Vichie said. "We are working with Indigenous-owned consulting firms to ensure our engagement with Mi'kmaq communities and organizations is done thoughtfully and in the spirit of listening. This engagement and consultation activities will increase in the coming months."

MORE INFO www.everwindfuels.com

INNOVATION

NRG adds ZX TM Lidar to remote sensing portfolio

NRG Systems Inc., a designer and manufacturer of smart technologies for a range of wind, solar, and meteorological applications, has added ZX Lidars' ZX TM to its remote sensing portfolio. NRG Systems has been selling and supporting ZX Lidars' industry-leading technology since 2019.

ZX TM is a nacelle-mounted Lidar that uses continuous wave technology to measure the full shear and veer wind profile across a turbine. The remote sensing device has been evaluated by DNV, a leading independent engineering firm, and UL, a global safety science leader, to support wind turbine power performance evaluations. This technology can also minimize measurement uncertainty via its availability and sampling rate. In addition to power performance testing, ZX TM is also suitable for nacelle transfer function calibration, including yaw alignment and wake detection. Working with DNV and UL, NRG Systems will provide ZX TM as part of a turnkey solution that includes installation, field support, and data management, with the option to calibrate using an IEC-compliant mast at UL's test site in the United States or DNV's test site in Janneby, Schleswig-Holstein, Germany.

"NRG Systems is always working to push the boundaries in wind technology.," said Gregory Erdmann, NRG Vice-President, Global Sales. "We have been doing it for 40 years, and we are very selective in which technology we

With achieving this first step in the certification process, DNV considers the BRUNEL concept feasible for further development. (Courtesy: Fred. Olsen 1848)

develop or partner with to offer the best possible solution. As the wind industry continues to evolve, that means providing cutting-edge technologies to optimize each stage of development and operation. We are excited to be broadening our relationship with ZX Lidars as well as building on our decade-long remote sensing experience by adding ZX TM to our turnkey wind measurement solutions."

In addition to ZX TM, NRG Systems offers the ZX 300 onshore vertical profiler as well as ZX 300M for near-shore or platform-based offshore applications. The product portfolio is further supported by the ZX North American Service Center operated by NRG Systems.

"Our team installed the first nacelle-mounted Lidar in 2003," said Ian Locker, ZX Lidars managing director. "Today, we support clients globally with operational wind-farm measurements, understanding what wind turbines actually see once constructed. Combining the unique measurements of ZX TM with the customer support, care, and attention from NRG Systems is a great partnership. Approved for use by DNV and UL, clients can be confident in their choice of Lidar and are in great hands, in-country, with NRG Systems."

MORE INFO www.nrgsystems.com

INNOVATION

DNV certifies floating turbine concept

DNV, the independent energy expert and assurance provider, has provided Fred. Olsen 1848 with a Statement of Feasibility (similar to an Approval in Principle) for the floating wind turbine concept, BRUNEL. By achieving this first step in the certification process, DNV considers the BRUNEL concept feasible for further development.

BRUNEL is a floating wind turbine support structure designed to support a 15-MW wind turbine. The substructure is a column-stabilized unit with three columns connected by submerged horizontal pontoons. The rotor-nacelle assembly (RNA) is supported by two inclined towers meeting at a distance below the nacelle interface. The structure will be a single point mooring through a turret in order to weather vane.

"We are happy to see the announcement by the Norwegian government on May 11, 2022, to develop 30 GW of offshore wind capacity by 2040," said Kim Sandgaard-Mørk, executive vice president for Renewables Certification at DNV. "To achieve this growth in a safe, reliable, and sustainable manner, Norwegian wind-energy projects need access to robust and trusted risk management measures such as certification. Mitigating risks via certification is particularly valuable for floating offshore wind projects in securing project finance and demonstrating operational application."

"As countries seek to reduce their CO_2 emissions in the race to meet net-zero targets and decarbonize their energy systems, interest in floating wind projects is beginning to grow across the globe, and Norway continues to be a leader in this field as we expect further calls for tenders later this year," said Sille Grjotheim, director and country manager Norway for Renewables Certification at DNV. "In Norway, DNV's local certification team based in Hovik is expanding to support the country's advances in offshore wind."

"Achieving the Statement of Feasibility is an important first step for BRUNEL," said Anne Lene Haukanes Hopstad, DNV's project manager. "It was an interesting project to undertake, and we are looking forward to continued certification of BRUNEL in the next development phases. As designs and technologies develop, ensuring safety is paramount for floating offshore wind projects in securing

project finance and demonstrating operational applications."

"The potential of floating offshore wind is immense," said Sofie Olsen Jebsen, Fred. Olsen 1848 chief executive officer. "To drive the industry forward, it is critical to unlock sustainable solutions with commercial viability and technical excellence. BRUNEL responds to these challenges, and by achieving a Statement of Feasibility from DNV an important milestone has been accomplished in our efforts to do our part to reduce LCOE and enable floating wind at large scale."

MORE INFO www.dnv.com

Snap-on Industrial offers a wide range of reaction arms, a key component of successful torque multiplier application. (Courtesy: Snap-on Industrial)

MAINTENANCE

Snap-on reaction arms improve torque access

Torque multipliers are essential when high torque is needed in heavy-duty applications including power generation, oil and natural gas, railroad, and other critical industries. Snap-on Industrial offers a wide range of reaction arms, a key component of successful torque multiplier application.

Reaction arms improve torque access for applications involving heavy duty fleet maintenance, structural bolting, flange bolting, wind-turbine erection, and general maintenance.

Reaction arms direct all torque forces back to the adjacent fasteners or structure, eliminating unintentional rotation of the torque multiplier during operation.

Popular styles of reaction arms include:

- **Straight reaction:** 11.8-inch length; light-weight reaction; reduces tool weight.
- **Straight reaction with peg :** 1.8-inch length, 3 offset inches; light-weight reaction; reduces tool weight.
- **Double-sided reaction fixture:** 7.9-inch length; light-weight reaction; reduces tool weight.
- **Short reaction foot:** 2.55-inch length, 3 offset inches; light-weight reaction; reduces tool weight.
- **Reaction adaptor:** Light-weight reaction; reduces tool weight.

Custom-built reaction arms and sets can also be designed for customers' exact torque application.

MORE INFO b2b.snapon.com/reactionarms

PSI repairs wind-turbine equipment such as Ingeteam controllers. (Courtesy: PSI Repair Services)

MAINTENANCE

PSI Repair reaches 60,000 repaired parts milestone

PSI Repair Services, Inc., a subsidiary of Phillips Service Industries and an independent service provider to the wind-energy industry, recently announced that it surpassed 60,000 repaired wind-turbine parts for the wind-energy market.

"For over a decade, the largest wind farms in North America have relied on PSI to fix their critical turbine parts," said Mike Fitzpatrick, general manager of PSI Repair Services, Inc. "Simply put, nobody can match PSI's comprehensive repair and engineering services or our highly skilled technicians."

PSI offers component repair and engineering services for GE, Vestas, Gamesa, Siemens, RePower, Acciona, Suzlon, Nordex, Mitsubishi, and Clipper wind turbines. PSI covers the critical electronic, hydraulic, and precision mechanical components that drive the turbines' pitch and yaw systems and down-tower electronics. Commonly repaired components include printed circuit boards, pitch drive systems, inverters, IGBTs, PLCs, VRCC units, AEBIs, proportional valves, hydraulic pumps, pitch and yaw motors, encoders, slip rings, transducers, yaw modules, 3-phase bridge rectifiers, blade bearing automatic grease dispensers, active crowbars, line reactors, oil level sensors, battery chargers, cold climate converters, anemometers, and more.

PSI's engineering services include custom tests, root cause analysis, product upgrades, remanufacturing, and new product manufacturing services. The test program uses diagnostic equipment, allowing PSI to detect hard part failures, as well as parts degraded due to stress, right down to the microchip level. The root-cause analysis service allows PSI to get a view into a customer's production environment to identify all the elements connected to recurring problems so the appropriate corrective actions eliminate the problem. The product upgrade service allows PSI to improve upon legacy design with newer, more reliable technology. PSI's remanufacturing services are available for obsolete and unsalvageable parts, such as circuit boards and power supplies. Finally, the new product manufacturing service is available for customers who need a cost-effective option to produce a small run of unique legacy parts or components.

MORE INFO psi-repair.com

MAINTENANCE

CrewSmart names new commercial director

CrewSmart, the end-to-end management system for maritime operations, recently hired Anna Saunders to support the global rollout of its software platform to maritime businesses. Saunders joins from offshore energy support vessel (OESV) operator Seacat Services, where she led the company's crew management team.

"CrewSmart transformed Seacat's

crew and fleet management into a highly efficient, simplified system, led by state-of-the-art cloud technology," Saunders said. "It's now time to build upon the company's successes and deliver this product to the global market. Our senior team is ready to show maritime operators that keeping up with complex regulatory and certification requirements doesn't have to be a burden."

The new commercial director will work alongside CrewSmart's founder and technical director Christian Adams as the company seeks to increase deployment of its proven software.

Providing integrated support for personnel, operational, commercial, and financial management requirements, CrewSmart is now an established platform across the European, U.S., and Asian markets chosen for its efficiency and technological simplicity. The system is now employed by operators across sectors, including maritime security, workboat, oil and gas, wind-farm support, subsea survey, and shipping.

Anna Saunders is the new commercial director at CrewSmart. (Courtesy: CrewSmart)

Having spent time leading Seacat's crew management team, where CrewSmart supports the team's operations, Saunders understands the effect that cloud solutions can have on certification and maintenance compliance, work scheduling, and operational safety. CrewSmart's senior team is now bolstered by in-house expertise that understands the complexity and requirements of managing modern maritime operations.

"Crew and fleet managers need to be on the top of their game to mitigate the growing compliance risks associated with modern maritime operations," said Christian Adams, CrewSmart's founder and technical director. "Over the past few years, we've refined CrewSmart into an effective and simple tool that's successfully been deployed across different sectors and regulatory zones. With Anna onboard, we're in a strong position to build on our successes and help a wider pool of global industry players up their game when it comes to compliant, effective maritime operations."

MORE INFO www.crewsmart.co.uk

Richard Burgos will oversee sales of the complete wind portfolio from the Dellner Bubenzer and Dellner Hydratech catalogs. (Courtesy: Dellner Bubenzer)

MANUFACTURING

Dellner names U.S. wind sales manager

Heavy-duty brake manufacturer Dellner Bubenzer USA Inc. has named Richard Burgos head of sales — wind (Americas). Burgos is bilingual and will oversee sales of the complete wind portfolio from the Dellner Bubenzer and Dellner Hydratech catalogs. He brings 25 years of experience, having spent the last decade with a focus on business development in Latin markets for one of the world's biggest wind-turbine manufacturers.

"I want to become an expert at renewable energy and, eventually, take that experience to educate the next generation of sales professionals," Burgos said. "Sustainability is the way to go, and renewable energy is a fundamental foundation to using less fossil fuel. The wind industry is still in the infancy of implementation, and many countries are looking to either expand or implement renewable energy. This position allows me to pioneer ongoing adoption of these principles, supported by a world-class suite of products."

Burgos started in sales after completing a term in the U.S. Marine Corps. His first job was selling consumer electronics before transitioning into wireless platforms, Internet of Things, data analytics, and eventually joining General Electric. There, he became global account director, managing the largest pump manufacturing company globally and was promoted to director of sales — Latin America for GE Power Conversion. Burgos will represent the whole Dellner Bubenzer (legacy Pintsch Bubenzer, JHS, Dellner) and Dellner Hydratech (legacy Hydratech Industries) ranges following ongoing group-level expansion.

"Few people acknowledge that, by country, we are behind only China right now for the most installed capacity," said Joel Cox, Dellner Bubenzer's managing director of sales and global sales director (Americas). "That means, as a manufacturer of high-performance disc and drum brakes for severe duty applications, we must position ourselves accordingly — and we're doing just that. We see our wind-energy business doubling in quick time, but we need the right leadership — like Richard — to realize that potential."

MORE INFO www.dellnerbubenzer.com

MANUFACTURING

B&K Vibro xannounces VCM-3 enhancements

Brüel & Kjær Vibro (B&K Vibro), an independent supplier of condition-monitoring solutions for rotating machinery, has delivered a range of product enhancements for its VCM-3/Setpoint offerings to deliver a single, integrated Setpoint condition monitoring system (CMS) solution.

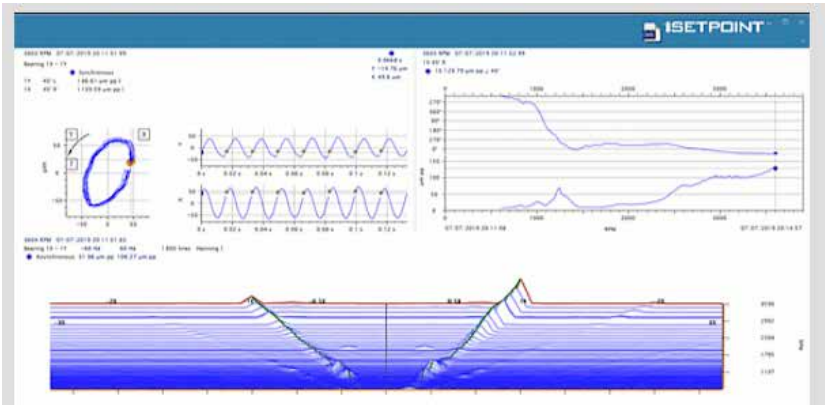
VCM-3 data can be integrated with VC-8000 data and fed directly into Setpoint CMS to create a plant-wide solution, encompassing machine protection and condition monitoring for both critical and Balance of Plant (BoP) machinery assets.

The new product enhancements will enable B&K Vibro to monitor every kind of asset, from critical (VC-8000) to BoP/auxiliary (VCM-3), integrating with Setpoint CMS and providing an improved diagnostic experience to sites in both hazardous and non-hazardous areas.

"B&K Vibro has listened and responded to our clients' needs for enhanced functionality and tighter integration across the range of solutions we offer," said Thomas Carvalho, commercial platform leader, Edge Devices.

"These improvements will provide additional value by allowing a single view of all asset types, delivering faster analysis, and diagnosis of impending issues, which means improved uptime for end users. We now have a complete range of asset monitoring solutions for both critical and auxiliary machinery."

MORE INFO www.bkvibro.com



B&K Vibro has enhanced the functionality of Setpoint monitoring system. (Courtesy: B&K Vibro)

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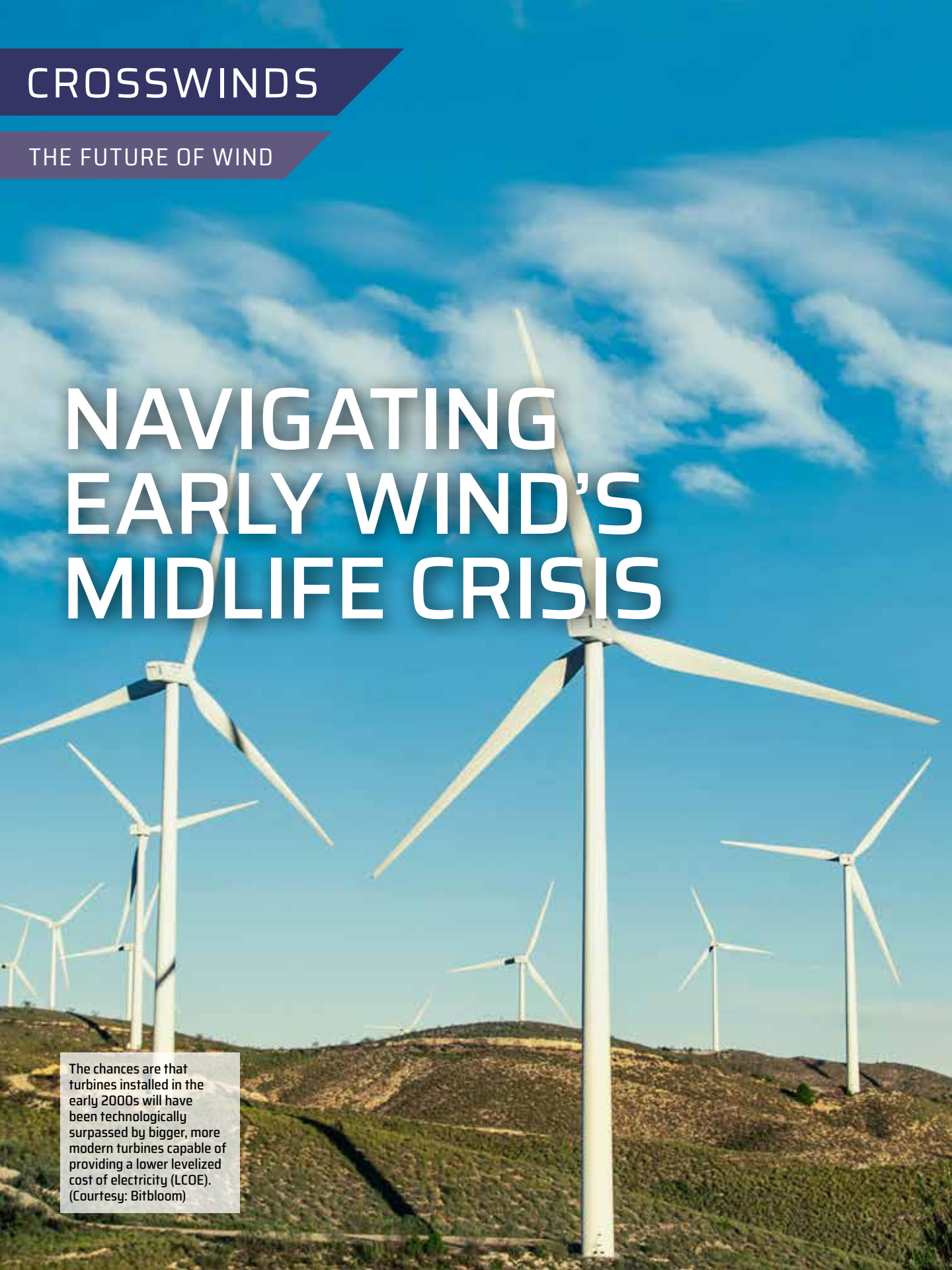
NAVIGATING EARLY WIND'S MIDLIFE CRISIS



The chances are that turbines installed in the early 2000s will have been technologically surpassed by bigger, more modern turbines capable of providing a lower levelized cost of electricity (LCOE). (Courtesy: Bitbloom)

Even for turbines reaching middle-age, there is usually more than enough underutilized data to extend asset life, increase efficiency, produce more renewable energy, and, ultimately, bolster the balance sheet.

By STAFFAN LINDAHL

Wind energy is no longer new, and a growing collection of generation assets has been operational for well over a decade. With the first flush of youth (turbocharged by subsidies) behind them but many years ahead before mandatory retirement, these early-mover assets can pose challenges for owners and operators.

The chances are that turbines installed in the early 2000s will have been technologically surpassed by bigger, more modern turbines capable of providing a lower levelized cost of electricity (LCOE). For site owners and operators, the question naturally arises over what to do with these middle-aged assets — should they persevere for as long as possible, or dismantle and upgrade to the newest models?

The latter option, known as "repowering," is certainly popular. Renewable UK makes the case for upgrading 12 GW of such capacity onshore alone. And you can see why: Even with the government backing onshore wind once again, it's not easy to secure a patch of land (or coastal shelf) with planning permissions and infrastructure ready and waiting for new turbines.

However, tearing down and replacing perfectly serviceable turbines can also be seen as a rather drastic option. It is expensive, for a start, and inevitably entails an additional carbon cost for the manufacture, transport, and installation of new components — on top of recycling challenges for the old ones. Repowering is certainly an option to consider, but should it be the first one to resort to?

Not necessarily. There are lower-investment, lower-risk options to explore first. In our experience, there can be large reserves of unrealized value in these older projects hidden in their data. Once properly collected, cleansed, and analyzed, talented engineers can uncover immediately actionable insights to improve asset performance and extending life — thereby yielding more green energy and improving commercial outcomes.

SLOW-SIMMER AND ACUTE PRESSURES

Why might we say that early wind assets are reaching midlife crises? Through a combination of long- and short-term pressures.

A new turbine or wind farm can generally be assumed to run pretty efficiently. Logic dictates that, as time goes by, components degrade and inefficiencies creep in. A common issue is blade surface degradation — a slow-build issue with a gradual impact on turbine efficiency. Other issues are less gradual and more abrupt, but nonetheless become progressively more likely over time. Anecdotally, we have seen that the design lifetime of certain common drivetrain components has probably been overestimated — something that has only become clear as the industry has built a library of real-world operational data over time. Physical componentry therefore introduces both slow-simmer and acute pressures over time that affect the risk/return profile of owning or operating a mid- or late-life wind asset.

More prosaic operational factors can also add to those efficiency pressures, too. For a lot of older wind assets, service contracts — or even ownership of the asset itself — have changed hands one or more times by now, meaning the company running the asset today is often not the one that designed and commissioned it. In theory, this should cause no issues — but that theory depends on perfect technical handovers and knowledge transfer, and, in the real world, aspects of operational history are often lost. This could be rectified at handover or due diligence stage with sufficient investigatory work, but companies looking to run a lean wind portfolio can be daunted by the prospective spend.

To these relatively steady pressures, we can also add some highly specific and exceptionally acute ones. For example, the current global energy commodity price rises, coupled with a European strategic acceleration towards energy independence due to Russia's actions in Ukraine, add heat to an already hot renewables market. Power prices are high and look set to remain so for the near future, adding extra pressure for owners and operators to get the most megawatt hours out of their assets as possible, as soon as possible.

SQUEEZING EXTRA VALUE FROM WIND FARM DATA

It's clear, then, that there is a huge potential upside in optimizing wind-asset performance. Versus repowering and replacing, projects can be completed in a fraction of the time and for a fraction of the cost with little-to-no supply chain risk.

That begs the rather important question of how. The good news is there is typically a wealth of untapped value in the data that asset operators tend to already have in hand. However, many companies leave that value unrealized either because they don't know it's there or suffer from misperceptions about how difficult (read: expensive) it can be to uncover.

For example, older turbines often exhibit yaw misalignment, reducing the asset's efficiency. This is relatively easy to assess using existing datasets, even if older assets lack some of the problem-specific data acquisition found with newer technologies.

In a multi-turbine context, it can be helpful to identify turbines with particularly high- or low-load metrics vs. oth-

A new turbine or wind farm can generally be assumed to run pretty efficiently, but logic dictates that, as time goes by, components degrade and inefficiencies creep in. (Courtesy: Bitbloom)

ers in the same farm or vs. industry benchmarks for similar technology. Operators can then make intelligence-led decisions on which assets can be sweated for more value by running at increased load and which are vulnerable to excessive fatigue. In the ideal world, operators would sweat each asset for maximum value while also taking care for all co-located assets to reach end-of-life at roughly the same time ahead of a repowering project. What they don't want is for some assets to fail after 20 years and others to stretch to 30 years with money left on the table in the interim. Live load management informed by intelligent analytics can help them achieve that balance.

WORK WITH WHAT YOU'VE GOT

Wind farm owners and operators — whether they're looking at a site they've managed for 15 years or one they acquired the week before — often assume uncovering these opportunities for optimization requires heavy investment in state-of-the-art new data collection hardware and sophisticated performance analytics. While this may be true if the goal is to eke every theoretically possible drop of value from an asset, in our experience, smart turbine engineers supported with built-for-purpose data analytics tools can achieve a great deal with the data already held within the organization.

Too often, the default approach is to design complex analyses that end up being expensive, taking a long time to implement and being so situation-specific that they don't scale. However, even for turbines reaching middle-age, there is usually more than enough underutilized data to extend asset life, increase efficiency, produce more renewable energy, and, ultimately, bolster the balance sheet. After all, the most valuable data is the data you already have.

ABOUT THE AUTHOR

Staffan Lindahl is co-founder at Bitbloom.

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