

FAG



FAG WiPro
Wind Turbine Protection

SCHAEFFLER GROUP
INDUSTRIAL

FAG Wind Turbine Protection

Down to the bare minimum

What has long been common practice in other areas of industry and is successful in application, is now becoming more and more established in the wind energy sector – condition-based maintenance. Investment in wind energy involves a high level of financial commitment. In order to protect this investment in renewable energy as effectively as possible and to ensure maximum plant availability, condition-based maintenance is absolutely essential.

In order to implement such a concept, it is necessary to develop a new strategic approach to the maintenance of wind turbines. In contrast to other industrial plant, wind energy is often characterised by a large number of individual installations that are distributed over a wide area and are in some cases very difficult to access. This significantly increases the maintenance costs. With its online monitoring system FAG WiPro, FAG Industrial Services (F'IS) offers a cost-effective system for condition-based maintenance that gives considerable advantages and potential savings.



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Increasing availability and prevention of unplanned downtime

Through permanent, continuous monitoring of installations by means of FAG WiPro, the operator has access at any time to information on the condition of the most important components of his wind turbine. With the help of this early warning system, it is possible to reliably prevent sudden machine damage and the associated costs. This gives the operator a high degree of investment security as well as of his machinery protection.

Furthermore, the early detection and monitoring of damage also allows appropriate measures to be taken in good time. In the simplest case, this could mean reducing the power level in order to diminish the load on the damaged component.



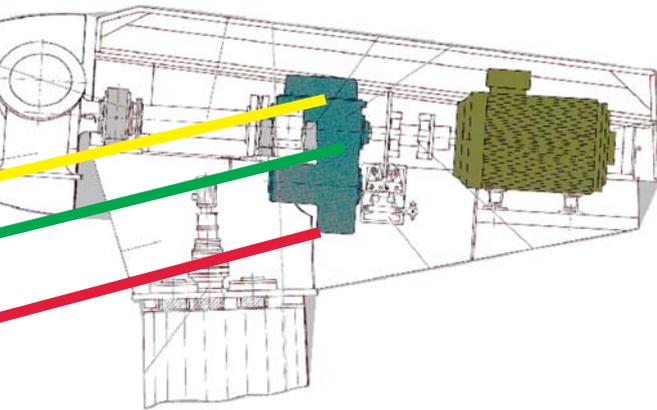
Planned condition-based maintenance

Anyone responsible for the maintenance of wind turbines knows the challenges involved in the planning of maintenance measures. In the offshore sector in particular, maintenance requirements will even increase significantly in future. Since there are limits to the personnel available for this task, the use of skilled personnel must be planned with care and foresight. At any time, FAG WiPro gives the operator the necessary information on the condition of the wind turbine. This allows optimum planning of maintenance work.



FAQ Wind Turbine Protection

Frequency-selective
Monitoring of
individual components



Monitoring strategy	Features	
<p>Less advisable</p> <ul style="list-style-type: none"> Regular measurements offline 	<ul style="list-style-type: none"> High travel costs High personnel costs Low equipment outlay 	<ul style="list-style-type: none"> Data with large time intervals Development can only be checked with difficulty
<p>Less than optimal</p> <ul style="list-style-type: none"> Measurements online Collection of data in the wind turbine 	<ul style="list-style-type: none"> High personnel costs High investment required for equipment 	<ul style="list-style-type: none"> Continuous data retention Information on the turbine not available at all points in time
<p>Optimal</p> <ul style="list-style-type: none"> Measurements online Access to the data via telephone, TCP/IP 	<ul style="list-style-type: none"> High investment in online monitoring Low personnel requirements 	<ul style="list-style-type: none"> Seamless data retention Current information on plant condition Immediate response possible in case of damage

FAQ WiPro

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Early detection of problems

In the wind energy sector, it is of the utmost importance to detect incipient problems or damage at an early stage. Otherwise considerable consequential damage may occur. If incipient damage is detected in good time (i.e. generally a matter of weeks or months in advance), the problem can often be resolved at low cost. This makes it possible to, on the one hand avoid unplanned downtime of the plant and, on the other hand, prevent damage from spreading to other components, leading to total failure of major components (such as the gearbox). In addition, the analysis of data can help in detecting the cause of the damage and thus preventing damage at this location in future.



Improvement in insurance terms

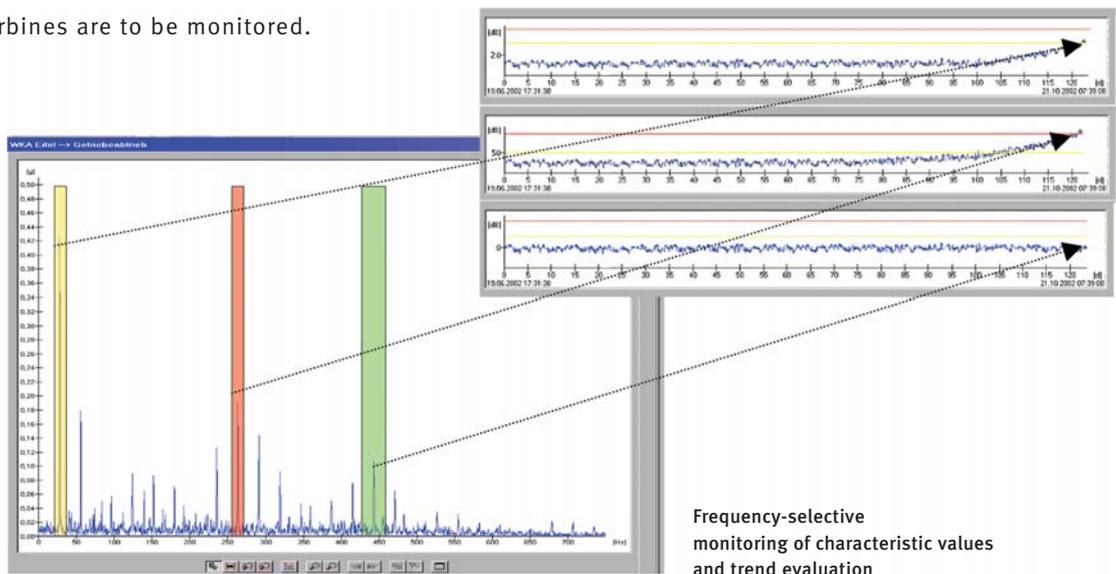
The insurance industry was the first to recognise that the costs involved in operating wind turbines can be reduced considerably through the use of a condition monitoring system. The use of the FAG WiPro system can lead to suspension or modification of the revision clause (replacement of all bearings irrespective of condition after 40 000 hours' operation or no later than 5 years).

“Since initial damage can be rectified very quickly, secondary damage and long downtime can be prevented. As a result, our indemnities are reduced and the operator pays lower premiums” notes a representative of a leading insurance company. (Neue Energie 11/2003, “Versicherungen für Windmüller“, page 31). Preventing even a single revision means considerable cost savings for the customer. Since the monitoring system FAG WiPro is acknowledged by Allianz insurance, insurance companies offer more favourable conditions to users of FAG WiPro. In addition to the acknowledge by the Allianz the FAG WiPro is also certified by the Germanischer Lloyd (GL). Since the monitoring service is of great importance for the result of condition monitoring (see page 6), F'IS decided also to have its monitoring center in Herzogenrath certified by GL.

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Retrofitting possible to any turbine

Due to the modular concept of FAG WiPro, wind turbines of any type can be retrofitted with the system. Any wind farm can be networked using the WiPro system, whether the turbines are connected using copper cables, fibre optics, ISDN or analogue lines or even if no telephone connection at all is present. Wireless networking (using GSM or another wireless standard) is also possible if the existing lines cannot be used. Instead of a flood of measurement data, the system supplies only the necessary information, which is required for monitoring the turbines. FAG WiPro is designed in such way that only a comparatively small amount of data has to be transmitted to achieve reliable monitoring. This may turn out to be an undeniable advantage especially if large numbers of turbines are to be monitored.



Frequency-selective monitoring of characteristic values and trend evaluation

FAG Wind Turbine Protection

Full service by F'IS or in-house monitoring?

The objective of a service concept must always be to give customers meaningful and usable recommendations for action. This can be achieved by means of comprehensive remote monitoring and diagnosis matched to customer requirements.

F'IS has therefore developed various service models for the wind energy sector. These introduce the customer step by step to the requirements of complete adoption of Condition Monitoring (CM).

CM Service Model 1

- Installation and initial operation of FAG WiPro systems by F'IS
- Complete monitoring and analysis by F'IS
- Regular provision of reports for the operator

CM Service Model 2

- Installation and initial operation of FAG WiPro systems by F'IS
- Customer-specific training of employees
- Partial monitoring of turbines by the wind farm operator
- Analysis of data by F'IS in alarm situations and as required

CM Service Model III

- Installation and initial operation of FAG WiPro systems by F'IS
- Qualification of customers within the framework of an individually tailored training concept
- Complete monitoring and analysis of turbines by the operator

Due to the wide range of services F'IS offers its customers, it is possible to knit together for each customer the right package of training and services from F'IS together with the activities carried out by the customer himself. This also offers, for example, customers that already have considerable CM experience the possibility of installing FAG WiPro systems themselves.



FAG Wind Turbine Protection

WiPro: Technical specifications

Inputs:	ICP inputs for ICP sensors with power supply 24 V, 4 mA (standard) Optional: voltage input +/- 10 V or input switchable between ICP and +/- 10 V for other sensors Amplifier: 1 x to 1024 x or autoranging with switchable overvoltage detection Additional channel (validation) 0 – 10 V e.g. for speed, load or other freely definable values	Speed-dependent tracking of frequency bands in RMS and demodulation including speed-variable alarm level
Measurement values:	Measurement value for vibration pickups: acceleration (standard), convertible to vibration rate and vibration displacement by integration Measurement values such as displacement, speed, force, pressure, temperature etc. can be detected by appropriate sensors Optional: change in oil quality and particles online; stationary torque measurement	Channels: 8 channels with up to 16 monitoring configurations and up to 12 individually adjustable frequency bands per configuration, additional 2 trigger / validation channels, each simultaneously with sensor signal
Characteristic values:	Characteristic values in time range: RMS, peak, peak to peak, constant component, crest factor Characteristic values in the frequency range: RMS value for vibration acceleration, vibration rate and vibration displacement (ISO 10816) broadband or freely definable frequency bands RMS value of demodulation (envelope processing) broadband or freely definable frequency bands	Filter: Analog antialiasing filter for band limitation, Butterworth 24 db/oct. cut-off frequencies, 5, 10, 20, 50, 100, 200, 500 Hz, 1, 2, 5, 10 and 20 kHz Filter envelope analysis: high pass, Butterworth 12 db/oct. switchable 100 Hz and 2 kHz Memory: For equipment/monitoring configuration, spectrum and time signal and storage of characteristic values of up to 3834 data records (dependent on the number of characteristic values and the information to be stored together with the characteristic values) FFT: 2048 lines, variable frequency range
		Outputs: 2 switch outputs for prealarm and main alarm 2 analogue outputs 4 – 20 mA, optionally 0 – 20 mA, 0 – 10 V or 0 – 5 V BNC socket – buffered sensor signal Display: LCD display, alphanumeric, 2 lines each with 16 characters, LED red/yellow/green signal for alarm status Interface: RS 232 for connection of modem / GSM / ISDN / TCP/IP etc.

FAG Wind Turbine Protection

WiPro: Technical specifications

- Sensors:** Special sensors for low frequency monitoring range
- Housing:** Dimensions: W x H x D = 400 x 600 x 220
Design: steel case IP 66

Electromagnetic

- compatibility:** EN 61000-6-2/1999
EN 61326/1997
EN 55011-A

FAG WiPro server software

Operating

system: Windows 98, NT (SP 6a), 2000, XP

Features: Database: Microsoft SQL Server, 2 GB
Software available in various languages
Versatile connection options
(Ethernet, GSM modems, landline modems, Internet etc.)

Configurable remote operation with automatic data transmission

Notification of alarm (e-mail, SMS)

Continuous detection and storage of all occurring operating data

Speed-dependent tracking of frequency bands in individual monitoring configurations

Option of data export (ASCII) for further processing by external programs

Optimised viewer for analysis of data

*Recognised by Allianz
and Germanischer Lloyd*



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