

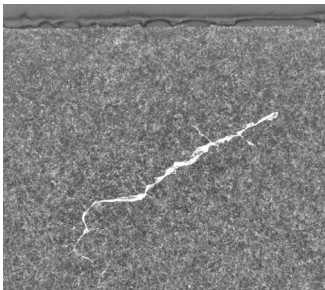
# WIND TURBINES – ROOT CAUSE ANALYSIS AND CONSULTING SERVICES

Allianz Center for Technology (AZT)

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Measured oscillation of rotor shaft



Microsection of bearing with crack

## MULTIDISCIPLINARY EXPERTISE

**The growing demand for renewable energy sources has seen a significant increase in the use of wind energy.**

**The rapid development in the size of these plants has generated a variety of challenges and some major technical problems.**

Since the beginning of the 1990s Allianz Center for Technology (AZT) has investigated damage and dealt

with damage prevention on major components:

- Rotor blades and hub
- Mechanical drive train components, such as gearbox and bearings
- Electrical components, such as generator, converter, transformer, switchgear and cables
- Protection and control systems
- Structural components, such as nacelle, base frame and tower

## ROOT CAUSE ANALYSIS

Root cause analysis is a core activity of AZT, including on-site investigation (On- and Offshore) and examination of components in the materials laboratory. To support a holistic RCA, load measurements and/or computational analysis can be carried out. Beyond that, the results can be compared with the design parameters.

### ON-SITE INVESTIGATION OR DURING DISASSEMBLY

- Visual inspection of mechanical components (see AZT Gearbox Consulting Services)
- Evaluation of electrical system and components
- Non-destructive testing
- Load and vibration measurement such as:
  - Torque and bending moments
  - Vibration of shaft, bearing pedestal and structure

### LABORATORY INVESTIGATION METHODS

- Fractography including scanning electron microscopy (SEM)
- Metallographic investigation (optical microscopy)
- Chemical analysis (materials and lubricants, water samples)
- Non-destructive testing
- Mechanical testing

### COMPUTATIONAL ANALYSIS

- Calculation of gears, bearings and shafts
- FEM calculations for extended analysis of mechanical and thermal behavior

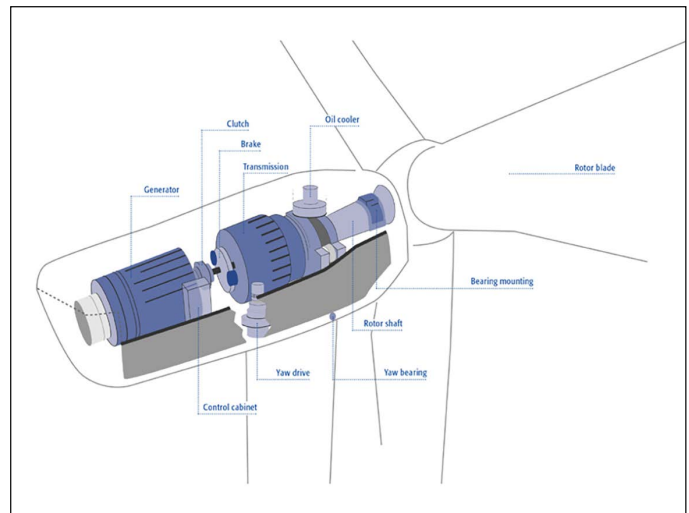
## CONSULTING ON DAMAGE PREVENTION

The activities of AZT are intended to reduce the frequency of damage to major components and thereby extend the service life of wind turbines. As a result, the activities go beyond root cause analysis.

AZT provides objective, vendor-independent assistance and support for all parties involved, to increase the availability of wind turbines.

### THE RANGE OF CONSULTING SERVICES COMPRISES OF:

- Design review and evaluation as well as computational analysis (including prototypes)
- Manufacturing process and quality
- Operation and maintenance concept
- Electrical protection and control systems
- Fire protection concept
- Review of lightning and surge protection concept including earthing system
- Corrosion protection and preservation
- Condition monitoring (recommendation on improvements and monitoring methods)
- Load and vibration measurement (methods for measurement of actual drive-train loads)



Main components

### YOUR BENEFITS

- ✓ Independent and holistic root cause analysis of damage
- ✓ Using our long-term experience of more than 25 years in damage investigation of wind turbine components
- ✓ On-site inspection (On- and Offshore certified by GWO)
- ✓ Specific recommendations on mitigation measures and improvements



**ENGINEERING HOTLINE OF AZT**  
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Find out more  
about our services  
and products.

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