



Wind condition monitoring solutions

A smarter way to operate your wind farm

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 **Bently Nevada**
a Baker Hughes business

Bently Nevada VbOnline Pro

With the increasing demand for clean energy, the wind sector continues to grow; and so do the challenges associated with achieving lower levelized cost of energy (LCOE). Wind farm owners and operators must find ways to operate smarter and maintain profitability by controlling operating and maintenance costs.

Bently Nevada* Wind condition monitoring solutions addresses those very concerns by proactively detecting impending drivetrain issues. From transducers to monitors and software, this integrated and scalable solution enables you to intelligently manage wind farm assets, increase availability and decrease maintenance expenses. Bently Nevada's wind condition solution is an integral component of a condition based maintenance methodology which can be applied to any turbine manufacturers' equipment.

Bently Nevada's wind power and condition monitoring experts know the turbines and instrumentation. We can provide a single point of contact for the entire project. We'll work with you to assess your needs, design and deploy a custom solution, and help you maintain the solution over the entire life cycle.

Why monitor?

Wind turbines can endure unpredictable conditions that negatively impact operation. Advanced condition monitoring techniques and experience are critical to reliably managing your assets.

The gearbox is priority #1

Planetary/helical gearbox failure is a primary concern for manufacturers and operators. *As much as 25%-30% of wind farm operating and maintenance costs are associated with the gearbox alone.*

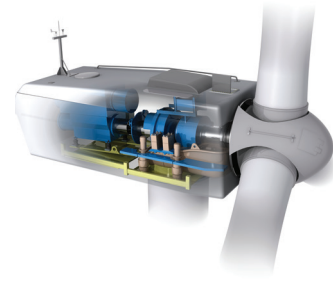
A Bently Nevada integrated condition monitoring system enables operators to understand the gearbox condition remotely. Dependable knowledge of the gearbox condition enables continued operation and revenue generation when a defect is not significant, while mitigating the risk of run to failure, an unplanned outage or catastrophic event.

Proactive condition monitoring across your fleet also helps operators plan efficiently for and coordinate maintenance outages. Consolidating maintenance into one outage, and scheduling one crane, can save hundreds of thousands of dollars.

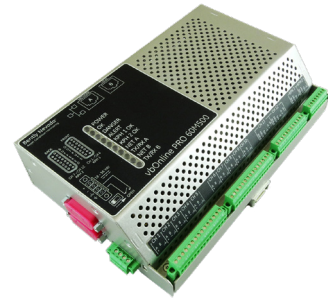
Increase availability by shifting from time-based to condition-based maintenance. Advanced planning helps shorten maintenance intervals and optimize maintenance outages.

Improve reliability by establishing baseline operating conditions for the drivetrain.

Early warning/detection can reduce crane costs by identifying problems soon enough to perform some maintenance up-tower.



Bently Nevada sensors
Monitors wind turbine drivetrains



VbOnline Pro condition monitoring system
Powerful continuous up-tower signal processing



System 1 Wind Software
Trending and diagnostic analysis

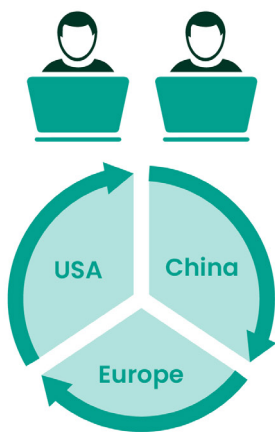
Bently Nevada wind customers have reported annual savings of \$4000 – \$6000 per turbine.

Why System 1 wind software?

Understand how your unit operates from day 1

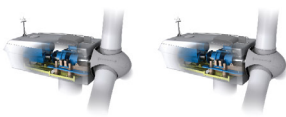
Reliable continuous condition monitoring for the main bearing, gearbox, generator and tower enables you to understand issues weeks, or even months in advance.

Global data centers
24/7 follow the sun
turbine monitoring



Cloud

VPN router



Domain knowledge

We've embedded more than 60 years of Bently Nevada condition monitoring expertise into our solutions, gained from having more than two million permanently installed transducers and monitoring channels—the largest installed base in the world. The Bently Nevada wind condition monitoring solution incorporates the intelligence of System 1 Wind software, Bently Nevada's industry-leading optimization and diagnostic software platform. By transforming data into knowledge, owners and operators alike can make informed decisions with confidence.

Network-friendly and scalable

The powerful up-tower processor contains all configurations and algorithms with inputs from accelerometers on the main bearing, gearbox, and generator. The System 1 Wind software can also be integrated with SCADA systems while minimizing congestion on the SCADA network. System 1 Wind software can be deployed at each wind farm or hosted in the cloud with our Software as a Service (SaaS) offering. SCADA interface improves overall drivetrain diagnostics correlating process data points to vibration, commonly through OPC DA interface.

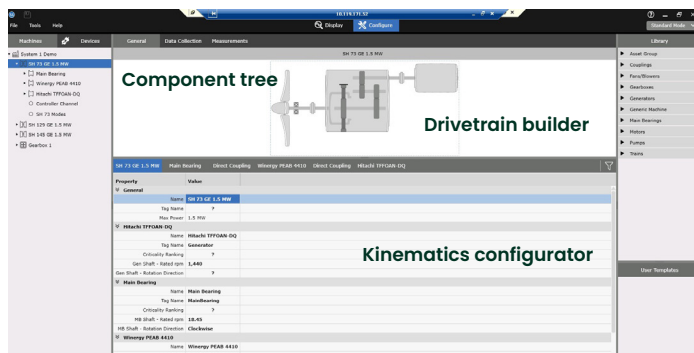
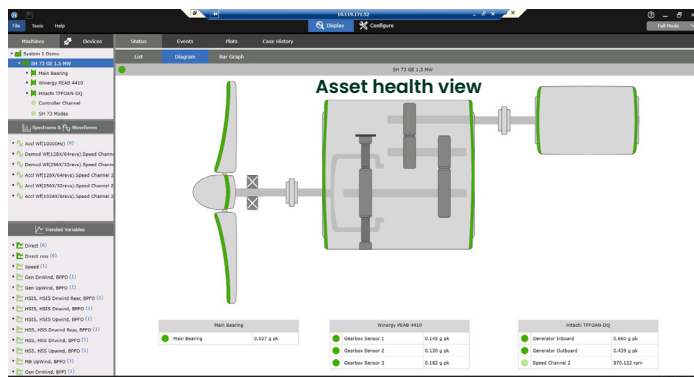
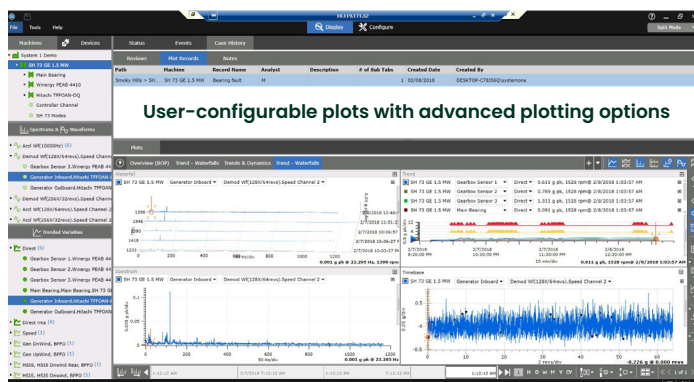
This solution is equally applicable for one or many wind farms. An entire wind farm can be monitored locally from the wind farm office. You can also remotely monitor a wind farm or the entire fleet from a central location. Centralized management enables increased productivity.

Advanced technology that solves gearbox complexities

Our patented **Planetary Cumulative Impulse Detection** algorithm is a set of measurements that detect and trend the passage of debris particles through the planetary stage of a wind turbine gearbox. This provides greater insight into gearbox condition and helps pinpoint problem areas. The **Dynamic Energy Index (DEI)** algorithm is specifically designed for variable speed machines. DEI spreads the variation over five bands of operation for more accurate spectral energy calculations and earlier fault detection. The **Sideband Energy Ratio (SER)** algorithm is used to aid in the detection of gear tooth damage where it calculates the ratio of side band energy to gear mesh center frequency energy, thus providing early indication of gearbox defects.

Powerful diagnostics and intuitive displays

Comprehensive alarm, diagnostic, analytic and reporting capabilities provide a clear picture of turbine health and facilitate maintenance with actionable recommendations. Over 300 static variables are monitored and trended for each wind turbine generator, and high resolution waveform data are collected for the general, bearing and gear measurements. Familiar navigation and filtering make it easy to access precisely the information you're looking for.



OEM agnostic turbine capability

As part of the Bently Nevada team's effort to make life easier for wind farm operators, **Bently Nevada hardware and software can now be deployed on any kind of wind turbine, regardless of the manufacturer.**

Flexible configuration

With our most recent release, we've also given you the flexibility of placing a speed sensor wherever it is most convenient for you. If you have a once-per-turn sensor in the high speed shaft, just tell the software "1 event per revolution" and "high speed shaft." If you want to tap off a 2048-pulse-per-revolution encoder on the low speed shaft, no problem! Just configure that as well. We can even handle speed sensors on intermediate stage shafts within the gearbox.

At Bently Nevada, we understand your turbines, and we understand that you may have hundreds of turbines to operate and an endless list of other tasks to complete on a daily basis. Vibration is the foundation of what we do. Let us handle all the legwork to get your CMS system up and running with the best diagnostics available on the market.

Integrated oil particle sensor

The Wind software offers the most advanced and powerful vibration diagnostics available on the market today. Additionally, there are other complimentary technologies available to help monitor your turbine. Notably, oil particle detectors can provide a confirmation of suspected damage detected by the VbOnline Pro vibration system.

To provide a single, simple interface to all of your condition monitoring data, whether it is vibration or oil particle, the VbOnline Pro system now provides support for direct integration of the leading oil particle sensors.

You can directly connect either a GasTOPS MetalSCAN sensor or a Macom to the VbOnline Pro wind condition monitor. There is no longer a need to have an additional monitoring system associated with these sensors. Simply connect the pulse output from these sensors to the VbOnline Pro, configure the system to include the sensor, and you will instantly see trending data for particle counts and rates in the System 1 software interface. The system will automatically fire alarms if those particle counts or rates exceed the preconfigured (and user-configurable) thresholds.

Service and expertise...delivered

To ensure your continued success, Bently Nevada offers custom service solutions from 24/7 remote monitoring to on-demand technical support. We'll work with you to craft a solution that delivers precisely the level of support you need.

Engineered by wind turbine and condition monitoring experts and backed by trusted services, the Bently Nevada VbOnline Pro and System 1 solution is a smart investment that pays dividends across your fleet.



Design and installation

Let our experts help retrofit or modify your existing machinery (such as turbines, compressors, and fans) for the installation of monitoring systems or transducers. By combining our services with our hardware and software, BHGE delivers fully installed, fully engineered solutions tailored to your specific requirements. We have completed more than 1,000 design and installation project retrofits to rotating and reciprocating machinery.



Maintenance and support agreements

A one-year renewable Maintenance and Support Agreements (M&S Agreements) is automatically included with every product we sell. Its structure consolidates all products installed at your site under a single agreement for ease of administration and entitles you to phone, email, and Web-based support from our global network of experienced support experts.



Supporting services agreements

A supporting services agreement (SSA) is a custom-tailored combination of individual remote and site-based service offerings that addresses the unique needs of your site and your installation. We work with you to help your instrumentation to perform well and to provide hands-on assistance that allows you to realize the full potential of your condition monitoring system.

Your SSA can include remote monitoring and diagnostic (RM&D) services to help your facility managers and operators recognize problems before they occur. Our dedicated team of global engineers is available 24/7 in our Remote Monitoring Centers to provide timely machine health information, analysis, and collaborative resolutions that help you realize lower project costs, reduce your outage costs, and improve your bottom line.



Remote monitoring and machinery diagnostics services

Our more than 160 machinery diagnostic engineers around the world are recognized globally for their expertise in gathering and analyzing data to document baseline conditions and troubleshoot even the most complex machinery problems. They can work onsite, offsite, and in our Remote Monitoring Centers.



Training

Our customers routinely praise our in-depth technical training for its highly effective "learn by doing" labs coupled with classroom-style instruction. A comprehensive suite of product training courses is augmented by coursework in the fundamentals of rotating machinery behavior and diagnostic techniques. Our courses can be provided at any of our 50 global training centers or even brought to your site.

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