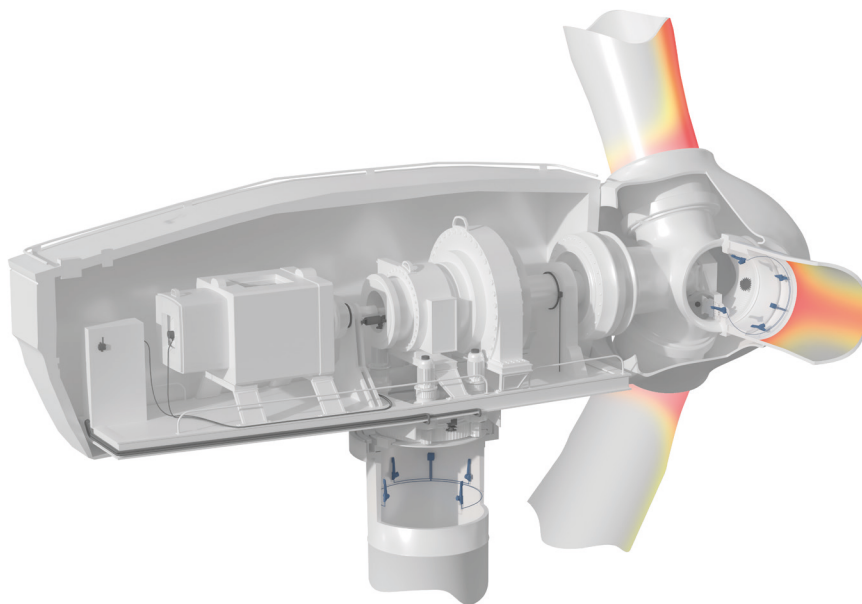


EMS – Elongation Measurement

Robust load measurement for wind power turbines



To increase the efficiency and lifetime of a wind power turbine, the control system needs reliable and fast measurements of the structural loads on rotor blades, machine frame and tower.

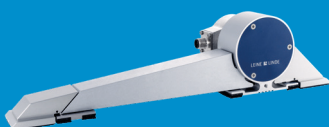
With access to realtime structural loads, you can integrate active load control strategies into the control system to achieve:

- Extended operational lifetime
- Minimized maintenance needs
- Higher energy yield
- Reduced material costs for the main structural components

Sensors and electronics from Leine Linde are built for use in tough environments to minimize the need for maintenance or replacement in hard-to access locations.

EMS, Elongation Measurement System, is designed for flexible integration at different levels:

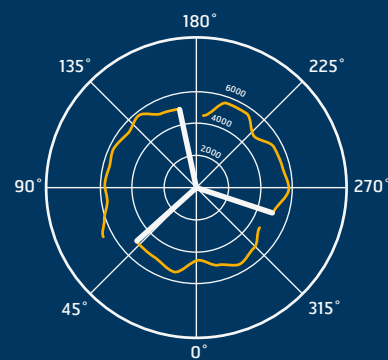
Raw sensor data



Verified sensor and system data



Rotor bending moments

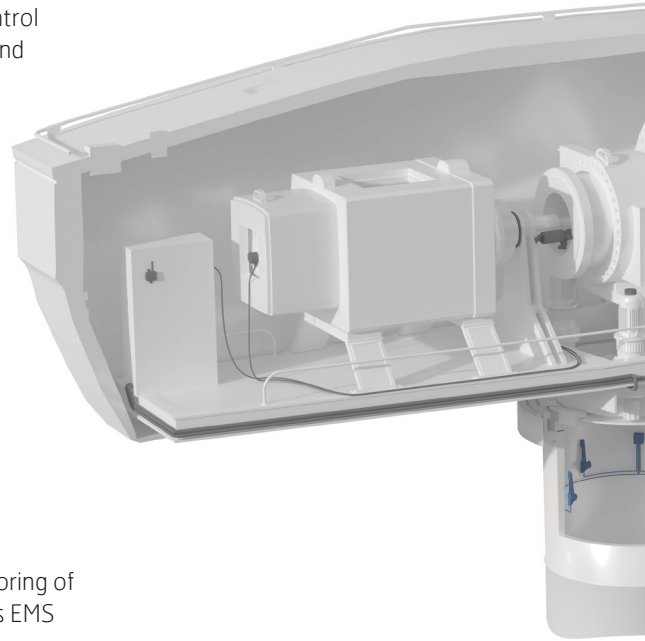


Flapwise bending moment [kNm]

EMS Turbine Load Control

- Reduces the structural loads by up to 10%

EMS Turbine Load Control is an application module which calculates the edgewise and flapwise bending moment of each rotor blade. EMS Turbine Load Control includes both the hardware (strain sensors, gateways and CPU cabinet) and the software needed for input to your load oriented turbine control.



EMS basic modules

- Save years of R&D by using off-the-shelf functional modules

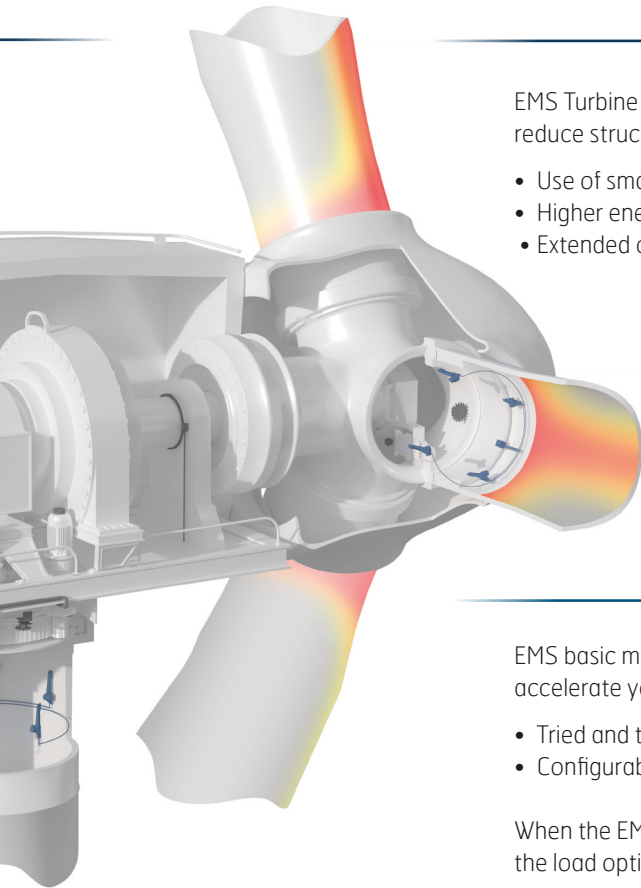
EMS basic modules provides processed and verified data, including monitoring of permissible strain levels, plausibility checks and multipoint calibration. This EMS software comes with a CPU cabinet, including sensors and gateways.

The ESR sensor

- Service life of 20 years and more

The ESR sensor for wind power turbines is based on an industrialized electro-optical encoder, which registers elongation changes in steps of $0.025 \mu\text{e}$ to measure the strain of the material. The easy-to-install sensor has a digital interface which provides real time data and self-diagnostic information.





EMS Turbine Load Control used with load oriented turbine control strategies can reduce structural loads by up to 10% to allow for:

- Use of smaller components and lighter materials
- Higher energy yield
- Extended operational life

EMS basic modules – make use of years of software and system development to accelerate your turbine development:

- Tried and tested software for strain monitoring
- Configurable limits and conditions - no programming required

When the EMS basic modules are used you can concentrate your time and efforts on the load optimized turbine control functionality.



Service life of 20 years and more, thanks to the ESR sensors verified components.

- No surprises during operation due to proven sensor technology
- Patented installation procedure allows significant time savings
- Measurement without signal quality losses and delays
- Passive temperature compensation

Durable components built for tough environments

Sensors and other components from Leine Linde are built for use in tough environments to minimize the need for maintenance or replacement in hard-to-access locations, such as wind power turbines.



Following selection of various tests shows the ability and durability of the ESR sensor and EMS system:

- ESR: Large sensor operating temperature span of -40° to $+100^{\circ}\text{C}$ with IP66 protection (dust tight and protected against direct high pressure jets).
- ESR: Sensor fatigue test with $>10^8$ load cycles at $1500\ \mu\text{E}$
- EMS: Lightning protected in compliance with IEC 61400-24. Testing includes induction testing with lightning currents up to 20 kA/millisecond.
- EMS: Tests of sensor data verification and calculations based on Hardware-In-The-Loop simulations as well as installations on wind turbines.

Implementation support and services

Application specialists are available to support every step of the EMS implementation, from system design and integration of EMS modules and ESR sensors to on-site installation training, testing equipment and support to service engineers.



- System design support, including appropriate hardware placement with setup and suitable system integration practices.
- Installation training, either on-site at the erection site or at the factory where rotor blades and tower sections are produced.
- Testing equipment, to validate sensor functionality after installation and the system functionality before commissioning.
- Training and support for service engineers, including mobile apps and computer systems that can be used for inspection of the strain sensors.

EMS – digital robustness for next generation wind power turbines