

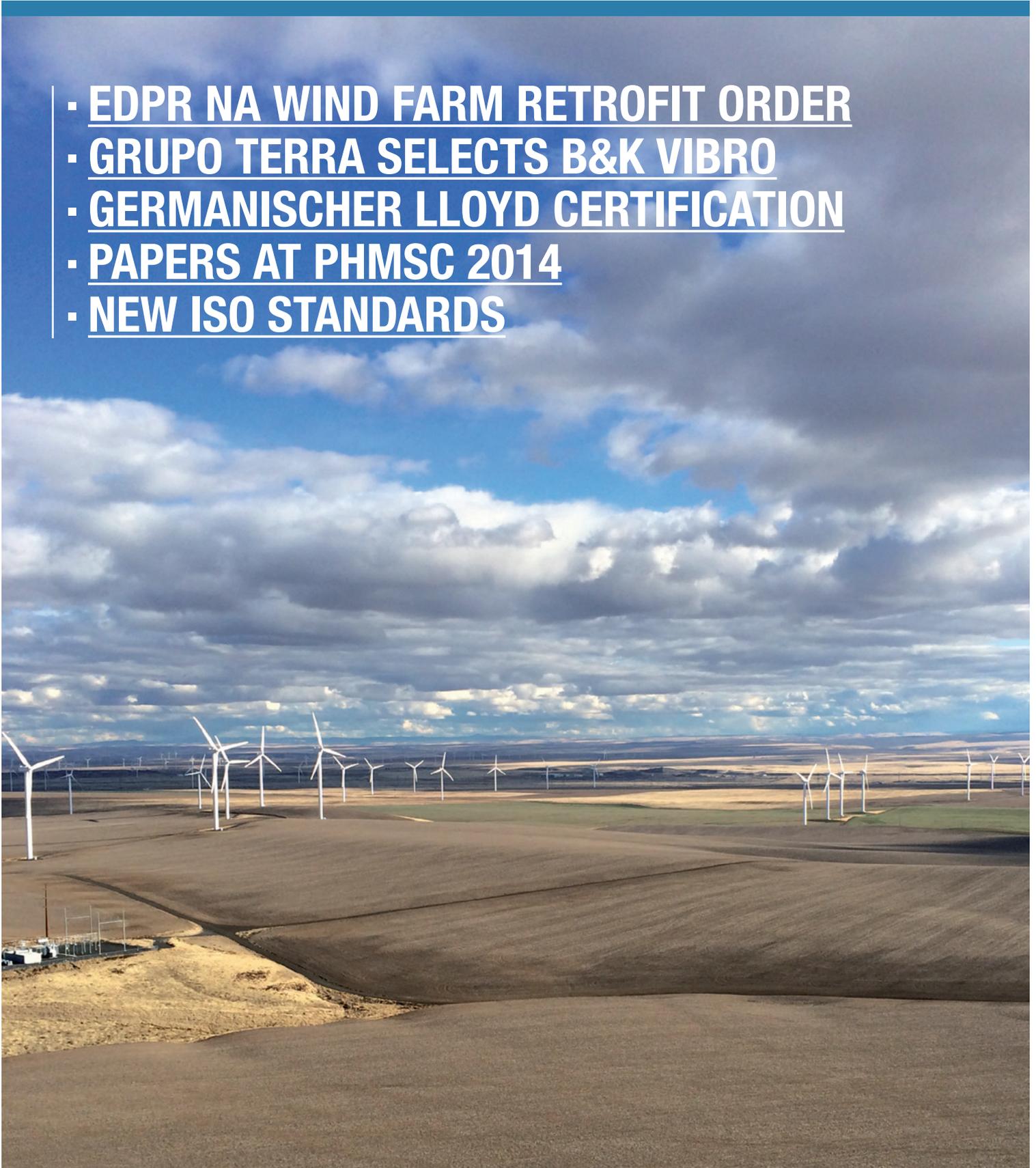


uptime

megazine

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Uptime Megazine is a newsletter published by Brüel & Kjær Vibro to keep you up-to-date with new machine monitoring trends and technologies. This issue focuses on the wind turbine monitoring.

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EDPR NA Rattlesnake Road Wind Farm

STRONG YEAR FOR WIND TURBINE MONITORING



**Pernille Wichmann
Christensen**

*Business Development Manager
Wind turbine monitoring group*

2014 has been an exciting and record-breaking year for the Brüel & Kjær Vibro wind power business! With more than 8,000 systems sold, we have subsequently expanded our offices in China and the U.S. with additional employees to meet the growing demand for delivering high-quality service to our global clients. We have also dramatically increased our footprint in the Americas, with projects like Grupo Terra in Honduras and EDPR NA in the U.S. What is special about these projects is that they support our strategy of being a strong partner with the wind power OEMs as well as with owners and operators. The Grupo Terra project includes a 10-year monitoring service contract that demonstrates our long-term commitment to our clients and their confidence in Brüel & Kjær Vibro. For EDPR NA, we delivered an extended retrofit framework agreement and have been selected as a preferred condition monitoring supplier. This particular project includes our VibroSuite stand-alone software platform and is our first ever turnkey project delivery that includes a retrofit installation. These two projects as well as the others illustrate our genuine commitment to meet our global clients' diversified needs by offering high-quality tailor-made solutions in a timely manner.

In 2014 we introduced our VibroSuite stand-alone monitoring software platform in the market and it has been well received. This new product enables owners and operators to take control of their monitoring system, yet still with the option of 3rd level support.

I am happy to see the strong interest in VibroSuite. The increase in sales of our system and service confirms our belief that there is a new trend in the market. Condition monitoring is increasingly being recognized as an essential part of a wind farm operators' O&M strategy for protecting their wind energy production and assets.

I am pleased to launch this issue of Uptime with a wind turbine monitoring theme! I hope you will enjoy reading the exciting articles about wind turbine monitoring as seen from a technical, market and institutional point of view. I also want to take the opportunity to wish everyone a prosperous new year!





FIELD NEWS



EDPR NA TEAMS UP WITH BRÜEL & KJÆR VIBRO FOR MONITORING US WIND FARMS

EDP Renewables North America (EDPR NA) has selected Brüel & Kjær Vibro to supply condition monitoring systems and monitoring for seven US wind farms.

EDPR NA, headquartered in Houston, Texas, is a subsidiary of the European based EDP Renováveis (EDPR) and the parent company Energias de Portugal (EDP). EDPR is the world's third largest producer of wind energy with an installed capacity of 8.5 GW (5000+ wind turbines).

The comprehensive retrofit project comprises the supply and installation of condition monitoring systems on the drivetrain and tower of 391 GE and Suzlon wind turbines located in the central and western US.

Initially, Brüel & Kjær Vibro will perform all monitoring, diagnostic and reporting functions, however, the VibroSuite software will be installed on EDPR NA servers to enable their diagnostic team to simultaneously leverage the diagnostics done by Brüel & Kjær Vibro and learn to use the system. Eventually EDPR NA will assume control of all surveillance activities, using VibroSuite as the monitoring platform.

The frame agreement for these seven wind farms was on the one side partly based on the successful results

Brüel & Kjær Vibro already achieved by monitoring several EDPR NA owned wind farms in the US. "As a major supplier of wind energy, the reliability and efficiency of our plants is very important to us" says Mr. Brian Hayes, Executive VP from EDPR NA. "We selected Brüel & Kjær Vibro because of their successful track record in working with several manufacturers, and they provide a range of services that meet our requirements."

Other factors that contributed to selecting Brüel & Kjær Vibro include:





- Local support office in Houston, Texas
- VibroSuite monitoring software has powerful functionality, but is easy to use
- Possibility for third-party monitoring systems to be accessed by VibroSuite
- EDPR NA has full control over the monitoring data

Torben Ekvall, president of Brüel & Kjær Vibro, sums it up by saying “We are very excited about this reference opportunity. This relationship benefits both companies. The additional turbines will add to our expertise in delivering accurate maintenance recommendations with greater lead time, and EDPR NA will benefit from having one system, not several, when evaluating their fleet.” ■



Top: One of the accelerometers used for monitoring the main bearing of the wind turbine drive train. Bottom: Gearbox of the wind turbine drive train. Right: Rattlesnake Road wind farm in Oregon, USA.



BRÜEL & KJÆR VIBRO'S WIND TURBINE MONITORING SYSTEM AND SURVEILLANCE AND DIAGNOSTIC SERVICE CENTRE RECERTIFIED



Our wind turbine Diagnostic and Surveillance Centre in Denmark has recently been recertified by Germanischer Lloyd Industrial Services, for the Renewables Certification. The certification is done every five years and covers both the diagnostic services and the condition monitoring system.



Why is there a need for wind turbine monitoring systems to be certified? Conventional monitoring systems used in industrial applications are simply not suitable for wind turbine applications. They are not able to detect many of the developing faults in a wind turbine drive

train, such as those from the complex planetary gearbox. Moreover, the widely varying wind loading on a wind turbine results in a vibration and operation parameter response that is completely different from one operating condition to the next, which can result in false alarms. A wind turbine study recently done concludes that by improving a monitoring system's reliability (i.e. increasing the number of faults detected and reducing false alarms), there can be an exponential decrease in maintenance costs and downtime.

Germanischer Lloyd Industrial Services recognizes this and consequently developed strict certification criteria to ensure wind turbine monitoring systems and services meet the minimum requirements for delivering value to the customers. One of the top three largest certification bodies in the world after its merger with DNV, Germanischer Lloyd carries out exami-

nations, certifications and develops guidelines and technical notes for the certification of wind turbines, wind farms, training systems, maintenance systems and many other areas.

Since 2004 when Brüel & Kjær Vibro's wind turbine monitoring system and services were first certified by Germanischer Lloyd, we have been working closely with some major wind turbine manufacturers and research institutes to refine our effective monitoring solution for all types of wind turbines. ■



GRUPO TERRA SELECTS BRÜEL & KJÆR VIBRO

FIELD NEWS



The owners and operators of the San Marcos Wind Farm, Vientos de Electrotecnia (part of Grupo Terra), have selected Brüel & Kjær Vibro to monitor the 25 wind turbines (50 MW) currently in the process of being erected onsite. The San Marcos Wind Farm is the second largest wind project in the country, located in the southwest portion of Honduras near the Nicaragua border.

The all-inclusive monitoring solution to be implemented at San Marcos is hosted by the Brüel & Kjær Vibro Surveillance and Diagnostic Service Centre, and includes the following:

- Continuous, remote monitoring of each wind turbine to automatically detect developing faults early
- Diagnosis and analysis of the detected faults by Brüel & Kjær Vibro analysts
- Alarm reports made by Brüel & Kjær Vibro analysts, when an alarm occurs

- Recommended action reports made by Brüel & Kjær Vibro analysts after the diagnosis to optimize operation and maintenance
- The VESA installation crew has been certified by Brüel & Kjær Vibro to install the monitoring system hardware
- All data is stored and maintained at the Brüel & Kjær Vibro Service Centre
- Vibration analysis software to be installed at customer's site so they can visualize monitoring and diagnostics conducted by Brüel & Kjær Vibro

Brüel & Kjær Vibro's condition-based monitoring solution is expected to significantly lower the life cycle costs of the wind turbines.

San Marcos is one of several renewable energy projects in Central America that Grupo Terra is actively involved in, including hydro. ■

WIND POWER IN HONDURAS

Honduras has been actively involved in developing their renewable energy resources.

The Honduran government announced last year that 300 million US dollars will be invested in building two new wind farms:

- **San Marcos** – 50 MW
- **Chinchayote** – 45 MW

In addition to this, 60 million dollars will be invested in expanding the **Cerro de Hula** wind farm (from 100 to 126 MW), which is estimated to supply 10% of Honduras' energy. Currently 48% of the energy in Honduras is renewable.







PAPERS PRESENTED AT THE 2014 PROGNOSTICS AND HEALTH MANAGEMENT SOCIETY CONFERENCE BY B&K VIBRO

Brüel & Kjær Vibro wind turbine diagnosticians presented two papers at the 2014 Annual Conference of the Prognostics and Health Management Society in Fort Worth, Texas, 29 September to 2 October. This conference focused on Prognostics and Health Management (PHM), which is an engineering discipline that links studies of machine failure mechanisms to system life cycle management. The conference brings together the global community of PHM experts from industry, academia, and government in diverse application areas such as energy, aerospace, transportation, automotive, and industrial automation. The papers were published in the *International Journal of Prognostics and Health Management (IJPHM)*.

One of the papers, written by Brüel & Kjær Vibro wind turbine diagnosticians Alexandros Skrimpas, Christian Sweeney and Kun Marhadi, together with three international researchers, was entitled “Detection of Wind Turbine Power Performance Abnormalities Using Eigenvalue Analysis”. Our specialists bring their years of experience in vibration analysis of thousands of wind turbines to research other monitoring and diagnostic techniques. One such technique, called power performance analysis, was the subject of their paper. Power performance analysis is a method specifically applicable to wind turbines for the detection of power generation changes due to external factors, such as icing, and internal factors such as controller malfunction and power de-rating. In the paper, power performance analysis was demonstrated by a sliding a time-power window and calculating the two eigenvalues corresponding to the

two-dimensional wind speed; power generation distribution. The power is classified into five bins in order to achieve better resolution and thus identify the most probable root cause of the power deviation. An important aspect of the proposed technique was its independence of the power curve provided by the turbine manufacturer. It was shown that by detecting any changes of the two eigenvalues trends in the five power bins, power generation abnormalities were consistently identified.

The other paper, written by Kun Marhadi and Alexandros Skrimpas, was entitled “Using Johnson Distribution for Automatic Threshold Setting in a Wind Turbine Condition Monitoring System”. Again, years of wind turbine monitoring and diagnostic experience paid off by enabling our specialists to tackle an area that has plagued condition monitoring system operators for years – setting optimal alarm thresholds. Most of the time, the thresholds are set based on statistics of the collected data. Often the underlying probability distribution that describes the data is not known. Choosing an incorrect distribution to describe the data and then setting up thresholds based on the chosen distribution could result in sub-optimal thresholds. Moreover, in wind turbine applications, the collected data available may not represent all operating conditions of a turbine. This can result in uncertainty in the parameters of the fitted probability distribution and in the thresholds calculated. In their paper, the Johnson distribution was used to identify shape, location, and scale parameters of distribution that can best fit vibration data. The study showed that by using the

Johnson distribution, it could eliminate testing or fitting various distributions to the data, and would have a more direct approach to obtain optimal thresholds. To quantify uncertainty in the thresholds due to limited data, implementations with bootstrap method and Bayesian inference were investigated. ■



One of the PHM 2014 Conference General Chairs is addressing conference attendees at the Wednesday Dinner and Awards Banquet.



NEW ISO STANDARDS CLARIFY WIND TURBINE AND HYDROELECTRIC GENERATING UNIT MONITORING

FIELD NEWS



The ISO subcommittee on “Condition monitoring and diagnostics of machine systems” (ISO TC108/SC05) held their 19th plenary in Paris, France, in September last year. This subcommittee consists of 13 work groups and three advisory groups that are drafting new ISO standards and upgrading existing ones on best practice condition monitoring standards and guidelines. The ultimate goal of these ISO standards is to ensure that end-users, machine manufacturers, EPCs, service companies, consultants and instrument suppliers can successfully work together to optimize machine uptime, performance and reliability, reduce the total cost of ownership and extend the lifetime of the machines.

The hydro advisory group held its first meeting during the plenary for drafting the ISO standard “Condition monitoring and diagnostics of hydroelectric generating units”. This standard focuses on the recommended, time-proven condition monitoring techniques for detecting and diagnosing developing machine faults associated with the most common potential failure modes that can be detected for hydroelectric generating units. The focus is on machine condition monitoring, not protection or offline tests where the unit is shutdown. This standard is intended to improve the reliability of implementing an effective condition monitoring strategy for hydroelectric generating units and to help foster mutual understanding and cooperation between the vari-

ous stakeholders and avoid confusion. Peter Surland and Mike Hastings, condition monitoring specialists at Brüel & Kjær Vibro, are two of the main drivers for the group. Mike Hastings is currently convenor (leader) of the group.

The work group responsible for creating comprehensive series of standards for the condition monitoring of wind turbines is currently working on two committee drafts of ISO 16079; Part 1: “General guidelines” and Part 2: “Monitoring the drivetrain”. Carsten Andersson, Remote Monitoring Product Owner of the wind turbine group at Brüel & Kjær Vibro, is convenor for the work group. (Carsten also is sitting on the IECTC 88 Work Group for vibration monitoring norms for wind turbines.) ■





*Photos from the ISO TC 108/SC05 plenary meeting in Paris.
Left page: Mike Hastings presenting (hydro advisory group).
This page top: Carsten Andersson presenting (wind turbine work group),
bottom: Peter Surland (hydro advisory group).*



SEE US AT THESE CONFERENCES



AWEA O&M AND SAFETY SEMINAR **2-3 FEBRUARY 2015** **SAN DIEGO/USA**

The AWEA Wind Project O&M and Safety Seminar is where leading owners, operators, turbine manufacturers, material suppliers, wind technicians, managers, supervisors, engineers, and occupational environmental, health and safety professionals come together to:

- Share the best strategies to manage wind project assets
- Analyze the environmental, health, and safety challenges workers face
- Learn about the future of the U.S. O&M market
- Network with top asset managers, OEMs, and vendors

www.awea.org/events/event.aspx?eventid=30255



EWEA OFFSHORE **10-12 MARCH 2015** **COPENHAGEN/DENMARK**

EWEA 2015 Annual Event, Europe's premier wind energy event, presents an international platform for the wind energy industry to showcase and demonstrate its latest products and services. As well as an extensive exhibition, the event features a broad conference program and unrivalled networking opportunities. Visit our stand E-D11 (Danish Pavilion) and see for yourself our flexible wind turbine monitoring solutions!

www.ewea.org/offshore2015



WIND ENERGY O&M SUMMIT **12-15 APRIL 2015** **DALLAS/USA**

Back for its 7th installment with three tracks, multiple workshops and loads of brand new networking receptions, this is North America's largest and best-attended meeting point dedicated to the wind O&M industry. Brüel & Kjær Vibro is a Silver Sponsor to this event. www.windenergyupdate.com/operations-maintenance-usa



AWEA WINDPOWER **18-21 MAY 2015** **ORLANDO/USA**

WINDPOWER is the annual conference and exhibition for the U.S. wind industry hosted by the American Wind Energy Association (AWEA). It's the nexus of wind energy professionals who converge to generate actionable ideas for expanding the wind energy economy through technology and collaboration. Visit our booth 2411 (Danish Pavilion)!

www.windpowerexpo.org



SMART **19-21 MAY 2015** **LINZ/AUSTRIA**

The SMART Automation Austria is the commercial platform for the Austrian automation industry and takes place on an annual basis, alternating between Vienna and Linz. It attracts around 270 exhibitors from 14 countries; many of whom are market leaders and technological pioneers. Our Austrian sales team looks forward to meeting you! Visit our booth 441 (and booth 409 co-exhibitors with Maschinendoktoren)

www.smart-automation.at/de/linz



ACHEMA **15-19 JUNE 2015** **FRANKFURT/GERMANY**

World forum and 31st leading show for the process industry - visit our booth A26 in hall 11!

www.achema.de/en.html