



Giving Wind Direction

WIND SYSTEMS

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PROFILE

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IN FOCUS

CHALLENGE TO WIND TURBINES

The review of current trends in wind-turbine bearings is important, not only for reducing the cost of energy, but also for ensuring the future of sustainable and zero-emission energy sources.

MORE OPTIONS THAN EVER FOR CONDITION MONITORING

But dynamics are shifting for those who require oil analysis service – and those who provide it. **18**

PROFILE

Bureau Veritas works with clients within the renewable-energy sector as advocates throughout the asset lifecycle to ensure projects run safely and efficiently. **24**



CONVERSATION

Jacob Beck, CEO of Electrom Instruments, discusses his company's role of providing electronic test equipment for wind farms **28**

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▀ THE FUTURE OF WIND



DIRECTION

8

Codling Wind Park sets up fund for local fisheries ▀ US Wind praises Maryland's POWER Act ▀ ArcVera Renewables hires business development manager



CROSSWINDS

40

BUILDING A BROAD BIPARTISAN COALITION

At CLEANPOWER 2023, officials and representatives from government and private sectors came together to discuss the recent great strides made in clean energy, as well as the challenges ahead to create a zero-carbon future.

TAILWINDS

THE BUSINESS OF WIND



▀ INNOVATION

Siemens Gamesa introduces GreenerTower **30**

▀ CONSTRUCTION

Codling Wind Park makes successful energy bid **33**



▀ MAINTENANCE

ONYX Insight, bp Wind Energy sign new deal **35**

▀ MANUFACTURING

New LUTZE cable catalog released **36**



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FROM THE EDITOR

Making it look easy in the Big Easy

One of the best reasons for having a digital-only issue is that I am often able to get wind-energy news to you a lot quicker.

Case in point: Our *Wind Systems* team recently returned from a successful trip to CLEANPOWER 2023 in New Orleans, Louisiana, May 23-25.

In between some amazing meals, we were able to spend time with colleagues and industry friends who have their finger on the pulse of the wind-energy industry.



According to the American Clean Power Association, more than 8,000 people explored the 480-plus exhibits that crisscrossed the Ernest N. Morial Convention Center floor. There were also dozens of panel discussions throughout the three-day event discussing practically every aspect of what renewables can do to advance zero-carbon goals that may seem like a long way off, but, in actuality, are closer than you might think.

This issue has several articles of interest that are a direct result of being at CLEANPOWER, but our June issue also has a lot of information designed to address the issue's main focus on maintenance and condition monitoring.

Crosswinds features a breakdown of CLEANPOWER's opening remarks panel. In the article, ACP CEO Jason Grumet talks about where clean energy stands today, as well as what will be needed moving forward.

During the panel, John Podesta, senior adviser to the president for clean energy innovation and implementation at the White House, also addressed the convention, pointing out what the Biden administration's Inflation Reduction Act will mean for renewables, as well as other initiatives in the pipeline that could also have a positive impact on moving toward a zero-carbon future.

With all that forward momentum, it makes it even more important to look at ways to ensure the turbines in operation today keep spinning.

Our cover article takes a deep dive into bearing and gearbox failures and how they can be a challenge to wind turbines.

On the subject of condition monitoring, our second feature looks at how there are more options than ever for this vital function, but the dynamics are shifting, especially for those requiring oil analysis service.

In our Conversation feature, I had the privilege of speaking with Electrom Instruments CEO Jacob Beck, where he discussed Electrom's role of providing electronic test equipment for wind farms.

As wind keeps a steady hand on the present while continuing to look ahead, CLEANPOWER was definitely a success, and it demonstrated there is ultimately no stopping the industry's drive to make a better future for everyone.

Enjoy your summer, and, as always, thanks for reading!

A stylized, handwritten signature of Kenneth Carter in black ink.

Kenneth Carter, editor

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Giving Wind Direction

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Opinion upholds permits for Vineyard Wind

From American Clean Power

The American Clean Power Association (ACP) applauded a Massachusetts federal judge for her recent ruling that resoundingly upheld key federal approvals for the Vineyard Wind 1 offshore wind farm under construction off the coast of Martha's Vineyard.

"The District Court held that the Bureau of Ocean Energy Management (BOEM) and the National Marine Fisheries Service (NMFS) fully complied with the Endangered Species Act (ESA) and the National Environmental Policy Act (NEPA) in approving what is about to become the largest offshore wind farm in the United States," said Josh Kaplowitz, ACP vice president of Offshore Wind. "This opinion validates what we've been saying all along: The environmental review process for offshore wind projects is rigorous and effective at ensuring that these projects are built in an environmentally responsible manner. The federal government did its job, and they did it well."

The District Court agreed with BOEM and NMFS that the best available science was considered in protecting the endangered North Atlantic Right Whale (NARW) and approving the project with an extensive suite of mitigation measures to reduce risk to the species. The court rejected all of the plaintiffs' claims that the federal agencies had failed to analyze certain studies and data relating to the NARW.

"We know that offshore wind farms can be built and operated in a way that protects marine ecosystems," Kaplowitz said. "Now it's time to get steel in the water and start reaping the significant benefits that offshore wind affords: reducing greenhouse gas emissions, improving our nation's health, powering millions of homes with secure and reliable domestic energy, revitalizing our maritime and manufacturing sectors, and creating tens of thousands of good-paying American jobs."

The district court was expected to issue opinions in the coming weeks regarding two other challenges to the Vineyard Wind project.

To read the full text of the opinion, go to: cleanpower.org/wp-content/uploads/2023/05/Vineyard_USDC_Mass_opinion071723.pdf



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DIRECTION

THE FUTURE OF WIND



The fisheries fund will support opportunities for both inshore and offshore fishing by fishers associated with Codling Wind Park. (Courtesy: EDF Renewables)

Codling Wind Park sets up fund to benefit local fisheries

Codling Wind Park is establishing a dedicated 500,000 euros Fisheries Fund to benefit the fishing industry operating within and around the Codling Bank area of the Irish Sea. The fund will have a 100,000 euro annual budget to support different initiatives for the next five years.

The fund will support opportunities for both inshore and offshore fishing by fishers associated with Codling Wind Park. Fishers are being asked to bring forward their own ideas about how the fund should be used. The project's fishing engagement manager meets regularly with local fishers and will discuss the terms of reference and progress proposals for the fund directly with them.

Codling Wind Park also confirmed it will consider other ideas to support fishers, including helping establish a lobster hatchery. The lobster hatchery would involve raising and releasing young lobsters back into the Irish Sea to increase fishing opportunities in the area. The project is engaging with fishers on this proposal that would significantly support a sustainable and productive fishery in the area.

Codling Wind Park has also published a fisheries charter or code of practice, which will guide its engagement with fishers and its care of marine life on the Codling Bank. The Fisheries Charter, which will be the first code of its type between an offshore wind developer and fishers in Ireland, commits Codling Wind Park to a range of sustainable development practices and responsible stewardship of the waters and seabed on the Codling Bank.

"The purpose of this fund is to support initiatives that could be of benefit to fishing communities, rather than benefiting one individual fisher over another," said Scott Sutherland, co-project director of Codling Wind Park. "For example, adding value to a fishery, improving port infrastructure, improving safety, or exploring innovation and fishery diversification."



US Wind and Haizea Wind Group are partnering on the Sparrows Point Steel factory. (Courtesy: US Wind)

"We want to hear from the fishers about what they think this fund should be used for," he said.

"We are making a commitment to the fishers who use Codling Bank that we want to help them build a sustainable future," said Thomas Gilbert, co-project director. "We have been engaging with fishers for a long time now on a wide variety of issues. One of the key benefits of this engagement is that we have been able to share with each other our different perspectives and see how the development can and will co-exist with the fishery. We are also very proud to be the first developer in Ireland to publish a fisheries charter, which commits the project to engaging fairly with fishers, to boosting marine biodiversity and to developing sustainable fishing practices."

Codling Wind Park, which is a 50/50 joint venture between Fred. Olsen Seawind and EDF Renewables will be approximately 13 to 22 kilometers off the Co. Wicklow coast between Greystones and Wicklow Town. When operational, it will generate up to 1,450 MW, enough electricity to power up to 1.2 million homes and support Ireland's 2030 offshore wind targets.

MORE INFO codlingwindpark.ie

US Wind praises Maryland's POWER Act

The Maryland General Assembly passed the Promoting Offshore Wind Energy Resources (POWER) Act, paving the way for a new clean-energy future for the state. Baltimore-based US Wind Inc. applauded the bill's sponsors Delegate Lorig Charkoudian and Sen. Katie Fry Hester, committee chairs Brian Feldman and CT Wilson, and House and Senate leadership for passing the landmark legislation. Gov. Wes Moore's desk was expected to sign the legislation into law.

"The POWER Act is a real game changer for Maryland," said Jeff Grybowski, US Wind CEO. "It sets a path for the people of Maryland to reap the benefits of huge amounts of clean energy in the coming years. It also tells the entire offshore wind industry globally that Maryland is back big time as a major player. Companies looking to invest in offshore wind have to seriously consider Maryland."

The legislation would quadruple Maryland's offshore wind generation goals from about 2 GW to 8.5 GW by 2031, improve its transmission infra-



structure, and provide a pathway to future procurement of offshore wind energy in the state. The 8.5 GW of offshore wind energy targeted in the POWER Act is enough to supply clean energy to more than 2 million homes in Maryland while creating tens of thousands of family-sustaining American jobs, as the bill ensures offshore wind projects provide equitable opportunities for local unions and minority, women, service-disabled, and veteran-owned businesses to join in Maryland's clean energy future.

US Wind also announced its partnership with Haizea Wind Group to manage and operate Sparrows Point Steel, Maryland's first permanent offshore wind factory in Baltimore County, Maryland. The facility will manufacture steel components for the U.S. offshore wind industry, including monopiles and towers, while creating hundreds of jobs for local unions and minority businesses.

MORE INFO uswindinc.com

ArcVera Renewables hires business development manager

ArcVera Renewables, a provider of consulting and technical services for wind, solar, and energy storage projects, recently announced the expansion of its business development team with the

appointment of industry veteran Adam Smith. Smith brings a mix of technical and commercial expertise, which will strengthen ArcVera's efforts to grow its customer base across all technologies and geographies.

Starting in the wind industry in 1994, Smith has built a solid track record as a technical consultant and developer for wind and solar projects throughout the United States and Mexico.

"I am very happy to welcome Adam at ArcVera at a time when the IRA has such a major positive impact on the renewables industry," said David Simkins, director of Business Development – Global at ArcVera Renewables. "It is generating abundant opportunities for us to support greenfield projects in need of prospecting and early development technical support. Adam's knowledge, expertise, and experience dating back to the early days of the renewable energy industry will make him a very valuable asset to our team's efforts to bring new business home."

ArcVera Renewables has experienced strong growth over the last few years. The company aims to take advantage of the renewable energy policy environment developing in the U.S. but also in its established global markets of India, South Africa, and Latin America.

"It's an incredible opportunity to work alongside a talented team of professionals who are passionate about driving the renewable energy industry



New ArcVera Renewables' business development manager Adam Smith. (Courtesy: ArcVera Renewables)

forward," Smith said. "ArcVera's total dedication to providing trustworthy, insightful, and accuracy-driven project services to clients makes it a really exciting company to work for. I am proud to be part of this amazing team."

MORE INFO www.ArcVera.com

North Star announces Bradford as chief technology officer

North Star, a leading offshore infrastructure support vessel operator in the U.K., recently appointed James Bradford as its chief technology officer (CTO) as the organization scales up its onshore operations for further growth in the offshore wind sector across Europe.

In the newly created role, Bradford will accelerate the company's ESG and decarbonization strategies by delivering a technological roadmap to drive performance and innovation investments as the firm progresses towards its fleet decarbonization target of 2040.

Bradford has more than 30 years' strategic and operational experience in the maritime sector. He joins from ship management specialist V. Group, where he was global head of technical. There, he played a key role in the company's innovation agenda that redefined the industry's fleet cell model for technical management.

Bradford has significant seagoing experience. As a chief engineer in his early career, he achieved Class I Unlimited certification, and project managed the ship construction team on a 16 vessel build over a two-year period.

His other significant tenures include almost five years at Gulf Marine Services where he was general manager for northwest Europe before being promoted to chief operating officer in the United Arab Emirates. Prior to this, Bradford was GM for operations at marine transportation company GulfMark for eight years, and at James Fisher also for eight years, where he climbed the ranks to technical director responsible for its tanker, offshore, and nuclear fuel fleets.

“It’s a very exciting time to be joining the business as CTO,” Bradford said. “North Star is an immensely well-respected, steadfast vessel operator with an enduring reputation in the North Sea. Since securing four long-term charters for its new hybrid propulsion



New North Star CTO James Bradford has 30 years’ strategic and operational experience. (Courtesy: North Star)

service operations vessel design, its prominence has rippled across the offshore wind market, opening up multiple new opportunities for the business and its next fleet.” “Ensuring the business continues to invest in the best

innovations to hasten its sustainability goals across its existing ships and implemented into new forthcoming SOV designs, is a very exciting time to join as CTO,” he said. “I’m looking forward to helping to shape the future of its fleet and leading its technical digitization strategy.”

“James has an exceptional track record for delivering results across all aspects of new fleet constructions for on-time delivery,” said North Star Chief Executive Matthew Gordon. “He is also very tuned in to the latest technical developments, which will help guide our executive team to identify and leverage new opportunities to maximize future investment and deliver value to our shareholders. His strong leadership and managerial skills will also add another layer of expertise as we expand our team and makes him the perfect fit for our organization. We look forward to working together.”

MORE INFO www.northstarshipping.co.uk

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A low-angle, upward-looking shot of a white wind turbine against a bright blue sky filled with fluffy white clouds. The turbine's tower and nacelle are visible, with one of its three blades extending towards the top right. The blade has a red stripe near its tip. The overall composition is dynamic and emphasizes the height and scale of the renewable energy infrastructure.

IN FOCUS

O&M: MAINTENANCE ► CONDITION MONITORING

BEARING AND GEARBOX FAILURES: CHALLENGE TO WIND TURBINES

Wind patterns across the globe vary over the year and can be unpredictable at times, with this variability in wind leading to fluctuating loads on wind turbine components. (Courtesy: Canstock)



The review of current trends in wind-turbine bearings is important, not only for reducing the cost of energy, but also for ensuring the future of sustainable and zero-emission energy sources.

By ANDREA R. AIKIN

With ever increasing energy requirements, the energy sector is seeing an unparalleled growth in renewable energy production with wind energy in the lead. Land-based, utility-scale wind farms offer the lowest priced energy source currently available at between 2 to 6 cents per kilowatt-hour. [5]

As of the fourth quarter 2019, the American Wind Energy Association (now the American Clean Power Association) reported there are 105,583 MW of wind energy operating in the U.S. with more than 59,800 wind turbines spinning across 41 states and two U.S. territories. [4] In 2019, 7.3 percent of U.S. energy demand was met using wind energy. [1] This percentage could be increased to 20 percent by 2030 and to 35 percent by 2050. [2]

A wind turbine creates electricity when wind flows across the turbine blade and spins the rotor. The rotor is connected to a generator directly in a direct drive turbine or through a shaft and a series of gears (i.e., a gearbox) that speed up the rotation and allow for a physically smaller generator (see Figure 1). [15] This translation of aerodynamic force-to-rotation of a generator is what creates electricity.

Wind patterns across the globe vary over the year and can be unpredictable at times, with this variability in wind leading to fluctuating loads on wind turbine components. A typical wind turbine consists of more than a dozen bearings that are expected to work simultaneously and continuously for many years. As a result, wind-turbine bearings and gearboxes are often susceptible to failure well before their designed service lives.

Bearing failures in wind turbines are a major cause of downtime in energy production for unplanned maintenance, repairs, and replacements. This failure type is a primary cost and results in higher operations and maintenance (O&M) costs for the energy operator and in higher utility bills for the customer. The National Renewable Energy Laboratory's (NREL) Gearbox Reliability Database (GRD) shows that 76 percent of gearboxes failed due to bearings,

while 17 percent failed due to gear failures. [11] This shows the importance of reliable bearings and gearboxes for wind-turbine operations to the economy and society.

WIND TURBINE BEARINGS

The gearbox in a wind turbine consists of several bearings that translate the wind energy from the spinning blades into electrical energy (see Figure 1). In the 21st century, bearings are one of the most critical mechanical/tribological components used in a wide range of applications, including aerospace, automotive, energy, medical devices, sporting equipment and so on.

Wind-turbine drivetrains include different types of bearings (see Table 1). Bearings and gearboxes in wind turbines are designed and certified to last for at least 20 years; however, only a small percentage survive that long in the field. As a result, many bearing OEMs are taking special interest in bearings used in wind-turbine applications with the desire to design stronger, tougher, and more reliable bearings.

STLE-member Shawn Sheng, a senior engineer at NREL in Golden, Colorado, notes that, while gearboxes “do not fail as often as electronic components in a turbine, they appear to be the costliest to maintain throughout a turbine’s 20-year design life.” If not detected and mitigated early enough, Sheng said these failures “can lead to entire replacement of these gearboxes, which require costly crane rental expense, in addition to revenue loss, capital cost on new or upgraded components, labor, and other costs, which dramatically increase the cost of energy for wind power, impacting offshore wind even more.”

In 2007, NREL established the Gearbox Reliability Collaborative (GRC) to foster understanding of the root causes of premature gearbox failures and to improve gearbox reliability. [6] GRC research has found the faults in most prematurely failed gearboxes are related to bearing failures in the intermediate and high-speed sections, with much of that failure occurring in as little as 5 percent to 20 percent of the bearing’s design life. [6]

“Bearings are key elements that enable rotational motion and support radial and axial loads in a wind turbine,” said STLE-member Harpal Singh, principal engineer at Sentient Science in West Lafayette, Indiana.

Singh noted bearing failures in wind turbines can be expensive due to lost production, replacement component costs, and maintenance costs, with the total cost of wind-turbine gearbox replacement varying depending on the turbine location, turbine type, gearbox type, etc. Gearbox failures on land-based turbines are assumed “to cost about \$250,000-\$300,000 per failure event.”

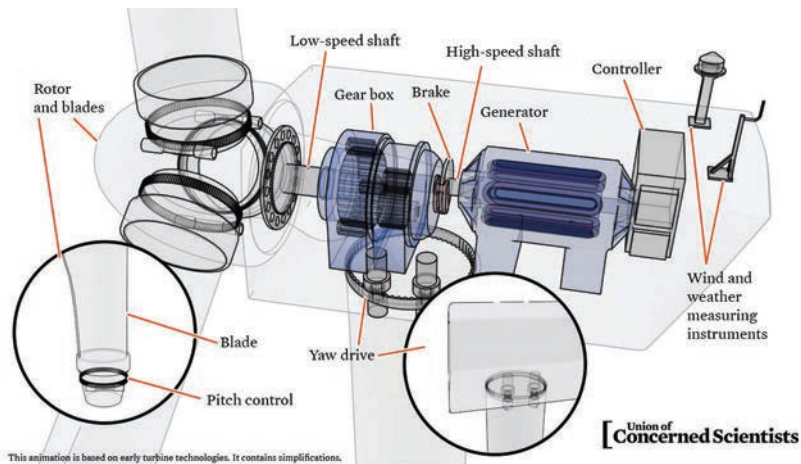


Figure 1: Simplified view of components of an upwind-facing, horizontal-axis wind turbine with a gearbox drive. [15] (Courtesy: Union of Concerned Scientists, www.ucsusa.org.)

TYPES OF BEARING FAILURES IN WIND TURBINES

Sheng reported NREL’s research “tries to help industry improve wind-turbine drivetrain reliability, both inherent and operational, through testing, modeling/analysis, failure mode investigation and O&M research, leading to reduced O&M cost and making wind power more cost competitive.” Sheng focuses on failure data collection and statistical analysis, fault diagnostics, and prognostics research.

NREL’s research on wind power reliability focuses on gearboxes, blades, and how turbines interact with the electric grid. [14] NREL collects gearbox failure data in its GRD, whose goal is to quantify the magnitude of the problem and identify top failure modes and root causes, while directing wind-turbine gearbox reliability research and development and providing a benchmark for evaluating technology advancements. [11] Main bearing failures caused by micropitting, white etching cracks in gearbox bearings, and generator bearing failures are identified as research priorities.


Singh identified five of the most common failure modes observed in wind-turbine bearings:

► **Axial cracking:** Characterized by the presence of a crack in the axial direction largely caused by improper fits, improper shaft grooving, rotation of rings, and microstructural alterations (also called white etching cracks [WECs]) in bearing material.

► **Scuffing/smearing:** A type of adhesive wear that occurs in two mating surfaces when material transfers from one surface to another under frictional heating.

► **Spalling:** Characterized by pitting and flaking of material from the raceways and rolling elements caused by “geometric stress concentration from deflection and misalignment, inclusions and defects in the material subsurface and high localized stresses from nicks, dents, and debris.”

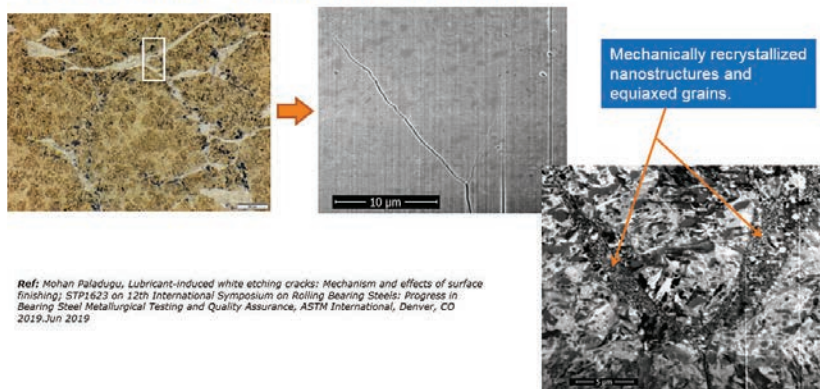
► **Micropitting:** Or surface-initiated fatigue, is caused by inadequate lubrication resulting in the contact surfaces no



Bearing Type	Turbine Drivetrain Component
Ball	Yaw bearings Pitch bearings Generator
Cylindrical roller	Gearbox
Tapered roller	Gearbox Main shaft Pitch bearings
Spherical roller	Main shaft Gearbox

Table 1: Different bearing types used in wind-turbine drivetrains. (Source: Adapted from Andrew, J.M. (2019), "Fundamentals of wind turbines," TLT, 75 (8), pp. 32-40. Available at https://www.stle.org/files/TLTArchives/2019/08_August/Webinars.aspx.)

What is in the "white etching matter"?



Ref: Mohan Paladugu, Lubricant-induced white etching cracks: Mechanism and effects of surface finishing; STP1623 on 12th International Symposium on Rolling Bearing Steels: Progress in Bearing Steel Metallurgical Testing and Quality Assurance, ASTM International, Denver, CO 2019, Jun 2019

Figure 2: White etching matter observed under an optical microscope. (Courtesy: Mohan Paladugu, "Lubricant-induced white etching cracks: Mechanism and effects of surface finishing," STP1623 on 12th International Symposium on Rolling Bearing Steels: Progress in Bearing Steel Metallurgical Testing and Quality Assurance, ASTM International, Denver, Colo., June 2019.)

longer being separated, and leading to asperity shear, plastic deformation, and break off. Asperity breaking causes microspalls, which can grow into macrospalls/spalling over time.

► **Dents/indentations:** Result when the lubricant is contaminated with foreign abrasive particles or when debris generated within the system is entrapped between raceways and rolling elements.

A 2016 Department of Energy report noted some bearing failures and their underlying physics are not well understood and remain a research priority. [6] Main bearing fail-

ures caused by micropitting, WECs in gearbox bearings, and generator bearing failures are identified as research priorities, but until the failure modes are well understood, the mitigation strategies being developed might only partially address these failures. [6]

Sheng identified scuffing and axial cracking as the top two failure modes for gearbox bearings, while fracture and cracking appear to be the top failure modes for gearbox gears. Sheng noted axial cracks or WECs have attracted research attention, but "there is still no consensus on the root causes and solutions to completely get rid of this failure mode, although case-carburized bearing steel with increased retained austenite and diamond-like carbon coating appear helpful with its mitigation." While axial cracking occurs on the surface, WECs, typically thought of as precursors to axial cracking, occur in the subsurface.

WHITE ETCHING CRACKS AND BEARING FAILURE ANALYSIS

Bearings in wind-turbine applications are known to show premature damage, typically as cracks in the bearing steel, with the crack faces often showing evidence of white etching matter. Based on their appearance, these are called WECs, and they are known to cause premature damage to the bearings. [9] WECs also are called white structure flaking (WSF), irregular white etching cracking (Ir-WEC), and brittle flaking. The cracks are thought to form first from the intensity of local shear stress, then the white etching matter is thought to form later from the rubbing of the crack faces against each other. [9,10]

While axial cracking occurs on the surface, Singh described WECs as the "premature bearing failures caused by extensive subsurface crack networks associated with altered microstructure." WECs appear white when etched with Nital and observed under an optical microscope (see Figure 2). They show a grain size of 5-300 nanometers, with a hardness 10-50 percent higher measured in microstructure adjacent to these cracks, compared to the unaltered microstructure.

In a 2017 Tribology Letters article, white etch areas were found to precede crack formation, and cracks are prerequisites for white etch formation. [3] The article confirmed

the microstructural alterations detected in the studied bearings were observed to have different crack morphology that could be initiated by different mechanisms, including material, mechanical, thermal, and chemical phenomenon. [3]

While what drives the occurrence of WECs in bearings is still being debated, Singh noted it is thought to be driven individually or by a combination of multiple factors, including:

- The presence of hydrogen resulting from lubricant decomposition, stray current, corrosion or water.

- Mechanical and tribological factors, including high, normal, or transient loads or frictional stress.

- Electrothermal and electrical effects.

Mohan Chand Paladugu, a materials science specialist with The Timken Co. in North Canton, Ohio, noted WECs “are seen as the main damage mode” for bearing damages from wind-turbine gearboxes and are “known to cause very premature bearing damages.” As previously noted, Paladugu confirmed premature bearing damage adds “significant costs to the maintenance of wind turbines.”

In WEC-induced failures in wind-turbine gearboxes, Paladugu noted, “subsurface cracks are seen in the bearing raceways, and these cracks seem to be oriented in the over-rolling direction.” The white appearance of some of these cracks, in optical metallography observations, is the cause of the WEC name.

In recently published articles, WEC damage was generated in metal subsurfaces under the influence of subsurface shear stresses but was caused by the tribochemical reactions occurring at the rolling contact. [12,13] In other words, although WECs form in the subsurface, their formation is a surface-driven phenomenon. This was demonstrated by applying abrasive particles on the raceway surfaces and testing the bearings in an oil that causes WECs. [13]

Paladugu concurred WEC damage is caused by a combination of multiple factors, including “significant slip at the rolling contact, combined with reactive oil additive chemicals, in the lubricant or reactive oil additive chemicals in the lubricant, combined with stray electric currents.” Tribochemical reactions are thought to drive atomic hydrogen into the steel, which results in deformation damage and cracking in the raceway subsurfaces.

Paladugu noted it is possible to generate white etching material through other ways, “but those ways do not seem to cause premature bearing damages under the typical loads in application.”

Testing the role of lubricants in generating WECs found bearings were damaged prematurely when the tests were performed in an oil with reactive additives. [12,13] The reports concluded that a tribofilm is formed, as a consequence of reactive additive elements, in the lubricant oil, and associated tribochemical reactions drove the formation of the subsurface cracks in steel. [12,13,14]

While WEC damage can be mitigated by avoiding reactive lubricant additives, Paladugu noted the lack of the reactive additives might result in other problems such as micropitting of gears and bearings. Chemically modifying



NREL's research on wind power reliability focuses on gearboxes, blades, and how turbines interact with the electric grid. (Courtesy: Canstock)

the steel surfaces at the rolling contact is one way to avoid WEC damage by avoiding the tribological reactions. Paladugu listed using black oxidized bearing components or using bearing components made of high chrome steels that form surface passivation oxide layers as ways to avoid these tribological reactions.

Paladugu said current trends in bearing designs that would improve bearing performance include “preloaded tapered rolling bearings, where roller skidding, axial and radial loads can be better controlled.”

COMPUTATIONAL SOLUTIONS FOR DETECTION, PREDICTION OF EARLY FAILURES

Computational solutions include algorithms or models that detect or predict impending failures of components. Sheng reported “various computational solutions are investigated in the literature for diagnostics and prognostics of component failures,” and although more of this work has been performed in applications other than wind turbines, some has been done. Sheng divided these solutions into “data domain, physics domain, or hybrid data-physics domain integrated approaches.” In regard to the wind industry, Sheng found that, for field deployment, diagnostic solutions in the data domain are more mature and widely used than prognostics, but both areas have been and will continue to be active areas of research in the foreseeable future.

Reduced O&M costs can be achieved by wind-power plants through prognostics and health management (PHM) technologies, but prognostics activities are still generally at the research and development stage. [7] The focus of the prognostics research, in relation to wind turbines, has been on

remaining useful life (RUL) prediction. [7] This research has indicated bearing axial cracking is the prevalent wind-turbine gearbox failure mode experienced in the field, while, in contrast, rolling contact fatigue is normally the only failure mode represented in the bearing design life calculation. The probability of failure is used as a component reliability assessment and RUL prediction metric and can be expanded to other drivetrain components. PHM technologies can be applied to both land-based and offshore wind turbines. [7]

The wind industry has been exploring ways to mitigate the impacts of these bearing and gearbox failures in wind turbines in areas ranging from design to new materials or lubricants and to O&M practices. [8] Condition-based maintenance, accomplishable under a PHM framework, has been explored for its ability to improve O&M practices in wind turbines. Numerous future research opportunities exist for wind turbine PHM technologies. [8]

Sheng noted computational solutions enable a “maintenance paradigm shift from time or usage-based maintenance to condition-based or predictive maintenance.” These types of computational solutions can help improve efficiency, reduce human errors, and save costs. While validation is challenging, cross-validation during the development of computational solutions is a typical approach, which uses a portion of the data for training and another portion for testing.

Comparing model predicted outputs with future actual measurements, from the modeled physical phenomena or system, also is another possibility. It is always better to start with something simple, integrate validation in model development, and then gradually increase the system complexity.

CONCLUSION

The review of current trends in wind-turbine bearings is important, not only for reducing the cost of energy, but also for ensuring the future of sustainable and zero-emission energy sources. As the wind industry adopts more advanced data analytics capabilities, more cost-effective prevention and maintenance can be performed to enhance wind energy. Sheng said “wind power has become an integrated piece of the energy solution around the world, and its capacity will continue to increase, helping to address global climate change.”

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IN FOCUS

CONDITION MONITORING

MORE OPTIONS THAN EVER FOR CONDITION MONITORING

Over time, equipment available for oil analysis has changed from wet chemistry to large spectrometers to small desktop and even handheld instruments. (Courtesy: Canstock)

But dynamics are shifting for those who require oil analysis service – and those who provide it.

By MARY BECKMAN

Oil and other lubricants are the lifeblood of vehicles, industrial machinery, agricultural equipment, and anything else with gears, bearings, and other mechanical bits. And like human blood testing, testing a bit of it can reveal whether its host is healthy and in good shape or has some underlying concern that might cause illness.

If you're a person, it's called blood testing. But the oil analysis industry calls it by a variety of names: in-service lubricant testing, in-service fluid analysis, oil condition monitoring, predictive maintenance, or predictive fluid analysis.

With people, doctors interpret results and recommend treatment, if necessary. But what if doctors just sent people home with a slip of paper and a set of values? As more in-house testing becomes available, the industry is finding a way to balance immediate needs for doctors in the house with the comprehensive analysis that commercial labs can offer.

Regular testing began decades ago to protect the large investment that industrial machinery and equipment represents. Then OEMs picked up on the idea — if an OEM was going to sell a customer an expensive piece of equipment and guarantee it with a warranty, it needed a way to monitor the health of that machinery. Even a large bulldozer can cost several hundred thousand dollars, so they needed to protect their investment.

"They wanted to hopefully be able to detect a problem before it became catastrophic," said Patrick Maggi, president and CEO at Cannon Instrument Co. in State College, Pennsylvania. [1] "The OEMs recognized that importance, and they've been doing it for at least 20 years now."

But with the advent of in-line sensors and smaller, more compact oil analyzers, are full-service oil analysis laboratories going the way of the passenger pigeon? Over time, equipment available for oil analysis has changed from wet chemistry to large spectrometers to small desktop and even handheld instruments.

Some industries are opting for small onsite labs that do not require highly trained technicians to operate. Some larger laboratories are opting for highly automated methods that can perform numerous tests and take fewer technicians to staff. Is this the way of the future?

"A rule of thumb in the industrial sector has been that traditional oil analysis via commercial laboratories only addressed 10 percent of the equipment that would benefit from oil condition monitoring," said STLE-member Dan Walsh, director of product management/technical sales at Ametek [2], a provider of onsite oil analysis solutions in Chelmsford, Massachusetts. "Onsite testing addressed that need."

FULL SERVICE MEANS FULL SERVICE

To put the pigeon question to rest, the answer seems to be

no, according to Walsh.

"We see full-service laboratories for oil analysis increasing their sample volume across the world, and newer approaches, such as onsite labs or sensors, are actually helping that trend," Walsh said. "Overall, the demand is increasing as a result of awareness of the benefits of oil analysis as part of an integrated condition monitoring program."

Even though instrumentation is getting smaller, that doesn't appear to be taking away the value of commercial labs, according to Robert Robie, president of Eurofins ANA Laboratories, LLC in Runnemede, New Jersey [3].

"What the smaller footprint allows is instrumentation to be a little bit cheaper, more space affordable in a garage or service area, or even more compact like a lab-in-a-box in their facility," Robie said. "We just don't see an overwhelming amount of competition from that."

Initially, tests for used lubricants were based on their fresh oil test standards. But then, with an increase in used oil analysis for predictive maintenance, ASTM International established a subcommittee to specifically examine standards for in-service lubricant testing.

"The increase in testing is not just bulldozers, cars, and taxis but things such as gearboxes in a machinery intensive industrial complex that could be making anything from aluminum foil to baby diapers," Maggi said.

Situated under Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants, the Subcommittee D02.96 addresses the fact that the composition of oils and fluids change through use, so the measurement or sampling technique for how you handle that sample also changes. The subcommittee has been developing separate test methods where necessary for oils once they've been contaminated or are in service.

It's not just the oils that need new testing standards. They are also addressing standards for new instrumentation specifically designed to measure in-service lubricants.

IN THE LABS

Using a full-service commercial laboratory requires owners take samples of fluids from various compartments on the equipment and send them into the lab. The laboratories put the samples through a battery of tests ranging from viscosity measurements to the presence of contaminants. They might often include an interpretation when they provide the results back to the owners. Commercial labs consider many different aspects when deciding whether to offer specific tests.

"All labs consider the test method they are looking to offer to their clients — such as whether it is an approved ASTM test method or an emerging industry demand," Walsh said. "They consider its performance in terms of reliability, performance, consumables, cost of ownership. Once those features are defined, lab managers consider the volume demand —



Commercial laboratories can be more accurate and have trained lab technicians. (Courtesy: Canstock)

is this an occasional or frequent demand? If it is a heavily requested test, then automation of the test via autosamplers, or the ability to work with some automation, becomes an important feature.”

OEMs have come up with another kind of lab midway between commercial labs and in-house ones: running their own testing facilities. For example, some Caterpillar dealerships have testing facilities they use to handle oil condition monitoring for their customers.

Maggi said that provides an added service for their customers.

“The OEM knows the most about their particular piece of equipment,” he said. “And if I was an end-user, I’d want to hear what they have to say about what they’re seeing in the oil. The further you get away from that OEM in terms of the knowledge of the system, the less reliable or informative the information from that analysis is going to be.”

In one of Caterpillar’s testing labs, for example, if they detect some metal in one of the samples, they can tell from the metallurgy of that particle which part it came from.

SMALLER FOOTPRINTS, MORE ELECTRONICS

Robie said the bigger change in the oil testing industry is not necessarily moving testing in house but the shrinking of the instrumentation and its footprint.

“I think commercial laboratories are going to be around for a long time,” he said.

The positive side of shrinking equipment for companies interested in in-house testing include having bench top accessibility, reduced sample volumes and electronics and computerization that handle what just 20 years ago was manual.

► OEMs have come up with another kind of lab midway between commercial labs and in-house ones: running their own testing facilities. ►

But the downside comes in servicing the equipment. The smaller workspace and the complicated electronics make in-house maintenance more complicated.

“I liken it to a mechanic working on cars where it was a lot easier in the ’70s and ’80s,” Robbie said. “But when the 1990s and 2000s came along, you really needed to have some experience with computers because everything was a computer diagnostic on your car.”

Even large laboratories, which are continuing to invest heavily in process automation, will consider compact or field portable equipment when looking for an occasional test requirement, or if they want to offer field support to their customers, Walsh said.

But in house can be drafty and smaller can sometimes be too small. A problem with shrinking instruments and in-house testing is ensuring accuracy. An uncontrolled environment or an instrument that is so small it is sensitive to temperature could affect the accuracy of the test. Measurements such as viscosity for petroleum-based fluids are very sensitive to temperature change.

“You can be off by half a degree, and that would correlate to being off in viscosity by as much as 3 percent,” Maggi said. “That might be enough to get a false negative or false positive.”

EXPERTISE IS HALF THE BATTLE

While OEMs of instruments suitable for setting up in-house labs provide education about their equipment [4], one of the biggest advantages of a full-service laboratory is the knowledge support that accompany such labs.

“A point I think worth making is whether the measurements are done in the field or in a proper lab, the critical piece is the oil analysis of the results from that testing,” Maggi said. “A typical maintenance mechanic is not a trained lab technician, doesn’t understand good lab practice, and might not fully appreciate that the dirt on his finger that just now got into the oil sample could definitely impact the viscosity and give you a false negative.”

Even with good technique, different tests can come out with different results, even if they are measuring the same physical property. For example, cold-temperature tests for snow machine oil have traditionally been performed at certain temperatures. Shrinking the instruments means using pressure instead.

“Going from refrigerator to pressure, your numbers might be a little different but still the same acceptable level for the product,” Robie said. “If you’re guaranteeing your customers that they’re not going to be waking up to a frozen snowmobile in the middle of winter in Minnesota, you need to be sure their product isn’t going to freeze.”

For in-house testing, Robie and Maggi both recommend having certain staff designated and trained to do the sampling and testing to take away the untrained technician factor. A final advantage to a commercial laboratory is documentation and tracking. Even if a municipality wants to perform a quick test when fuel is delivered for their fleet, sending regular samples off means they are documenting that delivery, should anything happen in the future.

TIME AND PLACE

Whether an owner should perform oil analysis in-house, send out samples, or a little of both depends on how quickly the information is needed and even where the equipment to be sampled is located.

Any kind of company or service that relies on instantaneous results will require in-house testing, for example, the railroad.

“You have a locomotive in the shop for a limited amount of time,” Robie said. “And if you’re waiting for four or five days for the oil analysis to come back, that locomotive might be well down the tracks by the time they get the results. Or if your team only has a few days to adjust the belts and check the fluids on an elevator, you may want to hook up something that can test it right there. There are some instances where you have the urgency or desire for that.”

Another example is fleet owners such as municipal transportation groups. When needed, a quick test of their fuel can confirm whether they should pull a vehicle out of service before more damage happens.

Some tests would be better performed onsite, such as mining equipment miles underground. An owner might

Marking Metals



(Courtesy: Canstock)

Although testing by OEMs can tell an owner what components certain wear metals in their oils are coming from, the aircraft industry goes a step further.

“They specifically dope the metal of certain components so that if they see the dopants in the oil, it’s like a marker,” Maggi said.

Airlines don’t own the engines on their jets. Companies such as Pratt & Whitney, Rolls Royce [7] and GE [8] “rent” the engines, and airlines pay for hours of flight time on each engine. By renting the engines for less than it costs to make them and charging for upkeep, OEMs can recoup their investments and, at the same time, ensure their engines are safe to fly with.



(Courtesy: Canstock)

“If the engine needs to be replaced or serviced, that service is provided by the OEM,” Maggi said. “So OEMs rely on that oil analysis to tell them if they have a problem before it becomes catastrophic.”

With different metallurgies in different parts of the engine, then even if the engine has two otherwise identical fuel pumps, the OEM can tell where issues are coming from without having to dismantle a whole plane.

need to test a piece of equipment below to make sure it doesn't die in a mine, and cause unexpected downtime costs.

"That's definitely a nontraditional brick and mortar lab," Maggi said. "We've seen an uptick in mine labs, especially with the increase in lithium mining for batteries."

SENSORS AND ALGORITHMS

As valuable as constant monitoring is, sometimes it can seem like overkill.

"A dirty little secret in the industry is that 80 percent or so of samples come in and show no problem," Maggi said. "There's a high volume of samples that take a lot of time and effort and money to process, only to find perfectly good fluids."

While that appears to actually be a clean little secret, simply cutting down the number of samples could be problematic. If, for example, an owner decides to start sampling four times a year instead of monthly, a problem could arise almost immediately after the last sample is taken.

"You might not know about the problem for three months, and that might be more than enough time for the engine to fail," Maggi said.

One option would be onboard sensors with diagnostics that monitor oil and fluids constantly, similar to how people with diabetes can now wear sensors that constantly monitor their blood sugar. The sensors send data and alerts wirelessly to a handheld monitor or even a cellphone.

The biggest advancement to get to such diagnostics, Robie said, is development of miniaturized sensors that can be put on units. These could be on a tractor trailer or in a pump on an escalator. Onboard command centers could be monitoring fluids internally.

Similar sensors already exist on some passenger vehicles made by OEMs such as Mercedes Benz and BMW. Oil passes through the filter and then through the engine to provide lubrication and then ultimately through a small scanner of a sensor as it passes back through the filter to be cleaned again. These sensors alert owners when to change their oil.

But most automobile oil monitors aren't directly testing the oil. Instead, auto manufacturers developed computer algorithms that predicted oil life based on the car's usage [5].

By running engines in varying conditions and analyzing the oil on those engines, for example, OEMs have simulated all the different possible driving dynamics and correlated that to the effect on oil. A car engine's computer knows how many times it was started, the position of the throttle while it is being driven, the fuel consumption and engine load, the temperature of the engine and more. The monitor puts all that information into algorithms that tell you how many miles or what percentage of useful life you have left on your oil.

"Those are predicated on time," Robie said. "But ultimately, they could be predicated on any kind of contamination or extreme situation that a sensor may pick up from the oil or fuel."

A sensor that directly tests fluids is just what OEMs have

been searching for. Although Mercedes Benz has developed a sensor that keeps an eye on oil directly, it only works with the right kind of oil [6].

"The heavy-duty and automotive vehicle industries have invested millions of dollars attempting to find a sensor that is robust enough to survive in that environment and has the accuracy to detect some meaningful change," Maggi said.

BOTTOM LINE?

"In my opinion, what forces people to do something in-house vs. sending them out to a commercial lab always boils down to price," Maggi said. "Depending on the volume of what you're doing, it might be cheaper to do it yourself. But that's usually what the motivator is, the cost."

To drive the costs down industry wide, instrumentation in commercial labs and in-house labs needs to decrease the cycle time for measurement analysis for faster turnaround time. More automation that reduces lab technician labor also helps.

Maggi said the industry also wants to reduce the environmental impact of testing. Many methods require the test instrumentation to be cleaned with solvent between samples, for example, so they are looking at ways to reduce solvent consumption and other consumables, such as being able to use the same test vial between multiple instruments.

"People get results in a timelier manner, and they pay less for them," he said.

After all, lubricants might be the lifeblood of industrial machinery and heavy equipment, but greasing the skids with cost and environmental savings will help keep the blood flowing freely. ✍

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PROFILE

BUREAU VERITAS NORTH AMERICA

LEADING THE ENERGY TRANSITION FOR A LOW-CARBON FUTURE

An onshore wind farm project supported by Bureau Veritas. The company's power and energy division provides expertise across the renewable energy industry. (Courtesy: Bureau Veritas)

Bureau Veritas works with clients within the renewable-energy sector – including offshore and onshore wind – as advocates throughout the asset lifecycle to ensure projects run safely and efficiently and comply with regulations and industry standards.

By KENNETH CARTER ▀ Wind Systems editor

There are many challenges wind-farm developers face before a turbine ever produces its first kilowatt. Industry stakeholders need to optimize wind-turbine energy production while ensuring wind-power projects are safe, economical, sustainable, efficient, and reliable. This means improving technology, while reducing the costs of wind farms, as well as accelerating and facilitating the permitting process.

To that end, it's important that owner-operators have a partner in their corner to ensure projects run safely and efficiently while maintaining quality control and compliance.

Backed by 200 years of experience, Bureau Veritas North America is helping accelerate the energy transition with a range of solutions that tackle the challenges of wind-project development and operations.

The organization supports both onshore and offshore wind projects, leveraging dedicated solutions for blades, gearboxes, generators, towers, and foundations for both. With about 80,000 employees and more than \$5 billion in revenue across 140 countries, Bureau Veritas is a leading global testing, inspection, and certification (TIC) company. Between onshore and offshore wind, Bureau Veritas has worked on 2,100-plus projects and installed 165-plus GW, with services across construction management, project management, owners engineering, and technical advisory.

"We serve as the eyes and ears for quality and safety for our clients," said Brendan Andrews, Vice President Sales, Energy and Renewables, for Bureau Veritas North America. "We support projects from pre-construction all the way through commissioning."

ADVISORY POSITION

Bureau Veritas serves as an advisory company for its clients, according to Andrews.

"Our services support the construction of projects and more importantly, assess and maintain safety and quality," he said. "We provide quality assurance and quality control (QA/QC) to ensure suppliers are meeting our client's expectations. We audit factories and check the quality of components on behalf of our clients. We also offer traceability

services, which trace components from the raw materials to better understand where they come from."

Traceability becomes extremely crucial when dealing with global economies as it relates to regulations and ESG commitments, according to Andrews.

"With people across 140 countries, our team has the boots on the ground to perform traceability services," he said.

POWER AND ENERGY DIVISION

"Our power and energy division provides expertise across the renewable energy industry, from onshore and offshore



An offshore wind farm project supported by Bureau Veritas. The organization supports both onshore and offshore wind projects, leveraging dedicated solutions for blades, gearboxes, generators, towers, and foundations for both. (Courtesy: Bureau Veritas)

wind, solar, battery-energy storage and to transmission and distribution," Andrews said.

Today's growing offshore and onshore wind industries must accelerate development to meet increasing renewable energy targets. To fulfill 2050 net zero targets for the power sector, wind generation must increase by 18 percent a year until 2030, according to Andrews.

To help bolster the wind industry, the U.S. has introduced fiscal incentives including the renewable electricity production tax credit (PTC) which provides up to 2.6 cents/kWh for electricity generated from wind.

Hydrogen has become a key part of the energy transition,



An offshore wind farm project supported by Bureau Veritas. In order to stay ahead of the curve for its clients, Bureau Veritas' power and utilities group is more proactive than reactive. (Courtesy: Bureau Veritas)

according to Andrews. Using wind power to produce hydrogen means renewable energy is used to run the electrolyzers that create the hydrogen, which Andrews believes will help grow the industry.

"I believe green hydrogen's connection with wind will help push the industry forward," he said. "Over the past few years, wind has taken a backseat to solar, however, the shift toward wind projects is happening."

The production of green hydrogen is going to be important, not just to established industrial areas in North America, but also in developing countries around the world.

BRINGING IN THE RIGHT PEOPLE

As the wind industry has evolved, it has become even more important to Andrews and his team that Bureau Veritas continues to hire and train the right people.

"We have to understand the new technologies and the regulations that



An onshore wind farm project supported by Bureau Veritas. The company's services support the construction of projects and more importantly, assess and maintain safety and quality. (Courtesy: Bureau Veritas)

governing bodies have in every part of the country, including federal and local,” he said. “This deep understanding enables us to confidently represent and advise our customers with full visibility.”

“We’re not a technology company — our commodity is our people,” Andrews said. “And it’s really important for us to continue to evolve and stay ahead of the curve. The only way we can do that is to upskill our existing team and bring in the right people.”

That means that companies can trust Bureau Veritas’ experts who are there at the beginning of a project to address any issues or problems that a customer may have, according to Andrews.

“Our people work closely on projects with owner-engineers to assess the situation and provide strategic guidance, particularly focused on quality management and quality systems,” he said. “Often our clients are not hiring people internally, so we can help provide this expertise and serve as an extension of their team.”

FUTURE OUTLOOK

In order to stay ahead of the curve for its clients, Bureau Veritas’ power and utilities group is more proactive than reactive, according to Andrews.

“We have to stay in front and understand what’s coming down the pipeline and have designated experts staying on the pulse of new technology and regulations,” he said.

Keeping that proactive edge is going to be paramount for Bureau Veritas as it moves into the future, according to Andrews.

“I think that these next eight to 10 years are going to be highly pivotal moments — similar to what we saw in the age of the internet,” he said. “The renewable space is going to continue to grow and boom. I think we’re going to see new technologies enter the marketplace and battery advancements will be critical.”

But with any industry going through massive growth, there are also challenges that must be addressed, according to Andrews.

“For example, the supply chain will continue to be a huge factor. Bureau Veritas offers solutions to help organizations combat supply chain challenges,” he said. “Our team can educate our clients on where certain products are derived from and assess the quality. We ask important questions like: Is that a qualified source? Do they have their own quality systems? What type of factory? Where are the locations?”

Bottom line is that keeping the wind-energy industry growing is a monumental task, but it’s one Andrews said the people who make up Bureau Veritas are more than prepared to take on.

“We’re a leader in this industry because of our people, and I’m proud to be a part of that,” he said. “Over the next eight to 10 years, the sky’s the limit, and Bureau Veritas will be at the forefront.”

MORE INFO: www.bvna.com

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CEO ▀ Electrom Instruments



“The objective for us as a company is to help the wind-power operators find their problems quickly, reduce maintenance or operating costs, and frankly, keep them running.”

▀ Who is Electrom, and what do you do for wind energy?

Electrom has been a developer and manufacturer of electronic test equipment for the motor industry and generator industry for 37 years now. The instruments are used to test the insulation systems in any rotating machinery, as well as other types of coils like antennas. In the wind industry, one of the most important components is the generator. The instruments are used for diagnosis of problems with the generators, as well as for maintenance programs. In a nacelle, there are also other motors that are often tested, and that would be yaw motors and pitch motors if they are electric. When something goes wrong with a wind-turbine system, they don't necessarily know what's impacted by it or exactly what it is that has failed. It can be all kinds of mechanical things, but it also can be all kinds of electrical things.

Testing the generator to make sure there's nothing wrong with it is pretty key. That can be done very quickly and efficiently. The objective for us as a company is to help the wind-power operators find their problems quickly, reduce maintenance or operating costs, and frankly, keep them running.

Sometimes owner-operators may plan to remove a generator for repair and reconditioning, and, it turns out through testing in the nacelle that there isn't anything wrong with it. There's something ancillary to that, and that's a gigantic savings. It's expensive to remove the generator and put in a new one, so the opportunity for savings with having proper testing is very big.

▀ How long have you been working with wind?

We probably sold the first testers to wind people at least 10 years ago. And when we say wind people — meaning people in the wind-power industry — it's a range. It is service

companies; it's what we call motor shops. Some of the motor shops are servicing the wind industry and then, of course, the O&M — the operators and owners. So, it's hard to say exactly when it started because we've been dealing with these motor shops and service companies for a long time. But, we started selling to wind farms probably about 10 years ago. And in the last three years, it's really accelerated. We are focused on it because the potential benefit to the operators is very big. Some of the biggest wind service companies that help out the operators are big customers of ours.

Recently, we've gotten some significant orders from wind operators — the people who operate wind farms. It's a big focus for our company. We have people who can help them in the field who are climbing certified. We're just now releasing a new series of testers that are significantly smaller than what we had before. Operators appreciate that, of course, having to bring this up in the tower. We also offer service capability in terms of training and helping people actually on-site up in the tower.

▀ Who uses Electrom motors and generator testers?

There are three broad markets. One is the motor shops and the service companies. The other one is motor and coil manufacturers. Somebody makes these generators and electric motors, and they need this equipment to detect anything that goes wrong in production and for diagnosing problems. And the other big market are industrial end users — people who are large users of motors and generators. You can say the wind market falls into that category, but, frankly, we look at the wind industry as a separate market.

▀ What is iTIG and what makes it ideal for wind energy?

The iTIG is a motor tester or generator tester. They're referred to as that. But they're also referred to as winding an-

alyzers because there are electrical windings in generators and electric motors. The objective is to be able to diagnose the condition of those windings to find out if everything is fine, if they are very dirty, if they need to be reconditioned, or if they have a weakness or if they are busted. The tester can find and diagnose all of those things. It has a range of low voltage measurements and tests. They measure the resistance in the windings, the inductance in the windings, the capacitance, and so forth.

They can do what is called a Meg test, which is very common. Most people in the maintenance industry will know what the Meg test is, an insulation resistance test. But the things that help you find weaknesses in the insulation are high voltage tests, because you have to stress the insulation in order to find out whether it has proper integrity or whether there is a weakness present. You stress the insulation by using a DC Hipot test. Hipot is essentially just a Meg test that's done at a much higher voltage. It can find out whether you have ground insulation issues. The most important test is what is called a surge test, which is putting fast rising voltage pulses into the windings, which helps you find weaknesses turn-to-turn in the windings, from one winding turn to the next, or a few down.

The reason why that is so important is that the industry guideline for the motor shop industry, as well as for industrial users who do maintenance programs, says something like 80 percent of the winding failures start with a turn-to-turn insulation weakness, then ends up becoming a fault. Once it becomes a fault, you're going to have excessive heat created where this happens, and it's going to get worse and worse, and eventually fail the ground wall and then you're busted.

If you can find out if you have a weakness in there, then you can usually prevent a problem from happening or you can schedule a replacement. In some cases, there are weaknesses in wind generators that can be fixed on-site up in the nacelle — especially with exit leads and wiring, and Y-rings in the rotor. There are a number of things that can be fixed before it becomes a really big problem right in a nacelle. And if not, then at least you can schedule to have the generator replaced and keep producing electricity in the meantime. That's what the instrument is used for. It has 20 different tests that you can make in one portable instrument that you can bring up in the nacelle.

► What are the benefits of high voltage testing of these generators?

The benefit is that you can find the weaknesses, which you cannot find without stressing the insulation. A high voltage test is designed to stress the insulation in the windings, both the ground wall and the turn-to-turn insulation. That's the benefit.

The objective often is to try to find those weaknesses before you have a catastrophic failure. But if the turbine has stopped, and you want to do a quick check to see if it is or isn't the generator, then you do one of these tests and you will immediately know whether this one is busted or if it has a weakness, that may cause trouble to get it started, for example.



► Can you test other motors in use in a wind turbine?

You can test any type of winding, so that would include yaw motors and pitch motors, and sometimes there are other types of equipment in a tower that can be tested as well. But those would be the two main ones.

► How does your company make high voltage testing more approachable for end users?

We provide training and support, which is critical to get people to become experts in this field. That training can be online and tailored to that particular customer and their knowledge. But we do both onsite and online training, and everything we do online or by phone and email, etc., is free, which people appreciate because they can get some refreshers, or they may run into some situation they have not seen before. When that happens, they can contact us. We do a TEAMS meeting or Zoom meeting or short phone training session on the subject at hand. Customer service is one of our strategic objectives to have that customer service be the best in the industry. And customers tell us we are there now, but it's something you always have to work on.

We have two main strategic objectives. One is to be the technology leader, and that's something that can always be argued as to who is the technology leader. But many of our customers have recently said that we have been the innovator, and that we have testers that are easier to use and more robust than others. The other part is the customer-service side, because without excellence in customer service, you are not going to necessarily have a customer for long.

When you are up in a tower and you have a problem or you see something you haven't seen before, time is of the essence. So, having good support that you can count on is critical, and that is one of the value propositions that we offer. ✍

MORE INFO

www.electrominst.com



The GreenerTower will ensure a CO₂ reduction of at least 63% in the tower steel plates compared to conventional steel. (Courtesy: Siemens Gamesa)

INNOVATION

Siemens Gamesa introduces GreenerTower

Siemens Gamesa has announced the GreenerTower, a wind-turbine tower made of more sustainable steel. Towers consist of approximately 80 percent steel plates. The new GreenerTower will ensure a CO₂ reduction of at least 63 percent in the tower steel plates compared to conventional steel. Siemens Gamesa's new thorough qualification process will verify that only a maximum of 0.7 tons of CO₂-equivalent emissions are permitted per ton of steel, while maintaining the same steel properties and quality.

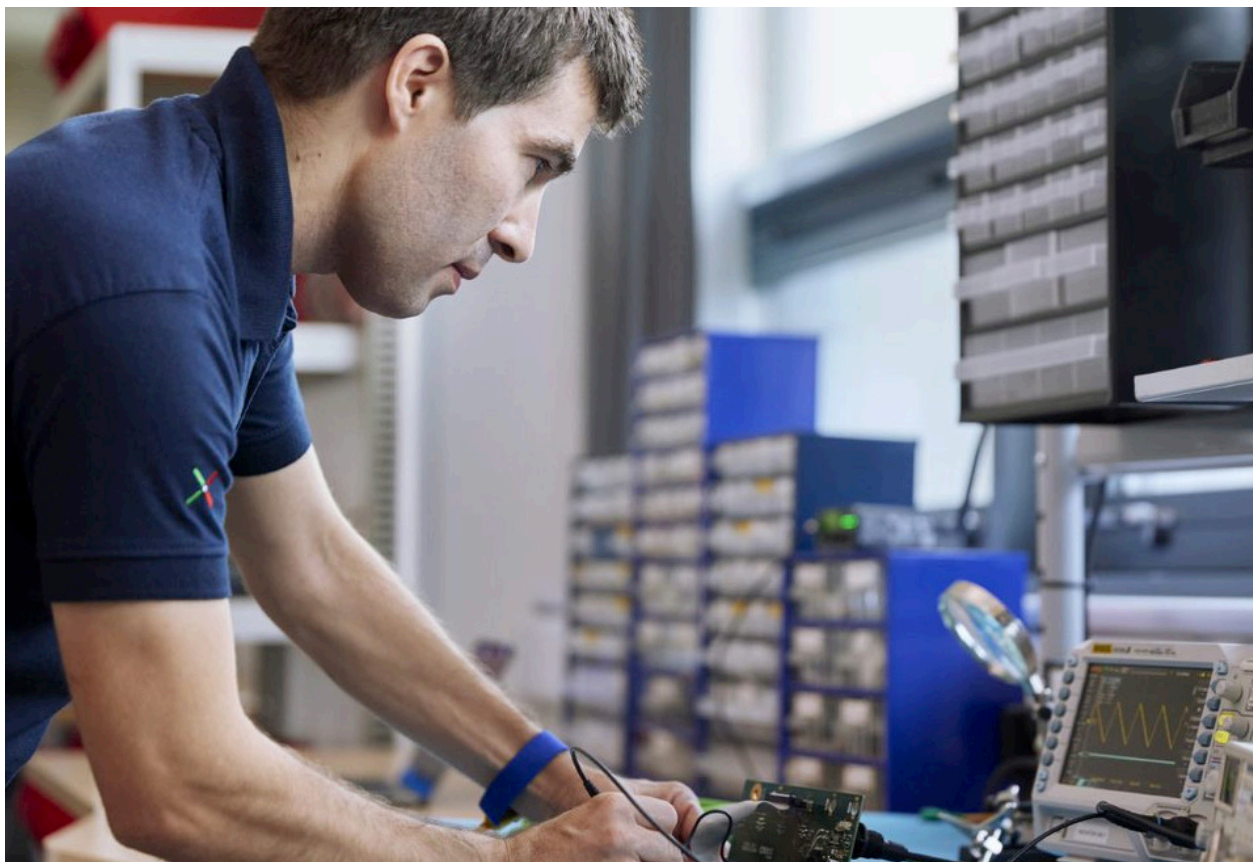
"Wind power is one of the cornerstones of the green-energy transition," said Maximilian Schnipper, head of sustainability at Siemens Gamesa. "With more than 600 GW of new capacity to be installed worldwide in the next five years, it is important for the wind industry to reduce its carbon footprint. Our project to address emissions with greener steel is one such solution. With the launch of the GreenerTower, Siemens Gamesa leads the efforts to further push wind circularity and net-zero emissions."

Tower production accounts for more than one-third of all wind-turbine-related CO₂ emissions. If all towers installed by the company in one year were exchanged with GreenerTowers, it would be the same as removing more than 466,000 cars from the roads in Eu-

rope for a year. This new CO₂-reduced tower will be available as an option for both onshore and offshore wind turbines for projects to be installed from 2024 onward.

The GreenerTower has already closed its first order. RWE and Siemens Gamesa have agreed to introduce 36 GreenerTowers at the 1,000-MW Thor offshore wind power project in Denmark. In total, 72 SG 14-236 DD offshore wind turbines are planned to be installed starting in 2026.

"Offshore Wind already has one of the lowest life-cycle carbon footprints of power generation technologies," said Sven Utermöhlen, RWE Offshore Wind CEO. "At RWE, we are fully committed to working toward circularity and net-zero emissions. We are already testing the world's first recy-



Funding will support ONYX Insight expanding its predictive maintenance solutions from the drivetrain to the blades. (Courtesy: ONYX Insight)

cleable wind-turbine blades by Siemens Gamesa under real-life conditions. By piloting the GreenerTower at our Thor offshore wind farm, RWE is now once again taking the lead by helping to significantly reduce the carbon footprint of wind turbines.”

The German steel manufacturing company Salzgitter AG, with its heavy plate mill Ilseburger Grobblech GmbH, is the first supplier to be qualified. The process to produce greener steel entails increased use of scrap steel, less energy-intensive steel manufacturing processes, and an increased use of renewable energy sources. As one of the measures to decarbonize steel production, for example, the electric arc furnace will be fed with green electricity from offshore wind projects.

On average, 1.91 metric tons of CO₂ are emitted during the manufactur-

ing process for every ton of steel. By setting an ambitious threshold of 0.7 tons CO₂-equivalent emissions per ton of steel, Siemens Gamesa reduces the footprint of the largest component in terms of CO₂-equivalent emissions.

MORE INFO www.siemensgamesa.com

INNOVATION

ONYX Insight wins grant to boost blade sensing technologies

ONYX Insight recently secured a grant that will supercharge the adoption of blade sensing technologies for the wind industry in a bid to reduce downtime for wind operators across their turbine

fleets. The Nottingham-based company has been awarded the funding by the U.K.’s Offshore Wind Growth Partnership (OWGP), part of the Offshore Renewable Energy Catapult.

The funding will support a project over the next 18 months that will see ONYX Insight expand its predictive maintenance solutions from the drivetrain into the blades. The project will build on the success of ONYX’s wind-turbine drivetrain condition monitoring product, ecoCMS.

“The funding from OWGP provides us with a welcome grant to accelerate the development of advanced sensing for the blades,” said Bruce Hall, ONYX Insight CEO.

As a provider of condition monitoring services (CMS) to the wind industry, ONYX Insight uses advanced sensing technology and data analytics to sup-



Biome Renewables' FeatherEdge shows promising results in noise reduction. (Courtesy: Biome Renewables)

port wind-farm operators in identifying potential faults and planning maintenance. The company collects data directly from more than 14,000 turbines across 30 countries. "Identifying when and where maintenance for wind blades is needed has been traditionally difficult for the industry, with operators often having to rely on drone technology, manual maintenance by technicians, or having to act once a fault occurs," said Henry Tanner, ONYX Insight product manager.

"Blade failures can incur expensive blade repairs and replacements, result in secondary damage to the wind-turbine structure, not to mention huge safety implications for the industry. Predictive maintenance allows operators to tackle progressive blade faults sooner at a relatively low cost. The grant will enable us to continue to develop holistic approaches to CMS that provide ever more detailed and wide ranging data insights for our customers."

Catastrophic blade failure in onshore settings can cost upwards of 300,000 pounds in materials, equipment, labor, and unscheduled downtime, and can be much higher in an offshore setting. However, if this same fault is predicted and remedied when it is less severe, repairs can be significantly less.

It is anticipated that the adoption of blade-monitoring technologies will increase over the coming years, delivering significant financial and time savings for wind operators, with blade failure being one of the leading contributors to offshore and onshore asset downtime after gearbox faults. OWGP funding is provided to projects that focus on the commercialization of technologies, products, and services that will either support offshore wind decarbonization or improve the reliability of offshore wind developments.

MORE INFO onyxinsight.com

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INNOVATION

Biome's FeatherEdge announces noise reduction success

Biome Renewables recently announced the results of wind tunnel test measurements carried out on the FeatherEdge® trailing edge serration technology, reporting a promising noise reduction of 8 dB off a baseline Ris B1-18 airfoil operating under similar conditions. The testing took place January 2023 in the Poul la Cour Tunnel (PLCT) at DTU Wind Energy, Ris Campus, Roskilde, Denmark.

"Noise emissions from wind turbines are largely caused through the formation of a turbulent boundary layer at the trailing edge of the airfoil in the outer sections of a turbine blade," said Ryan Church, Biome CEO and CTO. "To combat this, FeatherEdge design focused in on the specific morphology that enables an owl's silent flight."

To validate the technology, Biome entrusted DTU and their wind tunnel to complete a measurement campaign of aerodynamic coefficients and noise measurements. The PLCT uses a closed loop airline with a volume inside the airline of about 3,875 cubic meters. It is one of the largest university owned wind tunnels, with a test section of 2 x 3 meters and 9 meters long, and achievable flow speeds of 105 m/s (378 km/h). With turbulence intensity < 0.1 % and very low background noise, it is the ideal location to complete wind tunnel validation testing.

"The noise emission of wind turbines is one of the main obstacles for the increase of onshore wind installations all over the world," said Christian Bak, professor in rotor aerodynamics for wind turbines at DTU Wind and Energy Systems. "Trailing edge serrations have been commercially applied to reduce the noise emission of wind turbines, but it is believed that even more noise reduction can be achieved with optimized serration designs. In this context, the Poul la Cour Tunnel has shown its efficiency and value by

validating the FeatherEdge design at airfoils with the representative flow speeds and dimensions."

FeatherEdge is the latest in a series of technical solutions for the wind industry that Biome designs using a biologically-inspired approach to engineering and innovation.

MORE INFO www.biome-renewables.com/featheredge

CONSTRUCTION

Codling Wind Park makes successful energy bid

Codling Wind Park has been successful in Ireland's first offshore wind energy auction.

Codling Wind Park is a 50/50 joint venture between EDF Renewables and Fred. Olsen Seawind. With an expected capacity of up to 1,300 MW, it has the potential to supply the equivalent of more than 1 million Irish homes with low carbon, locally produced, low-cost electricity, and to save almost 2 million metric tons of carbon emissions every year.

EirGrid provisionally confirmed that Codling Wind Park's bid under the Offshore Renewable Electricity Support Scheme (ORESS) has been successful, ahead of final auction results to be issued in mid-June.

"This is a great day in the fight against climate change, and for Ireland's plans to become energy self-sufficient," said Codling co-project director Scott Sutherland. "With Codling Wind Park's successful bid, Ireland's largest Phase 1 offshore project of 1,300-MW capacity, moves a considerable step closer to reality."

"There is an immense wealth of low-carbon, potential power available in the seas around this country," said Codling co-project director Thomas Gellert. "Today's successful auction results will increase confidence in Ireland's ability to realize the opportunities of offshore energy. We look



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forward to working with the government, state agencies, and, most of all, local communities to ensure that the significant benefits of Irish offshore energy can be delivered to the people of Ireland.”

“We’re delighted that Codling Wind Park has been successful with its OR-ESS bid,” said Matthieu Hue, EDF Renewables UK and Ireland CEO. “As the country’s largest Phase 1 offshore wind farm, Codling will be crucial to Ireland meeting its renewable energy targets and securing its energy supply.”

“As the largest offshore wind-farm project in Ireland, considerable economic benefit will be brought to Ireland,” said Lars Bender, Fred. Olsen Seawind CEO. “We look forward to engaging further with local communities, government, and supply chain in developing Ireland’s offshore wind skills base and contributing toward Ireland succeeding in delivering on climate change targets.”

MORE INFO codlingwindpark.ie

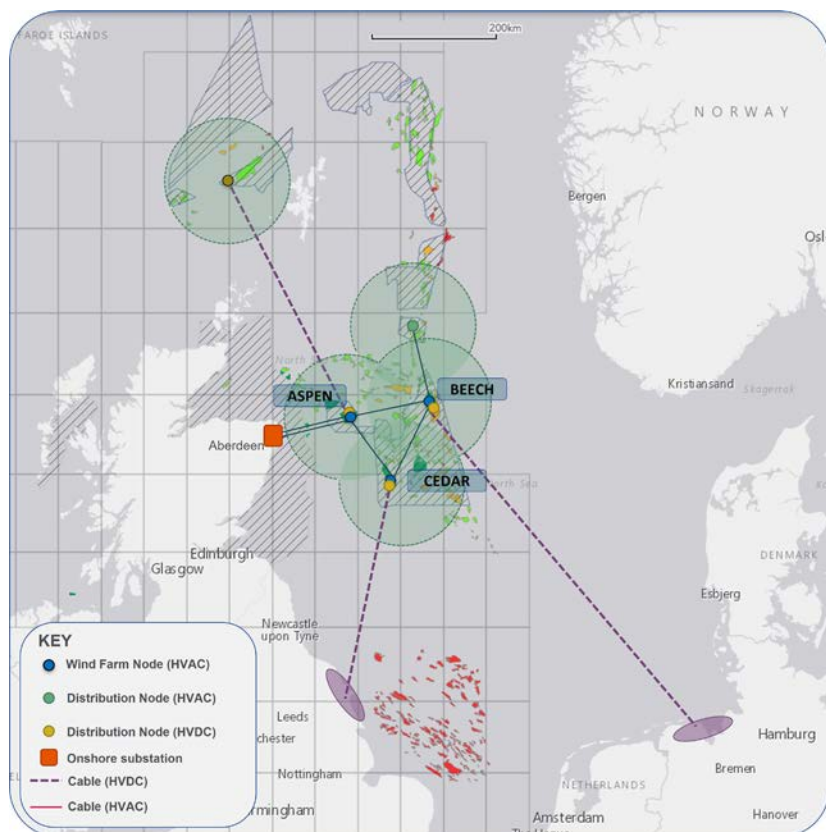
CONSTRUCTION

Cerulean Winds reveals North Sea grid plan

Cerulean Winds has revealed plans to build the North Sea Renewables Grid (NSRG), an offshore integrated green power and transmission system, powered by floating wind, that oil and gas platforms will plug into for clean power.

Cerulean and partner Frontier Power International will develop three 333 square kilometer sites of hundreds of floating turbines, producing multiple gigawatts of electricity, after being offered the lion’s share of seabed leases in the recent Crown Estate Scotland INTOG round.

The scale and location close together in the Central North Sea will enable a new basin-wide offshore transmission system to be constructed, which platforms can access, allowing them to



Cerulean Winds has revealed plans to build the North Sea Renewables Grid (NSRG). (Courtesy: Cerulean Winds)

remove millions of tons of production emissions by trading gas and diesel generation for a flexible, cost effective, and cleaner alternative.

With its delivery consortium of partners including NOV, Siemens Gamesa, Siemens Energy, DEME, and Worley, Cerulean Winds will deliver one of the country’s largest infrastructure investment projects (20 billion pounds) and support the sector’s decarbonization targets.

Phase 1 of the NSRG will focus on oil and gas operators to support brown-field modifications.

“The oil and gas sector is wrestling with the challenges of meeting the North Sea Transition Deal emissions reduction targets whilst supporting U.K. energy security,” said Dan Jackson, founding director of Cerulean Winds. “We recognize that, to achieve meaningful reductions at the pace required, a reliable basin-wide approach is need-

ed that they can plug into when they are ready to for affordable power. Early oil and gas electrification supports the country’s energy security, net zero action, and delivers huge benefits to the supply chain and economy, creating 10,000 jobs. With our partners, we will accelerate access to green power and provide the infrastructure for the next phase of the North Sea’s life.”

“For Scotland, the HVDC transmission not only provides clean energy to the National Grid, but provides export of power directly to continental Europe,” said Humza Malik, Frontier Power founding partner.

Cerulean has agreed to an approach with its industrial partners early to reduce risk in the project in the same way other large scale infrastructure developments are initiated. In total, the three windfarms will contribute more than 12 billion pounds GVA to the U.K.’s economy.

“We are targeting a build-out before ScotWind developments, allowing the supply chain to respond, creating crucial partnering opportunities for the ports and getting the market ready to deliver floating wind at scale,” Jackson said. “It will make a material impact on Scotland’s emissions, removing millions of tons of CO2 a year to support a just transition. Basin-wide scale gives greater flexibility, lower pricing, and supply robustness. Work with end users has begun in earnest so that we can aim for first power availability in 2028.”

MORE INFO ceruleanwinds.com

MAINTENANCE

ONYX Insight, bp Wind Energy sign new deal

ONYX Insight has deepened its partnership with bp Wind Energy with deployment of its predictive maintenance technology across the operator’s U.S. onshore wind portfolio.

The latest long-term deal will see ONYX continue the delivery of engineering, technical, and analytics solutions to bp for the next five years, following a successful seven-year relationship.

The two companies have worked together since 2016, when ONYX first deployed its fleetMONITOR condition monitoring software across 242 of bp’s onshore turbines. In 2017, as a technology leader, bp was the first company to deploy ONYX’s ecoCMS advanced sensing at scale and will continue its use as part of the new deal. The technology is a unique blend of advanced sensing and analytics, delivering effective data that allows engineers to understand the health of their assets. With successful payback in under 12 months, bp adopted the project as its go-to technology for turbine predictive maintenance.

ONYX’s solution can be deployed across any make and model of asset, such as bp’s GE, Vestas, and Nordex

sites, with nearly all the bp fleet using the technology. bp will also be adopting new technology with ONYX’s case management tools, enabling bp’s engineering and site teams to streamline their approach to all operations and realize even higher operational expenditure savings from predictive maintenance.

“By leveraging ONYX’s technolo-

gy, we can better understand the life span of turbine components at our wind farms, improve maintenance schedules, reduce costs, and avoid breakdowns,” said Alistair Warwick, CEO bp Wind Energy. “This agreement helps bp Wind Energy remain a technology leader. It also supports our commitment to produce secure, affordable, lower-carbon energy while accelerat-



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The Electrom® iTIG IV tester is essential for wind farm operators and maintenance technicians for diagnostics and predictive maintenance of generators, as well as auxiliary motors used in cooling systems, automated lubrication devices, nacelle yaw motors, lift/hoist motors, and blade pitch motors.

When performed during a regular maintenance schedule, the surge, DC hipot, and megohm tests give users trending data on winding insulation condition so O&Ms can prioritize wind turbine servicing and schedule maintenance rather than risk unplanned downtime.





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ing our net zero ambition.”

“We have been providing extensive engineering service to our key clients like bp Wind Energy, and, recently, more and more clients chose to sign a longer-term framework with us to streamline the procurement management process, and we can better manage the complex engineering issues across a large and diverse fleet more effectively and efficiently,” said Zhiwei Zhang, chief delivery officer, ONYX Insight.

MORE INFO onyxinsight.com

MAINTENANCE

AMSOIL acquires Benz Oil

Two Wisconsin-based, family-owned companies are joining forces. AMSOIL INC., a global leader in synthetic lubricant technology, has acquired Milwaukee-based Benz Oil. Founded in 1898, Benz specializes in the development, manufacture, and supply of industrial and metalworking fluids. Benz Oil will become part of AMSOIL and the AMSOIL Industrial business unit.

“Bringing the Benz team and facilities onboard as part of AMSOIL Industrial immediately boosts our capabilities and expertise with industrial fluids,” said AMSOIL Chairman and CEO Alan Amatzio. “This acquisition makes AMSOIL Industrial the premier choice for companies that want to maximize the efficiency and reliability of their operations. Our solutions, expertise, and passion make AMSOIL an indispensable partner.”

The AMSOIL Industrial product portfolio includes turbine oil, hydraulic oil, gear oil, compressor oil, stationary engine oil, grease, coolant, and flushing and cleaning products. Now, cutting and grinding metalworking fluid, process fluid, heat-transfer fluid, and other specialty fluids are added to that list.

“The most exciting thing about this



ONYX and bp have signed a new five-year deal. (Courtesy: ONYX Insight)

acquisition is how similar our companies are in our approach to business,” said Dave Meyer, AMSOIL VP, Industrial. “We both place high value on our people and our customers. AMSOIL Industrial is very focused on a consultative approach to selling and providing value outside the transaction, and Benz operates the same way.”

AMSOIL Industrial and Benz Oil both feature strong teams with rich industry experience.

“Benz has a very talented team already in place, and they will play a critical role in driving growth for AMSOIL Industrial and setting us further apart from the competition,” Meyer said.

The Benz facilities in Milwaukee will be rebranded as AMSOIL. Sales, laboratory operations, production, and distribution will continue on site.

“As the third-generation leader of a family-owned company with a strong legacy, it was important for us to find new ownership that would seamlessly embrace our values and preserve the core of what we have built over the past 125 years,” said Benz Oil CEO Dixon Benz II. “I truly believe that AMSOIL, another family-owned, Wisconsin company, with a highly capable team, will embrace the values of our organization and accelerate its trajectory. It’s exciting to know that AMSOIL embraces our foundation and is committed to growing the company in meaningful ways. This is a tremendous opportunity for our customers and employees.”

MORE INFO www.amsoilindustrial.com

MANUFACTURING

New LUTZE cable catalog released

LUTZE Inc. is releasing a new Cable Solutions for Industrial Automation North America catalog to support the fast-growing customer base in North America. LUTZE’s flexible and continuous motion cables such as SILFLEX®, SUPERFLEX®, MOTIONFLEX® and DRIVEFLEX® VFD cables are designed for harsh industrial environments and carry multiple approvals for code compliance.

LUTZE designs and manufactures control products for industrial automation and specializes in flexible industrial control and power cables, including control cables, electronic cables, Ethernet and BUS cables, motor supply, VFD, Servo, and Feedback cables; wire and cable management, and network connectivity.”

The catalog is user-friendly and includes 30-plus pages of technical overview on various cable and connectivity related topics to help customers find the right cabling for their applications. Cable gland and fittings selection charts take the guessing out of the equation when choosing the appropriate plastic, metal, or hygienic fitting in NPT, PG, or metric thread to suit specific cable applications. Wire and cable management components such as CABLEFIX® X and CABLEFIX® One



LUTZE's new catalog has been released. (Courtesy: LUTZE)

cable entry systems complement the offering for industrial automation.

In addition to printed copies, the new catalog is available in two easy-to-use formats: a downloadable PDF and an interactive, easy-to-navigate, digital catalog for online browsing.

MORE INFO www.lutze.com

▀ MANUFACTURING

R&D Test Systems gets test bench order from ZF Wind Power

R&D Test Systems, a Danish wind turbine test system supplier, recently received a follow-up order from ZF Wind Power to develop and deliver a new end-of-line test bench needed to verify the system functionality on manufactured powertrains, including the gearbox, generator, and main bearing arrangement, prior to shipping to the OEMs. The test rig, which features R&D Test Systems' automated concept

based on link-arm coupling, reduces mounting time by up to 90 percent, thus allowing two powertrain units to be tested per day.

The end-of-line test rig will be delivered to ZF Wind Power's production plant at Lommel, Belgium, in fall 2023. R&D Test Systems also was selected early in 2022 to supply a 30-MW validation test bench for ZF Wind Power's Test & Prototype Center at the same site.

"We are very pleased to be awarded this additional contract and to partner with ZF Wind Power on two of the most powerful test benches," said Peter Ulrikkeholm, CEO, R&D Test Systems. "This is a recognition of our competences in developing test systems for testing high-power offshore wind turbines both at the production and the prototype level."

Performing the final tests before the powertrain leaves the factory, end-of-line tests ensure the quality and performance of the final product.

"An end-of-line test cycle will check the function of the system under load, testing hydraulics, sensor connections, as well as contact patterns for the gears,

in addition to checking lubrication, temperature, pressure, and noise and vibration levels," said Martin Knops, chief technology officer of ZF Wind Power. A final flushing of the gearbox makes it ready to run from day one.

The gearbox is one of the most complex parts in a wind turbine due to the many dynamic interacting sub-systems. The whole powertrain therefore requires a series of final, high-load tests before going into the field.

"We believe once this test rig is up and running, it will be the most powerful end-of-line test rig in the wind-power industry," said Peter Winther, key account manager at R&D Test Systems.

The test rig for ZF Wind Power conducts load tests, powered by the more than 15 MW motor, providing 18 MNm of torque to test the unit at high load levels.

"This final test ensures that the powertrain with all its connections works as it should, even when exposed to 5,000 times the torque of Formula 1 cars," Winther said.

Capable of lifting up to 300 tons, the crane selected for the test bench



The first steel structure for the new end-of-line test bench has been made. (Courtesy: R&D Test Systems)

will both lift and precisely place the offshore powertrains in the test bench, which, at the highest point, is six meters above ground. Three automated hydraulic systems then clamp the powertrain in place with the link-arm-coupling thereby connecting the test motor to the powertrain.

“Mounting of a powertrain this size is time-consuming as there are literally hundreds of connections that need to be made, both mechanical and high and low power electrical,” Winther said. “Our design includes a complete high-voltage drive system with an automated connection solution that will optimize the process of installing the powertrain. Dismounting and disconnecting the verified unit will similarly benefit from the automated process. This saves manual work and is a major advantage for end-of-line testing when production flow is of high importance. The concept allows us to test two units a day.” R&D Test System will be using its automated link arm concept designed to connect the 15 MW motor and the powertrain unit, which must be robust enough to cope with the huge loads while still being sufficiently flexible to allow quick changeovers.

The engineering team consisting of software, mechanical, low-voltage, high-voltage, civil, and hydraulic specialists has already started the development of the end-of-line test bench at R&D Test Systems’ headquarters in

Hinnerup near Aarhus in Denmark. The company will be applying its test bench expertise in high-power drive-train testing of offshore wind turbines.

MORE INFO www.rd-as.com

■ MANUFACTURING

Vestas gets offshore turbine order in Japan

Vestas recently secured a 238 MW order from Hibiki Wind Energy for the Kitakyushu-Hibikinada Offshore Wind Farm Project off the coast of Kitakyushu city, Fukuoka prefecture, Japan.

The order includes supply and installation of 25 V174-9.5 MW wind turbines as well as long-term Active Output Management 5000 (AOM 5000) service agreement for the wind farm.

Commissioning is planned for 2025. Once installed, the project will feature the most powerful wind turbines operating in Japan.

With this project, Vestas will strengthen its position as a leader in offshore wind energy in Japan, leveraging its experience and expertise established through the number of offshore wind energy projects in global markets as well as in Asia Pacific.

“We are delighted to be partner-



Hibiki Wind Energy selected Vestas Offshore Wind V174-9.5MW as the wind turbine for the project. (Courtesy: Vestas)

ing with Hibiki Wind Energy and provide our V174-9.5 MW turbines for this important project in Japan’s offshore wind-energy development,” said Purvin Patel, Vestas Asia Pacific president. “We remain committed to contribute to Japan’s carbon neutrality goal, through our leading wind-energy solutions and strong partnership with our customers.”

“We selected Vestas because of the high reliability of its wind turbines, which have been in operation for many years around the world, and also because of the expectation for local contribution,” said Yutaka Mizumachi, representative director and president of Hibiki Wind Energy. “We hope that the service and maintenance provided by Vestas will be a catalyst for the revitalization of the local economy.”

MORE INFO www.vestas.com

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CROSSWINDS

THE FUTURE OF WIND

BUILDING A BROAD BIPARTISAN COALITION

More than 8,000 attendees walked the show floor of 480-plus exhibitors during CLEANPOWER 2023. (Courtesy Wind Systems)

At CLEANPOWER 2023, officials and representatives from government and private sectors came together to discuss the recent great strides made in clean energy, as well as the challenges ahead to create a zero-carbon future.

By KENNETH CARTER ▀ Wind Systems editor

More than 8,000 representatives from renewable companies and organizations from around the world gathered in New Orleans, Louisiana, in May for CLEANPOWER 2023.

It was an important event with a keen focus on the need for renewable energy and the innovation and challenging policy that will be necessary to keep it flourishing.

The event, sponsored by the American Clean Power Association (ACP), offered a variety of ways to connect with the renewable sector, whether that be wind, solar, or battery storage.

During the opening ceremony, ACP CEO Jason Grumet, who has only been with the organization for several months, took to the stage to express his optimism for renewables.

"It is a great time to be part of the clean-energy industry," he said. "Last year, Congress passed massive investments in infrastructure and clean power. We are building clean energy faster than ever before, but not nearly fast enough to achieve our goals by this century."

NEED FOR COMMITMENT

Grumet expressed the need for everyone involved in the renewable sector to commit to each other.

"We are not throwing away our shot to build the economy that this country deserves and to make sure that every American benefits from the clean-energy transition," he said.

Grumet pointed out that there are renewable projects and manufacturing in all 50 states and in 93 percent of congressional districts.

In the last nine months, according to an ACP study, there has been five times as much investment in clean power as any time in the last five years.

"We are investing \$150 billion in the utility-scale-to-clean-energy pocket," he said. "And I have to apologize that our study is now really out of date. Because in the month since we published it, there has been an announcement for 12 new manufacturing facilities of significance. And we've announced 25 GW of new clean power in the last month."

Additionally, Grumet said that large blades for offshore wind turbines are being manufactured in Albany, New York.

"In Iowa, a facility that has been shut for years is making onshore wind that has now reopened and expanded its operations," he said.

America's tool manufacturing base is also being rejuvenated, according to Grumet, with a 100-year-old Bethlehem, Pennsylvania, steel facility that has been shuttered for decades, being reopened and used by the solar industry.

"A steel mill in Kentucky is now running a second shift

to create the heavy-duty steel plates for offshore wind turbines," he said.

GOOD NEIGHBORS, GOOD PARTNERS

With technology and innovation at the forefront of renewables, Grumet said it was more important than ever to not lose sight of the people who will be needed to keep the industry thriving.

"Our energy is being a good neighbor and a good partner to this country as we go forward," he said. "There's no question that the energy transition has to be a clean-energy transition to all Americans; 80 percent of our new projects are being located in low-income communities around the country. Over the next decade, we are going to have to hire over half a million people. There is talent everywhere in this country, and it is our job to go find it."

Part of that will be focusing on workforce diversity and skill training, according to Grumet.

"This isn't an easy road — revitalizing our economy in the next 25 years requires a speed and scale that is fundamentally different from any challenge we've taken on before," he said. "The solutions to our clean-energy future are going to touch every single believer. And we have to recognize that we have some work to do. The clean-energy revolution is going to reduce climate risks, (and) it's going to bring jobs with clean air and cool water in historically burned communities across the country — communities that have been left behind. Communities that are suffering need help, and they need it now."

To that end, Grumet said ACP wants to be good partners as well as good neighbors.

"We are stepping up, and we are stepping out," he said. "We are strengthening our ties to working communities and labor across the country; we are working with front-line communities, and we are partnering with all aspects of the American energy economy. All technologies on their own have weaknesses, but if we combine strengths of the incredible diversity of the American economy and our added technologies, there is no question that we can achieve a future that's clean, that's pure, and that's economically sustainable."

THE CHANGING FACE OF POWER

That sentiment was mirrored by Leo Moreno, president of AES Clean Energy and chairman of ACP.

"AES today has 15 GW of renewal projects operating, and we have a pipeline of over 60 GW of projects, 400 projects across the U.S., and we're growing at a pace of 5 GW per year," he said.



ACP CEO Jason Grumet makes his opening address at the beginning of CLEANPOWER 2023. (Courtesy: Wind Systems)

Moreno emphasized that, over the last 15 years, the way power can be produced has changed since Thomas Edison opened the first power plant in New York.

“For the first time, we have power that has zero-variable cost,” he said. “For the first time, we have power that generates full energy independence because the resources, solar and wind, they’re local. And that means that cost can come down by 10 times, 100 times, 1,000 times. This is the revolution that we are experiencing.”

GOVERNMENT INVOLVEMENT

John Podesta, senior adviser to the president for clean energy innovation and implementation at the White House, was also on hand to share the Biden administration’s inroads into a zero-carbon future for the U.S. He pointed out that several renewable-energy projects were on their way to becoming a reality, including a manufacturing assembly line from GE Vernova that will make components for its 6.1-MW wind turbine.

“That announcement, they noted, was done because of the support from the Inflation Reduction Act,” he said. “Those are going to be good jobs, union jobs, and we’re very

excited to see that. Since President Biden took office, we’ve seen over \$230 billion in new clean-energy investment announcements from the private sector in every corner of the country. We’ve seen more than \$100 billion in just the nine months since the Inflation Reduction Act’s passed. Two years ago, those numbers might seem like a distance dream, but President Biden entered the office with a vision to rebuild the economy — to rebuild the American economy from the middle out and the bottom up — and to do it; the heart of that project was to transform our energy system and move toward clean energy.”

But Podesta said President Biden is still advancing renewable energy goals beyond that.

“He’s making it happen through his Investing in America agenda; through the bipartisan infrastructure law, the Department of Energy is upgrading and modernizing our electric grid, bolstering the domestic supply chain for batteries, investing in next-generation energy technologies, building out a charging grid network across the country, and lowering the cost of clean energy for American families,” he said. “And the Inflation Reduction Act, of course, makes the biggest investment in climate action and clean energy in his-

AD INDEX

Abaris Training Resources.....	BC
All Metals & Forge Group.....	3
American Clean Power.....	1
American Wire Group.....	32
Business Network for Offshore Wind.....	39
Electrom Instruments.....	35
Elevator Industry Work Preservation Fund.....	IFC
Malloy Electric.....	33
MISTRAS Group, Inc.	IBC
NTC Wind Energy.....	5
Pitbull Blade Demolition.....	11
Stahlwille Tools LLC.....	43
TORKWORX LP.....	23

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After the opening ceremonies, attendees were entertained by an authentic New Orleans-style street band. (Courtesy: Wind Systems)

tory, nearly \$370 billion. It targets every sector.” These goals keep the ball moving to cut emissions by 50 to 52 percent by 2030 and power the U.S. with 100 percent clean electricity by 2035, which will create millions of jobs, according to Podesta.

PRIVATE SECTOR INVOLVEMENT

However, Podesta was quick to point out that, although it’s one thing to pass a bill, it’s completely different to implement it. To that end, Podesta said it would be vital for the private sector to take the reins of the energy revolution and make those goals a reality.

“More than half a trillion federal dollars are flowing to clean energy over the next decade, but we’ll need trillions literally every year to make the clean-energy transition happen at the pace and scale that climate science demands,” he said. “So, if private sector could move at that pace and scale, like every great economic transition in history, the clean-energy transition will be government enabled, but private-sector led. The government has finally created the right conditions for an energy and economic transformation, but you’re going to deploy the capital, build the businesses, (and) create the good jobs.”

A lot of ground work is going to be needed to get clean energy to Americans, including grid issues, according to Podesta. “There are a number of challenges, but probably from my perspective, the clearest one is permanent transition and dealing with connection, so we get clean energy on the grid and to consumers,” he said. “That has proved to be a huge challenge. Transmission takes way too long to permit. Right now, it takes almost twice as long to permit a high-performance interstate transmission line as it does to permit a pipeline going in the interstate system. We’ve got to change that because we’ve got to build (and) increase the capacity to move that clean energy to customers by 60 percent between now and 2030.”

Moreno was also optimistic about the future of renewables, but it is going to take a lot of hard work to accomplish the challenging plans. “The decarbonization of the power sector is only the beginning,” he said “The U.S. has 6 billion tons of carbon emissions per year, and what we all want is to bring that to zero. One third of those emissions comes from the power sector, but one third comes from transport, and the balance comes from agriculture, from industrial groups. We will need to decarbonize it all.”

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