

# BLADEcontrol®

## Greater output – less risk





Expensive surprises?  
Unnecessary downtime?  
Rotor blade monitoring increases the  
output of your wind turbine generator  
system

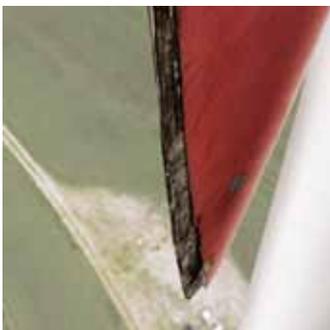
### Detect damage at an early stage

For motorists, it goes without saying: Numerous sensors constantly monitor the vehicle. Diagnostic functions let the driver know about changes at an early stage before they become problems. The continuous monitoring protects the owner's investment by running unnoticed in the background, thus increasing the reliability and operational safety of the vehicle.

In wind turbine generator systems, there are still large numbers of operators who are not yet taking advantage of continuous rotor blade monitoring. They rely on visual inspections. This approach does not save them any money over the long term and also increases their risk with each passing year.

The rotor blades are exposed to significant strain due to storms, icing, lightning strikes, and wind gusts. Damage occurs unnoticed and is often only detected by routine inspections when the repair expense is already quite high or a replacement is required. The system is then down for days or weeks and does not produce any power.

As rotor diameters of wind turbine generators increase, there is an accompanying rise in the technical and economic risk due to rotor blade damage. This is because the costs of rotor blades increase disproportionately with the turbine size.



- ◀ Risk of damage increase, e.g. after a lightning strike
- ▶ On the safe side: Continuous rotor monitoring with BLADEcontrol by Rexroth

### Eliminating risks

The solution: BLADEcontrol®, the continuous monitoring system from Rexroth. Around the clock, it continuously detects the state of each individual rotor blade. The sensor system detects the first signs of damage that usually go unnoticed in a visual inspection. This allows you to take appropriate steps at an early stage and to avoid turbine downtime. In the event of serious damage, BLADEcontrol immediately sends a signal to the system control unit, which can then shut down the turbine and thus avoid blade breakage.

In addition to direct damage to the rotor blade, BLADEcontrol also detects other rotor problems such as aerodynamic imbalances, loose parts in the blade and hub, and incorrect pitch settings. By doing so, the system makes an additional contribution to the operational safety of the turbine.



# Know exactly when a rotor blade has ice and when it is clear

Wintertime is high season for power generation. But it is exactly then that many wind turbine generator systems automatically switch off because the ice sensor on the nacelle signals the presence of an icing risk. Then the operators have to go to each individual turbine, personally inspect the rotor blades, and individually set each machine back into operation. This is very inefficient! High costs are incurred by having to make the inspection visit and also in lost generation caused by unnecessary turbine downtime.

## **Automatic restarting**

BLADEcontrol reliably handles safe ice detection. The system detects when rotor blades reach a preset degree of icing – and most importantly, when the danger has passed. It is thus possible to automatically restart the wind turbine generator system at any time, day or night. This is unique on the market and is certified by Germanischer Lloyd.

The reason for this is that BLADEcontrol is the only system that measures icing in the place where it happens: on the rotor blades. Up to now, icing has often been detected by an ice sensor on the nacelle. The blade tip, however, is up to 60 meters away and it is moving at up to 250 kilometers per hour through the icy air. As a result, totally different icing conditions occur on the rotor blade than on the nacelle.

BLADEcontrol gives you the assurance of an exact detection while other measuring methods are imprecise by their very nature. You thus avoid the risk of failing to notice icing or of unnecessarily shutting down turbines that are not iced.

## **Changes in natural oscillation with ice build-up**

The basis of the measurement precision is the patented conversion of a basic physical principle: Ice build-up, as an additional mass, results in a change in the natural oscillation of the rotor blade. The frequency of the natural oscillation decreases in proportion to the increasing mass of ice. With high-sensitivity sensor systems and special evaluation processes, the system is able to accurately measure ice thickness down to the millimetre.

This measurement can be carried out either when the turbine is turning or when it is stationary. It is thus possible to test the turbine to make sure that it is sufficiently free of ice before it is started.



# Be proactive instead of just reacting

Visual rotor blade inspection by specialists on site does reveal externally detectable damage, but the time that the damage occurred may have been a long time before. During this time, the damage may have increased significantly. One sensor module per rotor blade is enough to detect damage from the outset.

## **Reliably detect even invisible damage**

BLADEcontrol functions precisely, reliably, and reproducibly under all weather conditions. The system detects the first, often invisible signs of damage to the rotor blade, inside and out, as well as embrittlement or material fatigue phenomena because these change the natural oscillations of the rotor blade. In each rotor blade, the measurement is carried out by acceleration sensors – highly sensitive, multidimensional, and compactly arranged in a single module. The data from the rotor blades are brought together in a hub box and transmitted to the nacelle.

The Evaluation and Communication Unit (ECU) installed in the base of the tower analyzes the data continuously with specially developed methods and algorithms. These detect damage and classify it according to its severity. Critical states are transmitted directly to the system control unit in order to immediately permit necessary reactions. At the same time, evaluations are also transmitted to the Rexroth Monitoring Centre where experts carry out further evaluation of the data, e.g. via trend analyses. We use this evaluation to craft specific recommended actions for the operator. Operators can also consult the status of their systems at any time via the Internet.

## **Red, yellow, green: status at a glance**

Traffic signal colours indicate the status of each rotor blade: Green for perfect, yellow for slight damage, and red for serious damage. With slight damage, you can track its progress online and plan long-range repair measures. The Rexroth Monitoring Centre detects other failure causes such as incorrect blade positions and dynamic imbalances by evaluating dynamically alternating loads. It is thus possible to avoid high consequential expenses.



# Limit risks – reduce costs

Enjoy the benefits of continuous rotor blade monitoring by seeing how much more power you generate and how you reduce your maintenance and repair costs! Within a few short operating years, BLADEcontrol will put you ahead of the game.

## **Rotor blade monitoring pays off**

BLADEcontrol pays for itself in a few short years. Our customers are proof of this. The results they have achieved are based on experience with both new turbines and older turbines. A constant contributing factor is the higher availability in winter. With each gust of wind and each hour of operation, the risk of rotor blade damage increases. As turbines age, early damage detection takes on an ever greater importance. Replacement of a single rotor blade of the 45-meter

class incurs costs that are more than ten times the total cost of an installed BLADEcontrol system.

In other words: In a wind farm with ten turbines, if early damage detection allows you to avoid a blade replacement just one of the thirty rotor blades over the course of 20 years, then equipping the entire wind farm with BLADEcontrol has already saved you money.

## **Easy to retrofit**

BLADEcontrol is already available as an option for new turbines from many suppliers, but it can also be used to easily upgrade existing turbines. We will be happy to assist you with this. We place the sensors at exactly the right position in the rotor blade and calibrate the system to each individual blade. You specify which functions you want to use: Damage detection with or without direct reaction of the machine control unit, detailed damage monitoring and damage tracking with trend analysis by our Monitoring Centre, or just ice detection with the certified automated system for restarting after the ice thaws. You increase the availability of your turbines and reduce the cost of operation management and maintenance: Simply put, more output with less risk.



Risk reduced,  
output increased } Exactly



### Your advantages

- ✓ Increased power generation
- ✓ Reduced repair costs
- ✓ Early icing detection
- ✓ Damage prevention
- ✓ Automated start-up
- ✓ Improved economy

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