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When it comes to wind energy, it's not just about what you do, but also who you know. Identifying quality sources for equipment and services is a critical component of your overall business plan, but it can be a time-consuming task. That's why we publish the *Wind Systems Buyer's Guide* each year: to help you connect with the suppliers you need as well as to steer companies who require the products and services you provide.



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EXTRA VALUE, MINIMAL COST

MEMS technology is creating game-changing profitability improvements for wind. **36**



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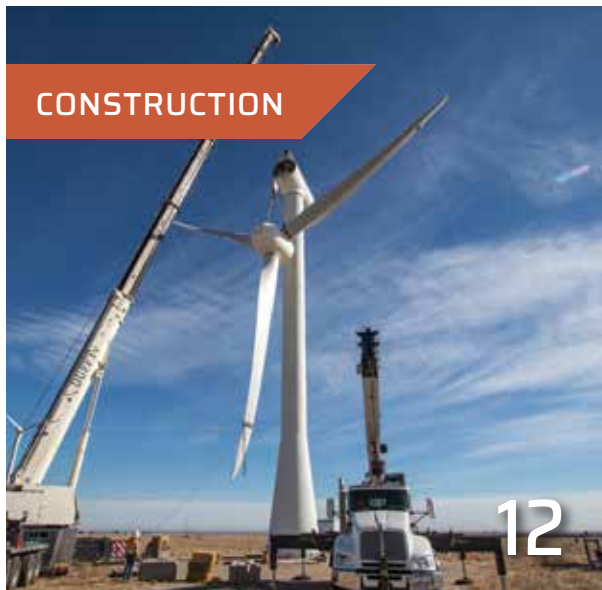
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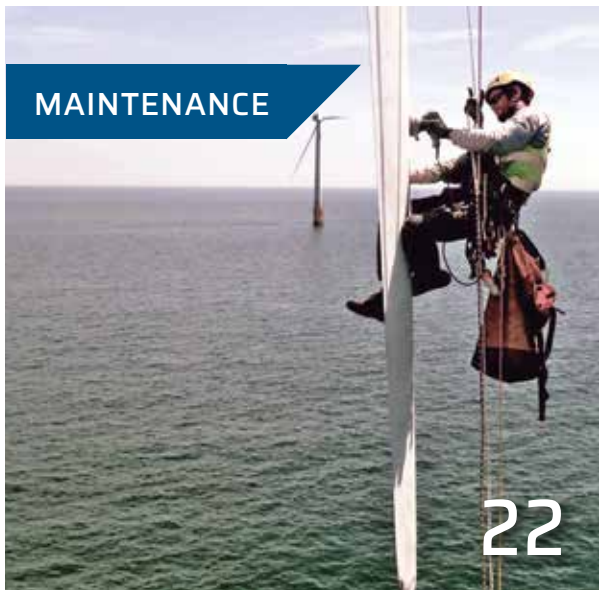
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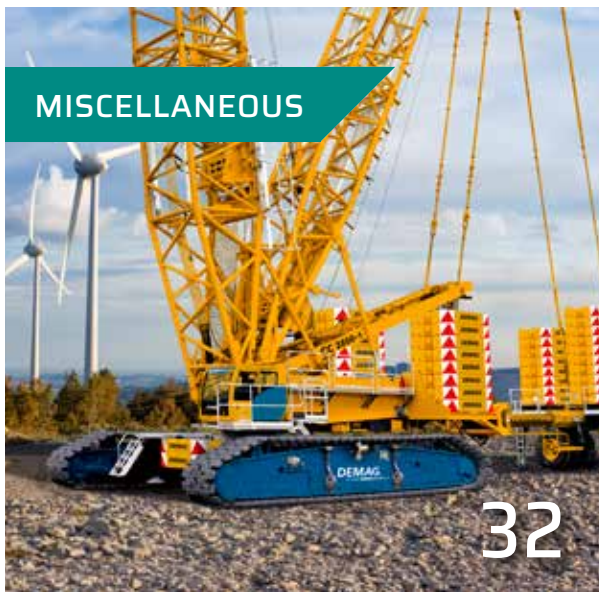
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The 2020 Buyer's Guide: Your go-to source

Ever since *Wind Systems* began publishing, we have brought you our Buyer's Guide, an annual resource of company listings in the wind industry. This valuable issue is categorized and organized to best fit your — our readers' — needs. Compiled in these pages, you'll find names, phone numbers, and websites of the hundreds of companies we've made contact with over the years.

And just like the ever-growing wind industry, the listings in the Buyer's Guide grow with it, serving as a tribute to the strides wind power has made in just a short time.

We at *Wind Systems* want to encourage, cultivate, and educate a workforce of industry professionals that have a common goal — a profitable, economical, and ecological world of wind power.

The Buyer's Guide will help serve you as a go-to information guide and resource for the wind-energy industry. We work throughout the year to make sure the companies listed in the Buyer's Guide are either

directly involved in wind or provide it with products or services.

But as informative as the listings in our Buyer's Guide are just by themselves, that's not all that's included in this month's *Wind Systems*.

In addition to our valuable listings, you'll find a company profile on POLARIS Laboratories.

In our Crosswinds feature, an expert with ONYX InSight shares his thoughts on MEMS technology and its application in wind O&M.

If your company isn't listed but would like to be, or if you need to update your existing listing, please contact us at info@windssystemsmag.com and include "2021 listings" in the subject line. Also, please make sure to include your company name, phone number, and website as you want them to appear. And don't forget to include the section and category your company should be in.

Wind Systems' 2020 Buyer's Guide is here to serve you, so make sure you keep it within reach through the end of this year and all through the next.

And as always, thanks for reading!



Kenneth Carter, editor

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2020 EDITORIAL CALENDAR

JANUARY

Bolting & Torque,
Wind Measurement

FEBRUARY

O&M: Operations,
Turbine Maintenance

MARCH

Systems & Parts,
Turbine Inspection

APRIL

Training & Workforce,
CLEANPOWER
preview

MAY

CLEANPOWER 2020

JUNE

O&M: Maintenance,
Condition Monitoring

JULY

Towers, Safety,
Wires & Cable

AUGUST

Lubrication & Filtration,
Turbine Foundations

Bonus section: Market
Outlook

SEPTEMBER

2020 Offshore Show,
2020 CanWEA Show

OCTOBER

Blades & Gearboxes,
Re-powering

NOVEMBER

Annual Buyer's Guide

DECEMBER

Construction,
Transportation

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Massachusetts Sen. Ed Markey receives his U.S. Wind Champion award. (Courtesy: AWEA)

Massachusetts senator named Wind Champion

From AWEA

Sen. Ed Markey (D-Mass.) has been named a U.S. Wind Champion for the 116th Congress by the American Wind Energy Association (AWEA) at a recent event hosted at Ørsted North America’s office in Boston. AWEA presents U.S. Wind Champion Awards to members of Congress with exceptional records of support for the U.S. wind industry and have demonstrated clean energy leadership.

Markey has been a long-time champion of offshore wind. Since 2011, Markey has introduced a tax credit for offshore wind energy. This year, he introduced the Offshore WIND Act, which would create a 30 percent investment tax credit (ITC) to help jump start America’s highly promising offshore wind industry. Over the next 10 years, offshore wind has the potential to create more than 36,000 U.S. jobs and presents a \$70 billion supply chain opportunity for businesses.

“From the winds of the Plains to the nor’easters that whip Plymouth, our nation is filled with the potential to harness energy from the wind. Wind energy is a win for American jobs, for American energy security, and for our climate, and AWEA is our great champion in building a clean energy future,” Markey said.



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



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POLARIS Laboratories® is headquartered in Indianapolis, Indiana but services more than 90 countries worldwide. (Courtesy: POLARIS Laboratories)

By testing lubricants, grease, and coolants used in wind turbines, POLARIS Laboratories® works to ensure a turbine can continue producing energy as efficiently as possible while lowering maintenance costs.

By **KENNETH CARTER** ▸ Wind Systems editor

Lubricants are important in many industries where friction ranges from being inconvenient to financially disastrous.

Making sure parts run smoothly is paramount when it comes to the smooth operation of a wind farm, and POLARIS Laboratories®, with locations around the globe, works to ensure friction and its related forces don't impede the production of energy.

"In the wind industry, we really have three different types of products and tests," said Bryan Debshaw, CEO of POLARIS Laboratories. "One certainly is the oil and testing the lubricants. We also get involved in testing grease. Some of the towers have cooling systems on them as well, and we can test the coolant."

All of these testing procedures are performed to help extend the life of a wind turbine and prevent catastrophic failure, while ultimately lowering maintenance costs, according to Debshaw.

"By pulling a sample, we can monitor the condition and let owner-operators know when the optimal time to change the fluid is," he said. "And based on the contaminants in the fluid, we certainly can get indications of excessive wear or other damage that could be happening internally so that they can take a small corrective action versus having to do a major repair."

THE IMPORTANCE OF MONITORING

Debshaw points out that wind-turbine maintenance can be costly, given the environment, and being able to monitor them is critically important.

"Even the fluids that they use are very expensive; they are high quality fluids," he said. "It's a very demanding application when you look at the temperature extremes that these towers or turbines will operate in and you look at the load factors and so forth."

Think about going from low speed to high speed under extreme temperatures and conditions, not to mention just the sheer amount of work and costs involved on doing what should be a simple task like changing the lubricant. There aren't simple tasks when dealing with wind, for sure."

DATA ANALYSIS

In addition to its lubricant testing capabilities, POLARIS Laboratories® also offers data analysis and management with its HORIZON® platform, according to Debshaw.

"We have excellent tools for the customers to manage their data, their history, their trends," he said. "Our service is very much a trending service. And we have the ability to connect directly to their data monitoring systems and pass

information to them so that they have the ability to access our information in their information management systems."

HORIZON can help with a wind farm's overall condition monitoring and predictive maintenance, according to Debshaw.

"I think with the wind industry in particular, there is the challenge of pulling a sample, and there's certainly a lot of interest around sensors and technology and how do we move to predictive maintenance," he said. "If we look across that spectrum of maintenance, it's run to fail and then it's we'll do preventative maintenance, and then we'll condition monitor."

Now, in today's world with data and the tools that are available to us, how do we help the customer get out into that predictive maintenance area? And it's really by bringing the data together and being able to utilize the data together and build the appropriate data science models that help. They can predict where we'll be in the future based on the current information and trends."

HELPING CUSTOMERS SAVE THEIR EQUIPMENT

POLARIS Laboratories' bottom line is it wants to help its customers with their bottom line, according to Debshaw. "When we look at what we want to do for our customers, we want to help them save their equipment," he said. "We're very much focused on how we can help them optimize their intervals, extent, optimize their life of the equipment, and



POLARIS Laboratories' fluid testing and analysis capabilities include oil, coolant, diesel fuel, and grease. (Courtesy: POLARIS Laboratories)

make sure that they are very much a reliable producer of power at a low cost.”

Debshaw said POLARIS Laboratories starts that process by working with its customers to define what the overall objective is and lay out the appropriate testing.

“In many cases, the testing regime is going to be set up based on what the OEM requirements are,” he said. “From there, if they’re experiencing a particular failure, we may do additional testing like analytical ferrography where we can actually view particles in the samples under a microscope and look at the type of wear that we’re seeing, the types of metals that are coming off, and give them some indication of how and when we think it’s happening.”

POLARIS Laboratories’ process is aimed at understanding customers’ objectives while providing the best information possible so they can make good decisions on their equipment, according to Debshaw.

“We work to help our customers save millions of dollars of equipment,” he said. “Oil analysis is about helping reduce that maintenance cost, but at the same time, it’s very much about safety because if we can help the customers by providing good information so they can schedule maintenance and take small actions, it helps reduce the exposure and risk to personnel. When we look at most accidents in maintenance, they’re going to happen during unscheduled downtime, and by helping give them the information, it’s making it safer

for the industry as well.”

BROADENING ITS TESTING

In that vein, Debshaw points out how POLARIS Laboratories has been expanding its testing capabilities as the wind industry continues to evolve.

“This year, we added pretty extensive grease testing capability,” he said. “Many companies will say they do grease testing, but they’re testing new greases. What the industry needed was appropriate testing for used grease and to give it some indication of the asset health or the health of the equipment that it’s coming from.

So one way we’ve evolved is certainly by adding used-grease testing capability. The other way would be in the data side and the connectivity of being able to connect directly with the customers. Once again, I think that’s an area where the wind industry has really evolved; everything’s a connected device, and they’re working to monitor everything they can. It’s truly a business that is driven off of large amounts of data.”

SEVEN LOCATIONS WORLDWIDE

In order to assist an industry that is worldwide, POLARIS Laboratories has expanded its global footprint since it began 20 years ago in Indianapolis, Indiana.

In addition to its Indianapolis laboratory, POLARIS Laboratories now has locations in Houston, Texas; Salt Lake City, Utah; Edmonton, Alberta, Canada; Poznan, Poland; Guatemala City, Guatemala; and now in Bogota, Colombia, according to Debshaw. The wind industry is only part of POLARIS Laboratories’ oil-conditioning monitoring.

“Our primary business is lubricants, and we have many branded private label customers, so many oil lubricant companies, as well as OEMs, will use our service to help their customers improve their equipment reliability,” Debshaw said. Part of that involves POLARIS Laboratories’ powerful statistical tools used to analyze data generated from the laboratory testing, he said.

“We really want to be able to open it up and analyze other sources of data that are being monitored today on the equipment in real time,” Debshaw said.

“So, to be able to pull that information and combine it with the laboratory information is really where we see the opportunity to move to a much more of a predictive model.

And the wind industry seems certainly perfect for that when you consider the capital investments and the costs of doing maintenance. It just seems to be an ideal industry to develop those predictive technologies.”

As wind energy moves offshore in the U.S., Debshaw thinks the process of monitoring an asset’s lubricants won’t change.

“Whether it’s onshore, offshore, probably to us it probably doesn’t change much of what we do,” he said. “It certainly increases the challenge of getting a sample from the customer. Potentially, there could be different contaminants. But I think largely we’d be seeing the same things.”

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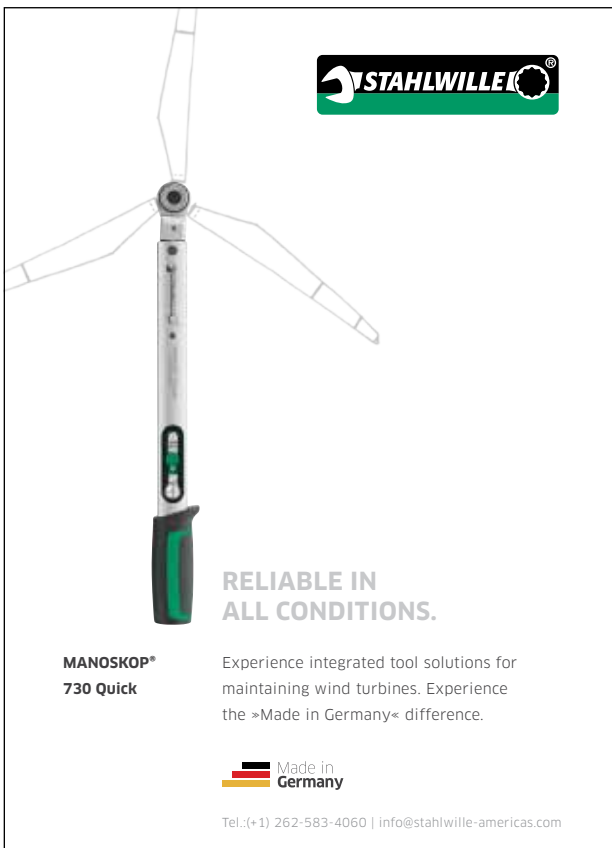
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An aerial photograph of a wind farm situated in a lush green agricultural landscape. The wind turbines are arranged in a line, with their long shadows cast across the fields. The fields are divided into irregular plots by hedgerows. The sky is bright and slightly hazy.

CROSSWINDS

THE FUTURE OF WIND

EXTRA VALUE WITH MINIMAL COST

ONYX InSight has found that wind-farm owners using MEMS sensors in their condition monitoring systems can make significant OPEX savings of up to 8 percent. (Courtesy: Shutterstock)

MEMS technology is creating game-changing profitability improvements for wind.

By DR. JOHN COULTATE

Today's world is all about data, and wind turbine reliability is no exception. ONYX InSight maintains a database of every turbine fault it has detected across 10 years for tracking performance indicators, assisting in operating expenditure (OPEX) forecasting, and other critical engineering works.

These performance indicators are tracked with condition monitoring systems (CMS). Historically, many turbines have been running without CMS covering the major components, and old turbines in established markets, as well as many new turbines in emerging markets, still don't have monitoring systems fitted. This is mainly because of the high associated capital expenditure (CAPEX), as traditional CMS units that use piezoelectric accelerometers are too expensive to justify the business case for many wind-farm owners.

Of course, many would argue that the business case for CMS in the past was still strong, even with a high initial CAPEX and particularly as turbines aged. Now, MEMS (micro electro-mechanical systems) sensor technology has dramatically cut the cost of CMS hardware and, as a result, doubled the value proposition.

WHAT ARE MEMS?

MEMS sensors are microscopic devices, typically etched from a layer of silicon and mounted inside an enclosure with integrated electronics. MEMS were first commercialized in the 1980s. Today, they are mass-produced components that feature in a huge number of home electronics and industrial applications.

For example, every car leaving the production line typically has dozens of MEMS sensors installed, including accelerometers, gyroscopes, pressure sensors, flow sensors, and inclinometers. Mobile phones and video games also use MEMS accelerometers and gyroscopes, and it is estimated that more than 11 billion MEMS sensors were produced globally in 2018. There are significantly more MEMS sensors than people on the Earth today.

DRIVING THE ADOPTION OF MEMS IN WIND

With a strong history in a wide range of industries and applications, MEMS sensor technology is not only low cost, but highly reliable.

ONYX InSight has found that wind-farm owners using MEMS sensors in their condition monitoring systems can make significant OPEX savings of up to 8 percent.

The low cost of MEMS-equipped CMS has transformed turbine monitoring for owners of smaller or older models, allowing owners to refine their repair and maintenance strategies. This has enabled the market to optimize activity, extend useful component and machinery lifetime, and realize greater OPEX savings, while ultimately boost the

profitability of their wind farms, especially across aging fleets. MEMS sensors in CMS hardware have also brought the benefits of condition monitoring within reach of smaller turbine portfolios.

A DETAILED INSTALLATION PROCESS

Every wind turbine CMS installation requires a detailed work instruction to be developed that describes the safe installation process, including sensor locations, cable routing, electrical installation, and mounting details.

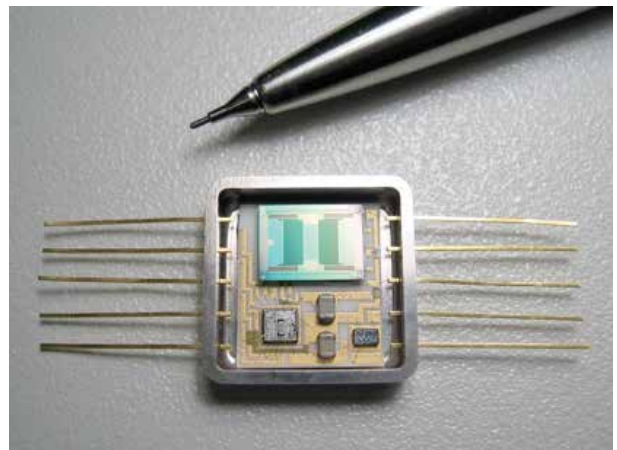
Sensor location is one of the vital elements of CMS installation. Proper placement of the sensors ensures the correct and most valuable measurement data collected by the CMS hardware to maintain accurate analysis and diagnostics that effectively inform a turbine's maintenance strategy.

Depending on the scale of the installation and the individual requirements of the wind farm, an independent service provider (ISP) or the original manufacturer of the CMS equipment will come on-site to install the unit and hook up the sensors. For larger fleets, training can be provided to a customer's technicians.

TRANSFORMING CONDITION MONITORING IN WIND

MEMS have radically changed the upfront costs and O&M expenditure of turbine condition monitoring, as well as return-on-investment considerations.

For example, in North America, crane costs are relatively high and wind farms are becoming larger. By extending the lead time of fault detection, providing warning long before



An example of a MEMS accelerometer. This is a large sensor typically used for inertial navigation (low frequency, high-precision applications). Although this device is much larger than the ecoCMS MEMS sensor, the underlying technology is similar, and the silicon wafer can be seen at the top of the enclosure. (Courtesy: ONYX InSight)

▼ ONYX InSight has found that wind-farm owners using MEMS sensors in their condition monitoring systems can make significant OPEX savings of up to 8 percent. ▼

a catastrophic failure, CMS hardware incorporating MEMS sensors allows multiple repairs to be combined into one crane deployment. If a main bear-

ing is repaired on one turbine during the same crane deployment as a gearbox on a neighboring turbine, the cost saving can be up to \$300,000. For a typ-

ical medium-sized onshore wind farm, this pays for the installation of CMS hardware across the farm.

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SET TO BOOST THE COMPETITIVENESS OF WIND

A significant proportion of the wind-turbine population has been running in the dark for too long. Low-cost CMS units, powered by MEMS sensors, detect vibration signals that spotlight component faults well in advance of failure. A more advanced warning of failure cuts the incidence of unplanned maintenance, delivering significant cost savings.

However, with more data collected on the full spectrum of the turbine performance, it still needs to be available to the right people so they can establish a robust predictive maintenance strategy. Turbine owners and operators face a number of restrictions that prevent their condition monitoring specialists from accessing the performance data of their own assets. This is often due to the data being held behind a pay wall by the OEM, where it is processed before it is passed to the owner's O&M team or sometimes because the CMS equipment is not being used to full capacity.

Full visibility of turbine performance data goes hand-in-hand with the increasing use of MEMS technology in CMS systems, and together these developments shift the value proposition of installing and using CMS hardware. More and more turbines of all capacities can now be continuously monitored by their owners, helping to reduce operating costs and ultimately enhance the competitiveness of wind energy. ↴

ABOUT THE AUTHOR

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