Online load monitoring for gear boxes

2009 Wind Turbine Reliability Workshop

June 17-18, 2009

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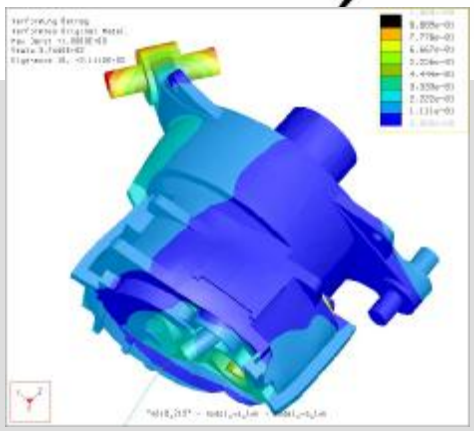
What is reliability?

". . . the ability of a system or component to perform its required functions under stated conditions for a specified period of time."

"….in general, reliability is the ability of a person or system to perform and maintain its functions in routine circumstances, as well as hostile or unexpected circumstances."

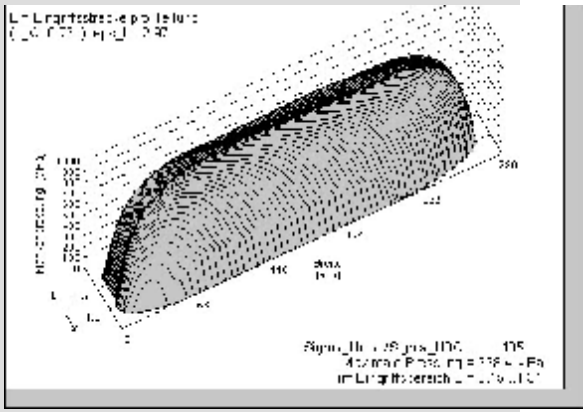
What are "hostile or unexpected circumstances" – how to prepare?

What makes a gear unit reliable?



No brainer:

- **Knowledge of loads**
- **Solid design / engineering work**
- **Latest calculation tools (FEM etc.)**
- **High quality raw material**
- **Top-of-the-line manufacturing machines**
- **Clean assembly environment**
- **Top-notch and well-defined quality standards and diligent quality department**
- **Full load test**



Today's standard!

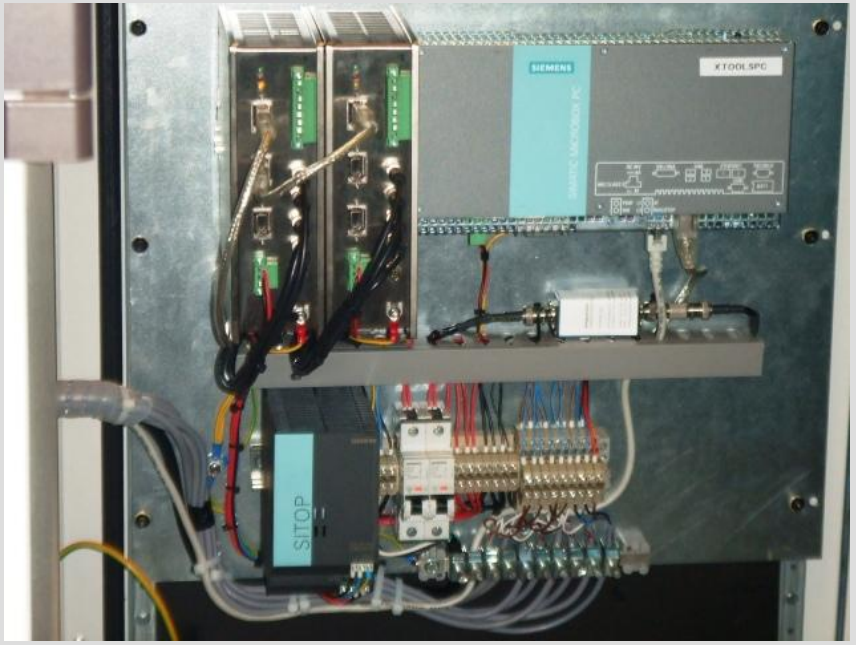
What makes a gear unit reliable?

“Not so” no-brainer:

- **Actual loads? Start / Stops? Torque?**
- **Interaction between different components?**
- **Influence of base plate deformation?**

What to do?

- **Know what happens to your equipment:**



<u>Option 1:</u>

CM System reactive

<u>Option 2:</u>

System required to collect accurate loads while occurring!

Load Measurements

Current:

Shaft speeds plus turbine parameters

Disadvantage:

High dynamic load peaks or vibrations not getting detected

New approach:

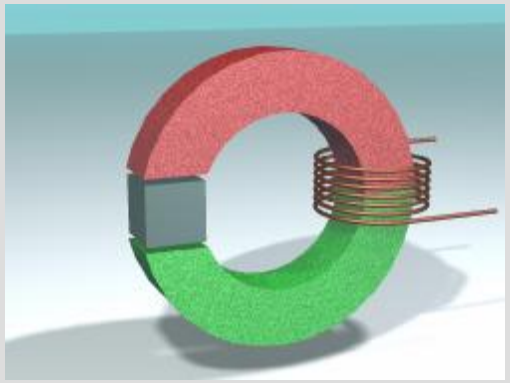
Non Contact Real Time Torque Measurement Technology

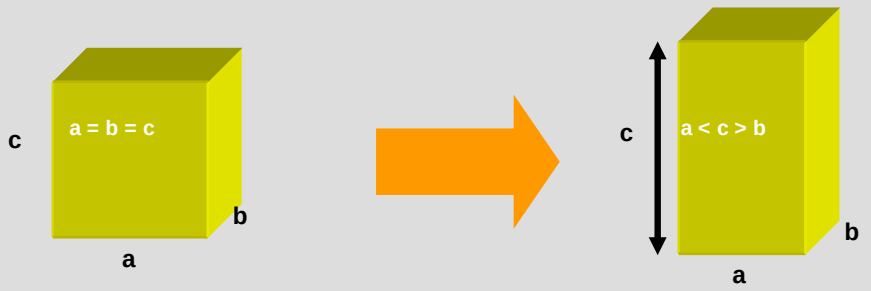
Magnetostriction

What is magnetostriction?

Magnetostriction is the relationship between the volume of a Ferro magnetic body and the presence of magnetic field.

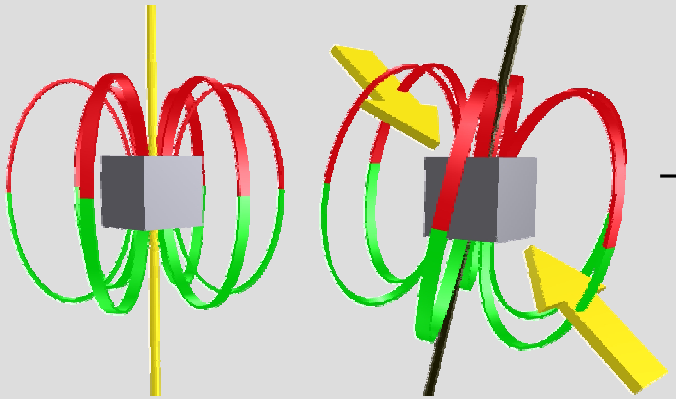
The effect was first identified in 1842 by James Joule known as the “Joule effect”.





What is magnetostriction?

When applying mechanical forces (stresses) to a magnetised Ferro Magnetic body, the “Magnetic Main Axes” will react in proportion to the applied mechanical forces.



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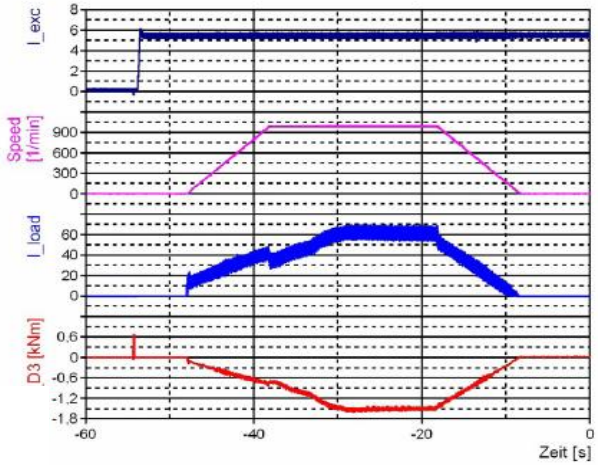
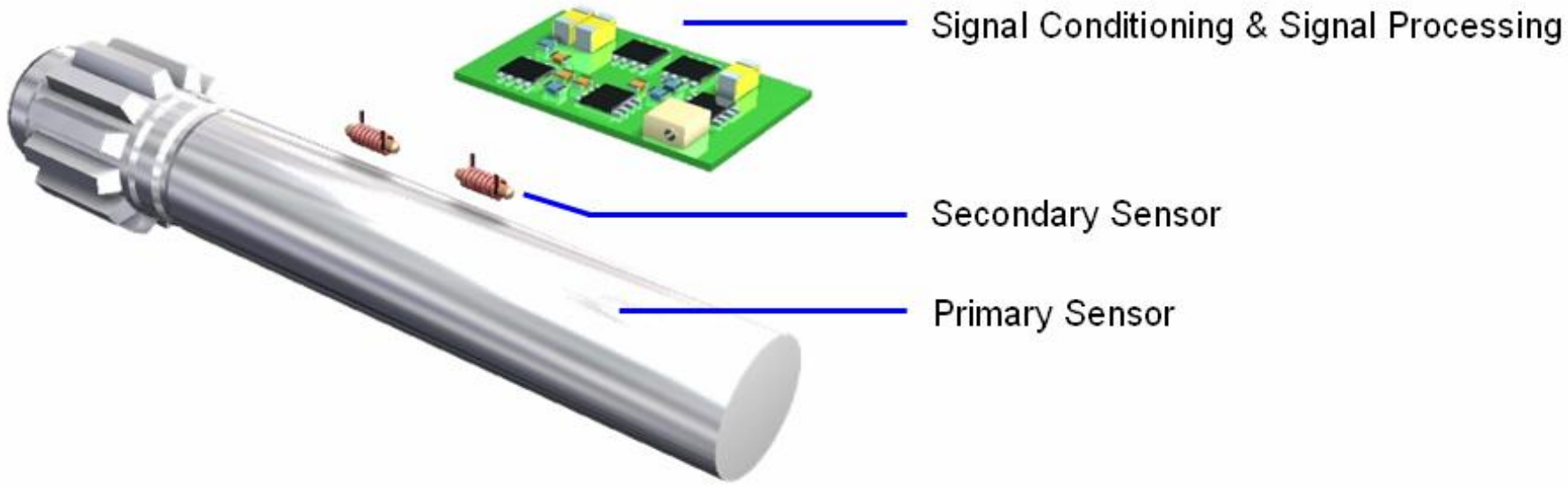


Restrictions apply when entering the state of “Plastic Deformation”.

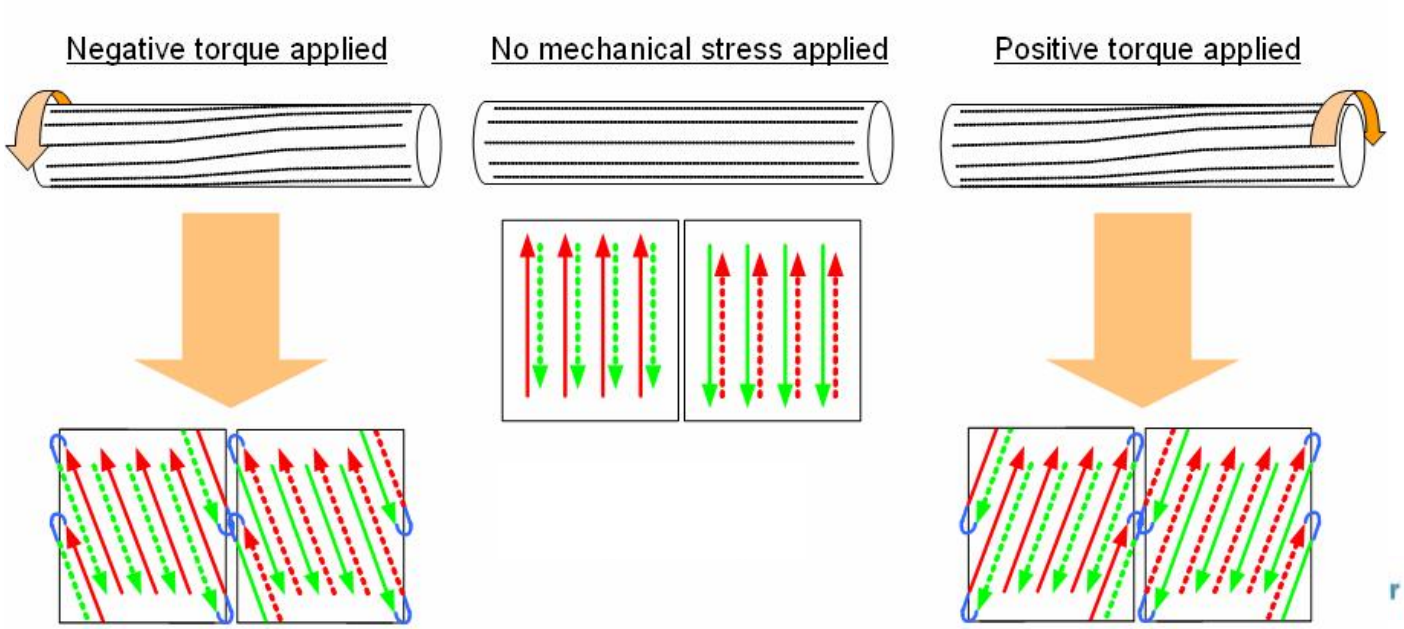
Sensor System

- **Primary Sensor (magnetically encoded region on the shaft)**
- **Secondary Sensor (Magnetic Field Sensor)**
- **SCSP (Signal Conditioning & Signal Processing Electronics)**



Key features of torque sensor

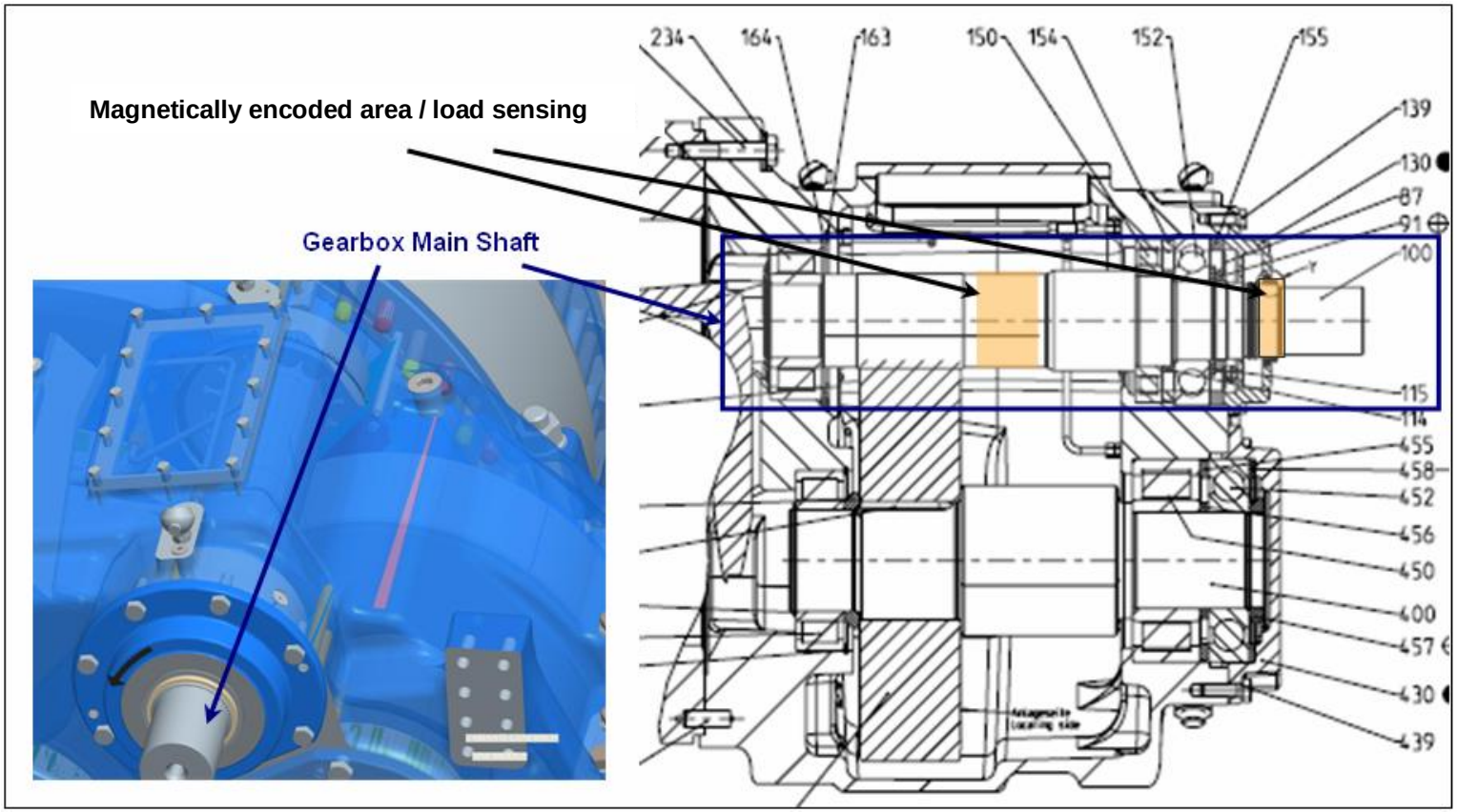
- **True Non-Contact sensing technology**
- **Low system complexity**
- **No mechanical changes are necessary on the existing shaft, nor will anything be attached or glued on the shaft in any way**
- **The shaft keeps all of its mechanical properties when the technology is applied**



Test Phase

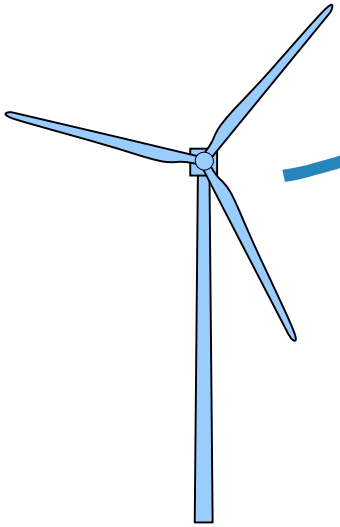
To implement that sensor technology into Winergy gearboxes an intensive test & validation program is currently in process:

A University in Germany and Winergy AG (1.5 MW gear unit)



Planned Use

Feed back loop between gear unit and turbine control system

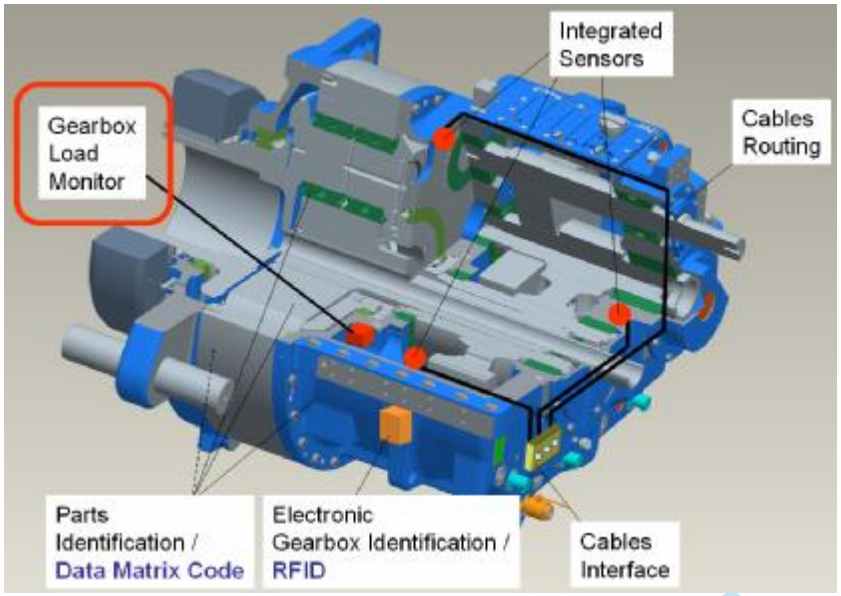


Load Condition etc.

Controller

- **Power**
- **Speed**
- **Wind Speed**
- **Torque**

Improved running condition



Thank you for your time.

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