



Brüel & Kjær Vibro
a spectris company



360° coverage

Wind Turbine Condition Monitoring



Wind energy has benefits – and costs

As technology, competition, turbine size and wind park size drive costs down, wind energy is finally becoming cost competitive to fossil fuel energy. Even with subsidies being phased out, wind turbine installations are still increasing every year and within the next couple of decades will represent a significant part of total electricity production.

Wind energy is paving the way for a greener future, but it is also presenting challenges to wind park owners and operators. Availability becomes more important now, while the cost, size, complexity and operational demands on the drive train components increase.

Maintenance can be the single most important controllable factor for achieving profitability, and condition monitoring undisputedly plays an indispensable role.

Reducing unplanned maintenance is key for O&M cost reduction:

58%
of the total operating expenditure are O&M-related

64%
whereof are due to **unplanned maintenance***

The optimal condition monitoring solution adds value

Nearly all wind turbines are delivered with some sort type of condition monitoring system. However, it is important for the owners and operators to understand the difference in value these systems deliver to the operation and maintenance of their assets. How raw data is processed, stored, and accessed is one area of value, and the actionable information given is another one.

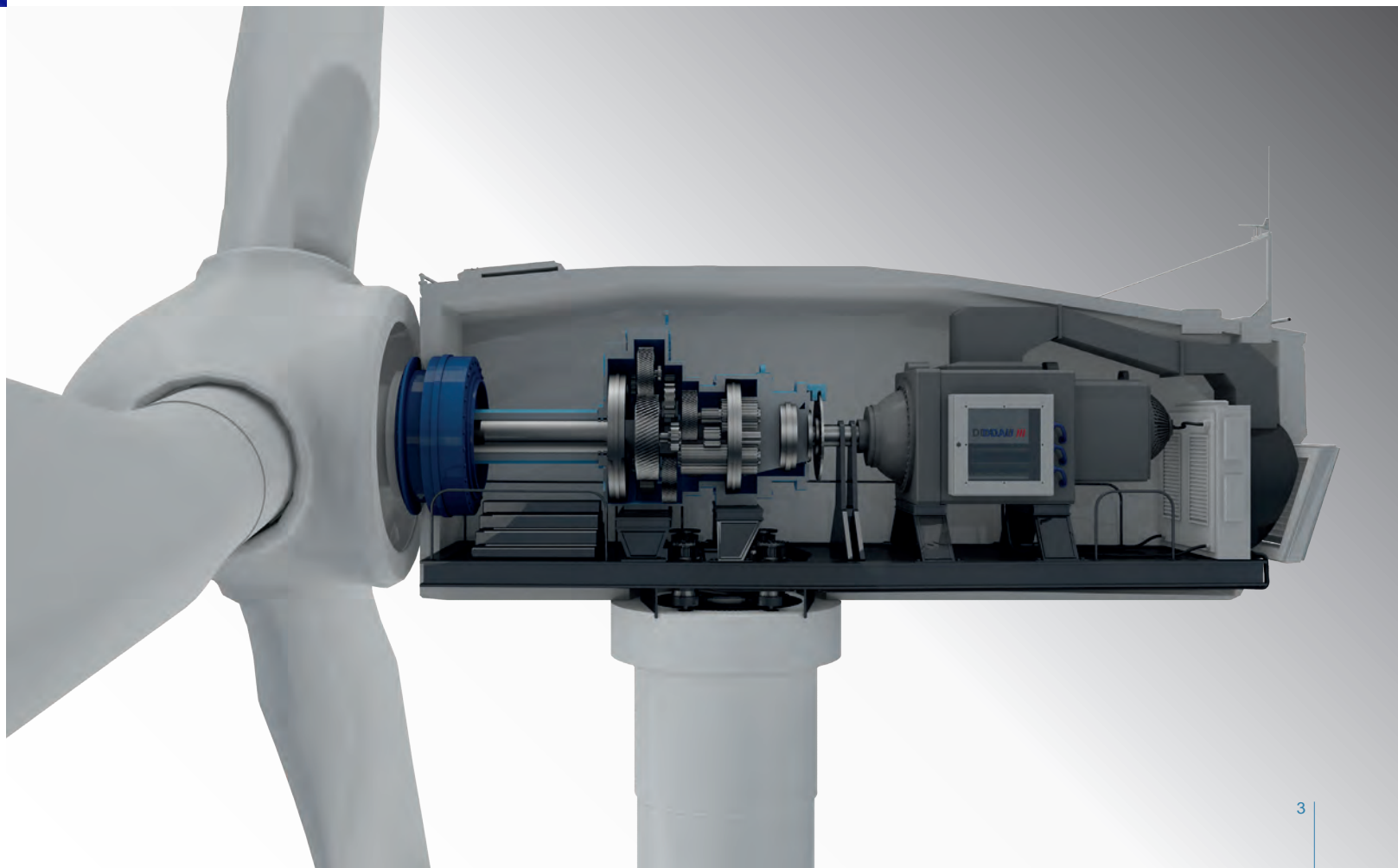
The system has to do more than just detect an anomaly. It also has to determine the type of fault, its severity, lead-time to service and the maintenance action needed. The system has to produce high quality, high resolution data that can be analyzed, both on-the-fly and for post-processing. Much is automated, but diagnostic services can fill the gaps. In fact, diagnostic expertise, balanced to the user's needs, should be the foundation of any condition monitoring solution.

The ultimate value of the condition monitoring solution, in the long run, is the **optimized return on investment**, and the **increased availability** and **reduced life-cycle costs** of the wind turbines. This is accomplished by:

- Enabling a larger number of repairs up-tower
- Maximizing component life by addressing unbalance, misalignment and lubrication problems
- Reducing risk of failure of troubled turbines by reduced operating load recommendation
- Resolving warranty claim disputes

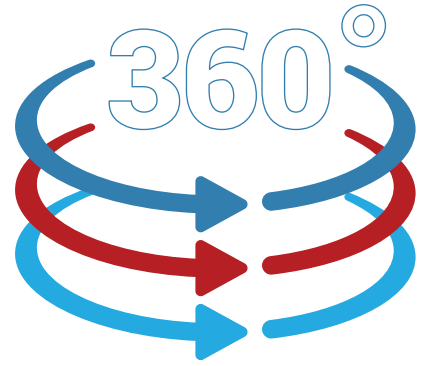
Early fault detection pays off:

For example, a gear bearing might be replaced up-tower at \$13,000 instead of having to replace the entire damaged gearbox at **23 times** this amount!



Next-level condition monitoring

Brüel & Kjær Vibro is one of the pioneers in wind turbine condition monitoring. Since 2003, Brüel & Kjær Vibro has worked closely with the major stakeholders to develop and optimize the way wind turbines are monitored. Based on this extensive experience with an amount of data, our condition monitoring solutions have been brought to the next level. This is what we call a 360° monitoring experience:



Holistic monitoring

This is more than just monitoring the drive train. We assess the health status of the entire wind turbine. Seamless connectivity between the data acquisition hardware DDAU3, sensors, controller units, SCADA system, data historian and other monitoring systems enables you to view more than just vibration. Together with wind speed, power, wear debris, temperatures, blade pitch, yaw, etc., you get an overview on turbine and fleet health and performance across the entire operational spectrum.

Fleet monitoring

You can compare data across the entire fleet and reference and benchmark performance down to the component level. Comparison and correlation of this data let you not only detect machine wear, but also fleet wide, site specific and weather-related faults as well as manufacturing, transportation and assembly-related issues.

Data management

Data can be stored and then remotely accessed processed as a service for diagnostics and statistical analysis. We combine our long experience with modern technology into our wind turbine condition monitoring solution. It addresses all types of wind turbines, all types of wind farms and for both expert and non-experienced owners and operators. As an independent supplier, our advice is unbiased and full data transparency is guaranteed.

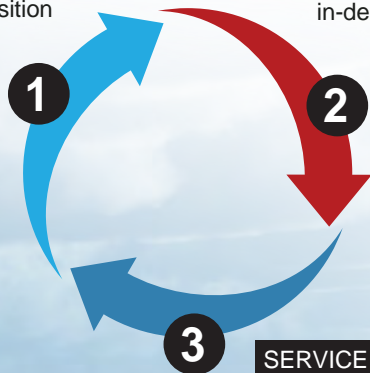
The three primary parts to our monitoring solution

HARDWARE

Powerful data processing –
Advanced data acquisition
and management

SOFTWARE

Extensive analysis –
Wind park overview with
in-depth diagnostics



SERVICE

Comprehensive 360°services –
Dovetailing your expertise
with ours

Our unparalleled track record:

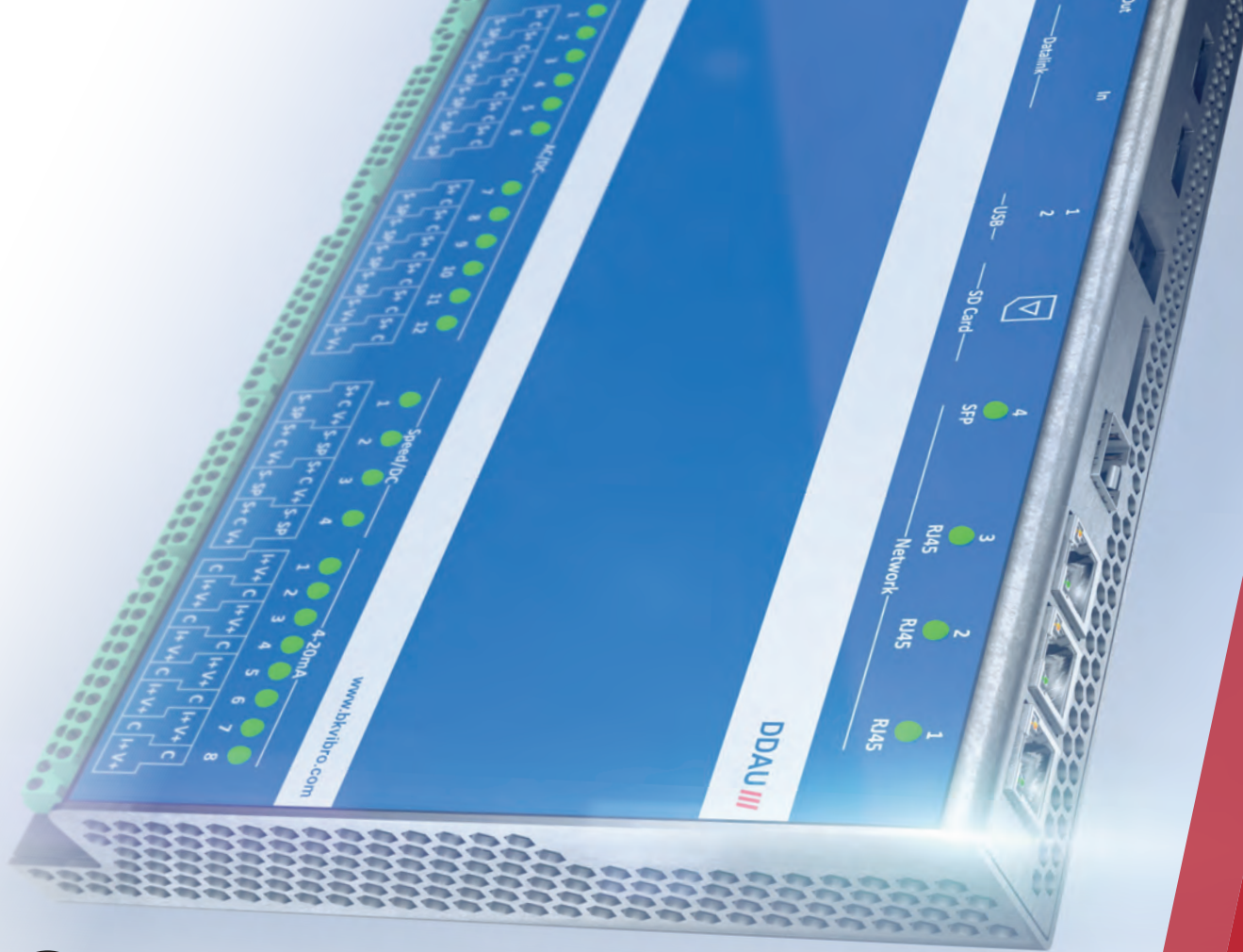
200,000+
monitoring hours in over 15 years

20,000+
condition monitoring systems sold

1,180+
bearing types monitored

121+
gearbox types monitored

42+
generator types monitored¹



1 HARDWARE

DDAU III

Powerful data processing – Advanced data acquisition and management

Our third-generation condition monitoring data acquisition device (DDAU3) is an important part of Brüel & Kjær Vibro's 360° monitoring strategy. It features:

Flight recorder – Automatically records data at a high resolution for diagnostics even if the network is down

Full remote operation – Once installed, all operation and service can be done remotely. No server required!

Cyber security – Encryption, built-in firewall, certificate exchange and hardened operating system with security updates to limit access

Customization – Built-in Python calculation engine with advanced analysis library that can be used for defining specialized measurements for detection, diagnostics and analysis



Open interfaces for system integration – Embedded OPC UA, Modbus and HTTPS interfaces for true plug and play connectivity with the SCADA system and controllers. Integration into the SCADA system is seamless, and can include a wide range of other interfaces such as Profinet, CAN Bus, etc.

Powerful, high performance platform – 0-80k Hz frequency range, excellent low frequency monitoring capability, high-resolution transient event analysis for root cause analysis

Simple IT landscape – Direct connection to remote unit, no park servers required



2 SOFTWARE

VibroSuite Highlights

Proven in use for on-line monitoring of 10,000+ turbines

Global user access to alarm information, data, statistics and analysis of historical data

Advanced tools for detailed investigations and root cause analysis

Extensive analysis – Wind park overview with in-depth diagnostics

Interfacing directly to our DDAU3 monitoring hardware, our unique VibroSuite software package provides market-leading fleet monitoring, diagnostics and data mining analysis capabilities. These capabilities are combined with detailed analysis and comparison of individual wind turbines.

Client-owned

VibroSuite enables all customers to host, process, and analyse the data in-house.

Alarm management system

VibroSuite efficiently avoids alarm flooding and has been designed with intensive focus on the alarm handling and reporting process. This, together with a complete overview of the alarm history of the turbine, greatly reduces the workload of analysis specialists.

VibroSuite.WEB

The customer portal of VibroSuite provides access to current and historical alarm and report status. It provides an at-a-glance overview of the wind park and enables the user to perform fleet-wide comparison of data as well as detailed analysis of individual wind turbines.



Comprehensive 360° services – Dovetailing your expertise with ours

Brüel & Kjær Vibro's 360° condition monitoring solution not only includes a dedicated monitoring system, but also offers a suite of services that can be customized to the customer's personal requirements, such as your specific monitoring strategy, data visualization, and interfacing to existing controllers. The end result is actionable information for ensuring lead-time to maintenance of your wind turbines, optimizing uptime.

Brüel & Kjær Vibro offers services that cover the entire value chain:

TURNKEY SOLUTIONS



PLANNING



INSTALLATION

DATA SERVICE



DATA SECURITY



DATA HOSTING



FLEET MONITORING

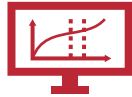
REMOTE MONITORING SERVICES



CONDITION MONITORING



DIAGNOSTIC SERVICES



PROGNOSTIC SERVICES

Brüel & Kjær Vibro is dedicated to service. For us, service is not just a department, it's an attitude, and you can feel this in everything we do.

Our highly skilled diagnostic engineers, all of whom are ISO 18436 certified, are ready to help with your demands and requirements. From our four global Surveillance and Diagnostic centers in Shanghai, Beijing, Copenhagen, and Houston, we are monitoring thousands of wind turbines every day.

Customized services

Our comprehensive service packages can be tailored to your specific operation and maintenance strategy, and monitoring requirements. By combining your expertise with ours, you achieve optimal benefits from our 360° monitoring solution.



What do our customers say?

Our data management technology, monitoring strategy, and actionable information reports are second to none. That's why our customers score us as "excellent".¹

We are very happy with your trend analysis functionality and would definitely recommend it to others.

Operations Manager, Europe

B&K Vibro has a very good monitoring team with highly skilled analysts.

The pricing is fair in view of the service provided, and with very informative alarm reports.

Owner/operator, Europe

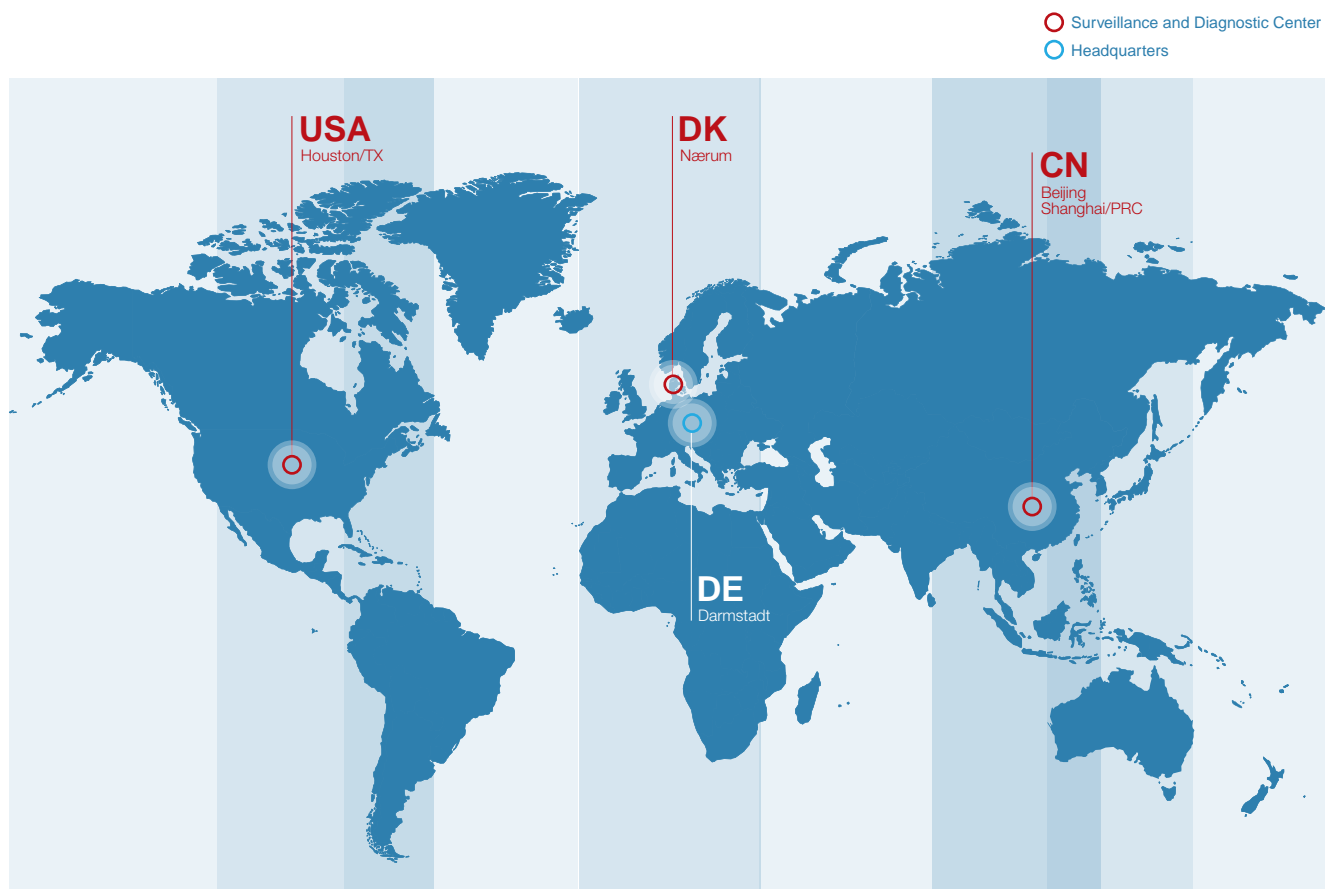
The B&K Vibro diagnostic engineers have a very good success rate and their recommendations are reliable.

Owner/operator, North America

The B&K Vibro systems and components are easy to install, commission, inspect and troubleshoot with really good technical support.

Senior specialist, Europe

¹Excerpts of feedback provided in the 2018 Net Promoter Score (NPS) survey. Overall score was 56%.



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