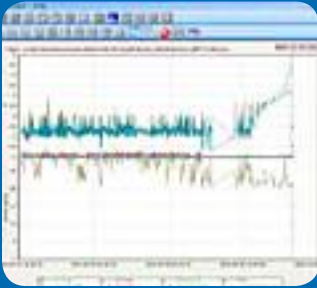


Make the most out of your maintenance resources

with SKF WindCon online condition monitoring system





A lot can happen out there before your next service visit

Given the operating conditions a wind turbine faces over a typical 20-year service life, maintenance problems aren't a question of "if," but "when". For many wind farms, the number of maintenance technicians trying to delay the inevitable is limited, and determining how best to deploy them is a challenge.

When inevitable maintenance problems occur, farms are faced with the prospect of exorbitant crane mobilization costs, lost energy production and soaring costs per kilowatt-hour. And to make matters worse, spare parts for wind turbines are very difficult to come by in this rapidly expanding industry. SKF WindCon can help.

By enabling operators to monitor and track deteriorating component conditions in real-time, SKF WindCon enables maintenance decisions to be based on actual machine conditions, rather than arbitrary maintenance schedules. Along with the possibility that maintenance intervals can be extended, the system provides a powerful tool for managing day-to-day maintenance routines and consolidating risky, costly maintenance activities. Data can be uploaded to SKF Remote Diagnostic Centres, operating globally 24-7, for expert analysis and reporting.

And unlike any other condition monitoring system on the market, SKF WindCon is backed by more than one hundred years of SKF rotating machinery expertise, application experience dating back to the earliest turbine designs and the continuous expert support of a dedicated remote monitoring facility.

SKF WindCon benefits include:

- Extended maintenance intervals
- Consolidated maintenance activities or prolonged repairs
- Reduced operating costs and costs per kWh
- Reduced risk of unplanned shutdowns
- Fewer costly tower climbs
- Predicting machine failures before they occur
- Preventing lost energy production due to breakdowns
- Predicting remaining service life by turbine
- Monitoring of operating conditions remotely via the Web
- Interfacing with SKF WindLub automatic lubrication systems to monitor lubrication conditions
- Integrated ISO bin norms and displays enable online oil monitoring
- Newly designed, improved and integrated software with new displays and tools that provide easier review of data

SKF WindCon

SKF WindCon is an easy-to-manage, proactive maintenance system that helps wind farm owners reduce operating and per-kWh costs. Easily installed on all turbine sizes and types, on land or at sea, the system continuously monitors single units or entire farms to reliably predict when maintenance activities will be necessary.

Using vibration sensors mounted on a turbine's main shaft bearings, drivetrain gearbox and generator, as well as access to the turbine control system, the system collects, analyzes and compiles a range of operating data.

The system provides a reliable performance overview that identifies faults and predicts failures before they occur, enabling operators to consolidate maintenance activities and perform necessary inspection and repair work during planned turbine stops. This also means a possibility of extended maintenance intervals, less unexpected downtime, fewer unexpected costs and longer turbine uptime.

The collected data also enables root cause failure analysis, which can eliminate recurring failures. When accessed with SKF WebCon, the system enables operators to monitor turbine conditions in real-time via any computer or hand-held device with Internet access.

Monitor a range of operating conditions

The system enables condition monitoring on an unlimited number of turbines and turbine data points. Sensors and software combine to continuously monitor and track several operating conditions:



- Unbalanced propeller blades
- Misalignment
- Shaft deflections
- Mechanical looseness
- Foundation weakness
- Bearing condition
- Gear damage
- Generator rotor/stator problems
- Resonance problems
- Tower vibrations
- Blade vibrations
- Electrical problems
- Inadequate lubrication conditions

User-friendly, anywhere you want to use it

SKF WindCon uses WebCon data analysis, warehousing and web hosting services. WebCon enables centralized remote monitoring and makes it even easier to access and act on collected data.

Utilizing wireless communication, WebCon helps shorten lead-time from alarm to solution, as operators can review data from any location with a computer or hand-held device with Internet access. And with WebCon, operators don't have to develop or maintain any databases – SKF manages and stores all data remotely. Other benefits include:

- Easy access to the monitored data via web browser
- No user-training or special access software required
- No special machinery analysis software required
- Temporary, third-party access available for single turbines



Dedicated support: SKF Remote Diagnostic Centres

While SKF WindCon is user-friendly enough to be operated by wind farm technicians, many users choose to have SKF monitor and manage the system for them. With our hosted software and monitoring services, implementing a world-class predictive maintenance program for periodic or continuous monitoring of critical machinery is just an Internet connection away. SKF Remote Diagnostic Services combine SKF condition monitoring tools such as offline and online monitoring systems to collect data, SKF experts to analyze data and the Internet to communicate management of machine health for informed decision-making. These services are ideal for plants with limited staff trained in predictive maintenance techniques, operations with sites located remotely from a central facility and original equipment manufacturers that want to provide a value-added service to their customers.

Our systems enable condition monitoring on an unlimited number of turbines and turbine data points. Sensors and software combine to continuously monitor and track several operating conditions.

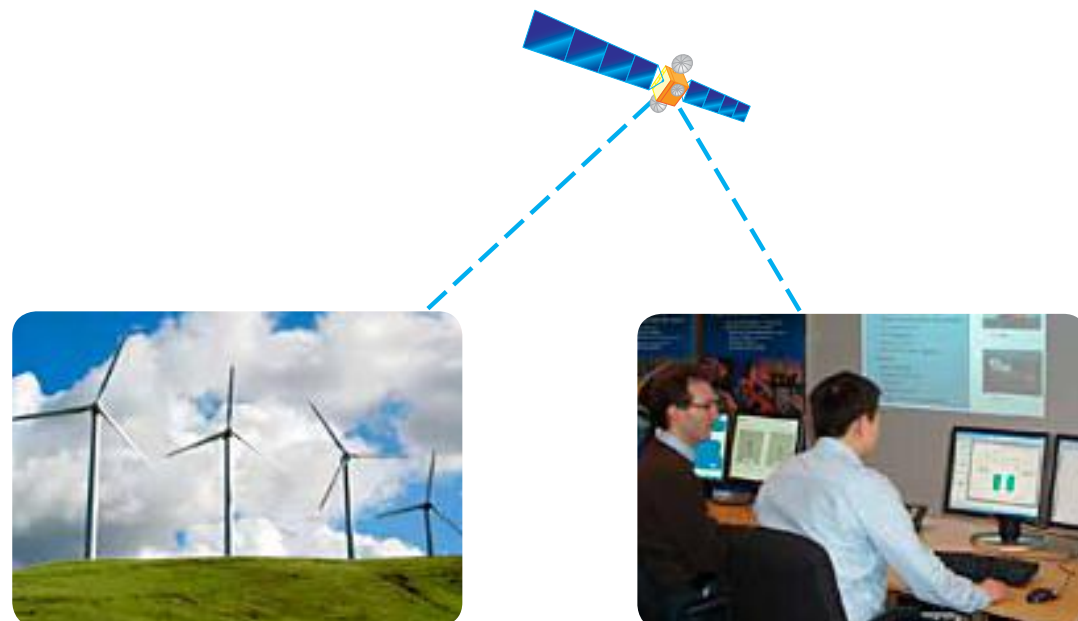
Greater reliability starts here

SKF WindCon's robust sensors and software enable highly reliable maintenance forecasting, an essential requirement for improving turbine reliability and availability. The system continuously recalculates fault frequencies, delivering accurate values based on reliable trends. SKF WindCon can carry out order analysis and perform multiple measurements simultaneously, this facilitates highly reliable alarms at variable speeds and loads, including very low main shaft speeds. The trend data also enables trend-based root cause analysis.

Additionally, SKF WindCon has a CAN-bus interconnection to monitor other wind turbine systems, including central lubrication systems. It also features an automated report writing system, and can generate alarm messages through text messaging and e-mail.

Field-tested, industry approved

Built to withstand offshore wind park conditions, the system's hardware features a compact stainless steel cabinet, a robust, weather-resistant cabling and sensors that have passed repeated turbine field tests. It has earned the official certification of Germanischer Lloyd and approval from Allianz Versicherungs-AG.



SKF WindCon Lubrication Interface

The SKF WindCon Lubrication Interface allows the SKF WindCon system to monitor lubrication pumps and components, including pump status and grease levels. If failures such as empty or blocked pumps or torn feed lines are detected, operators are notified immediately.

The use of SKF WindCon Lubrication Interface allows original equipment manufacturers and wind farm operators to control maintenance demands and reduce their costs per kWh.

1

SKF WindLub lubrication systems

A lack of proper lubrication can bring your equipment to a standstill. Vibration, high mechanical loads, contamination and moisture are all threats to the life of your bearings. With SKF WindLub, featuring an SKF or Lincoln automatic lubrication system, you can lengthen bearing life by delivering frequent, small amounts of grease to each bearing while the machine is running. Precisely controlled amounts of lubricant, delivered at preset intervals, keeps bearings coated, enabling them to perform at their rated capacity.

2

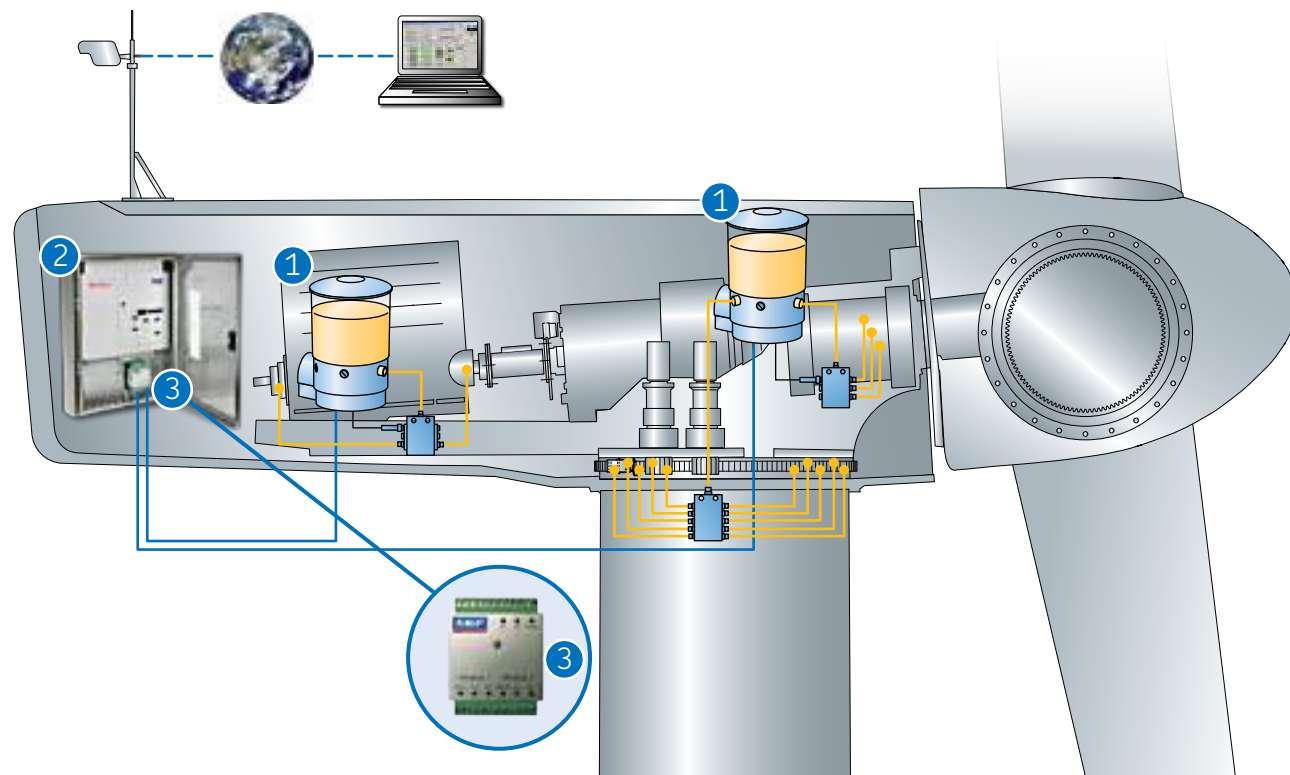
SKF WindCon online condition monitoring system

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3

SKF WindCon Lubrication Interface

Utilizing the SKF WindCon Lubrication Interface as a link between SKF WindCon and SKF Windlub systems provides the ability to monitor lubrication system health. In addition, the unit can be used to remotely trigger a lubrication cycle.



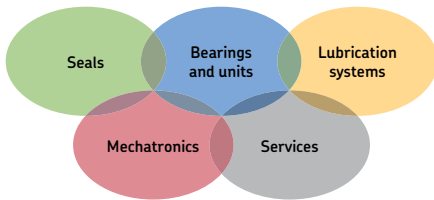
SKF WindCon provides great savings to a wind farm in the United Kingdom by controlled postponing of repairs

For one United Kingdom-based wind farm, WindCon enabled a novel condition monitoring approach that truly paid off. SKF installed a WindCon unit on a wind turbine that had already had damage to the low-speed part of the gearbox. A gearbox replacement was already being planned when SKF WindCon was first installed.

The system not only registered the damage – it also determined that the damage was stable enough to postpone the gearbox replacement and keep the damaged turbine in operation. After monitoring the damaged part for almost twelve months, the SKF WindCon system detected a rapid increase in the damage pattern, and the turbine was taken offline for the planned gearbox replacement.

By postponing the gearbox replacement for nearly twelve months, the wind farm was able to accrue interest on the money needed for the overhaul, which was almost enough to pay for the SKF WindCon installation. But more important in terms of cost savings, the farm was also able to efficiently plan for parts delivery, shipping, personnel and cranes for the replacement – something that would have been impossible with a rushed operation accompanied by several weeks of downtime.





The Power of Knowledge Engineering

Combining products, people, and application-specific knowledge, SKF delivers innovative solutions to equipment manufacturers and production facilities in every major industry worldwide. Having expertise in multiple competence areas supports SKF Life Cycle Management, a proven approach to improving equipment reliability, optimizing operational and energy efficiency and reducing total cost of ownership.

These competence areas include bearings and units, seals, lubrication systems, mechatronics, and a wide range of services, from 3-D computer modelling to cloud-based condition monitoring and asset management services.

SKF's global footprint provides SKF customers with uniform quality standards and worldwide product availability. Our local presence provides direct access to the experience, knowledge and ingenuity of SKF people.

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