



September 18, 2007

Understanding Drive Train Reliability

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Understanding Drive Train Reliability



- Drive Train Functionality
- Operational Dynamics
- Maximizing Life
- Running After Failure
- Allocating Resources
- Going Forward



What does the Gearbox do?

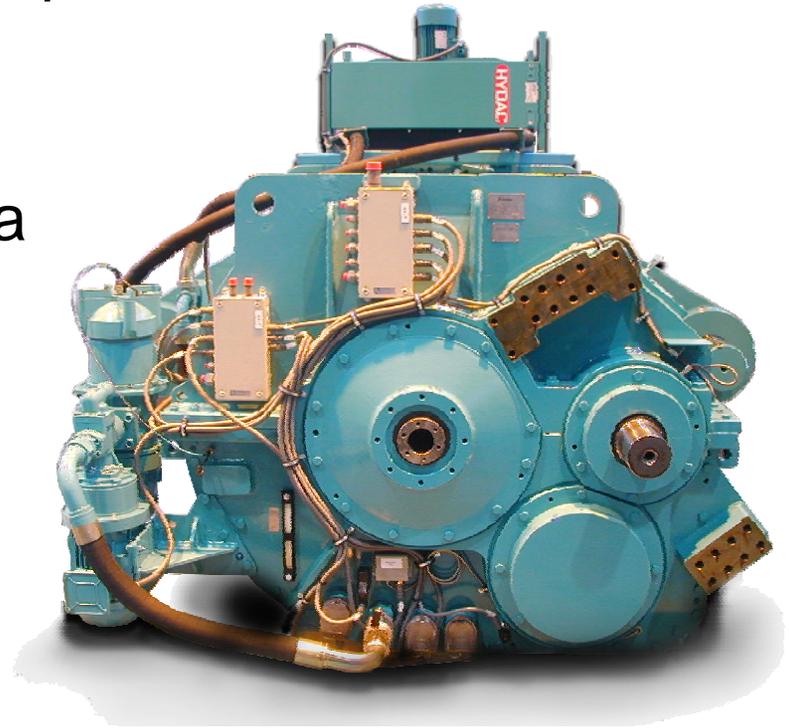
- Converts high torque, low speed rotational energy to high speed, low torque rotational energy
- Mitigates all loads mechanically, both operational & transient, throughout the drive train.
 - Input end torsional loads from random wind conditions.
 - Output end torsional loads from generator loading and unloading.
 - Radial and axial Loads from normal operation and various misalignments.





Why Wind Turbine Drives are Different

- Demand for very high power to weight ratio
- Designed very close to load spectrum
- Operational misalignments
- Driven by a random force
- Relatively little historical data
- Remote maintenance crew



Inside the elusive planetary gearbox...





Planetary Operation

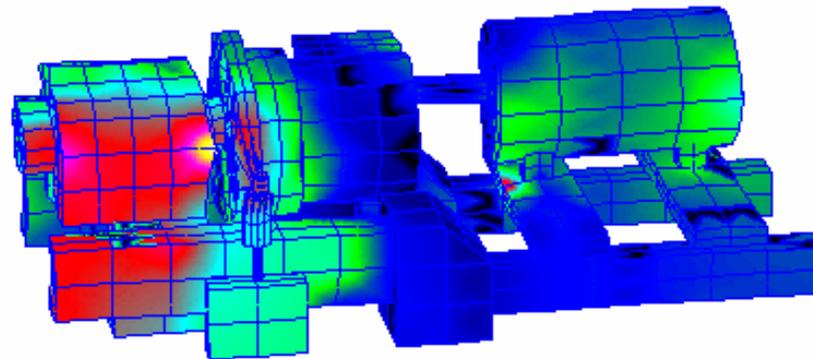
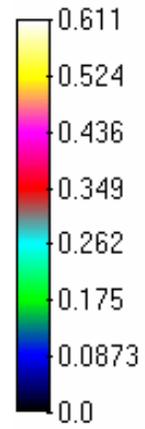


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Operational Misalignments

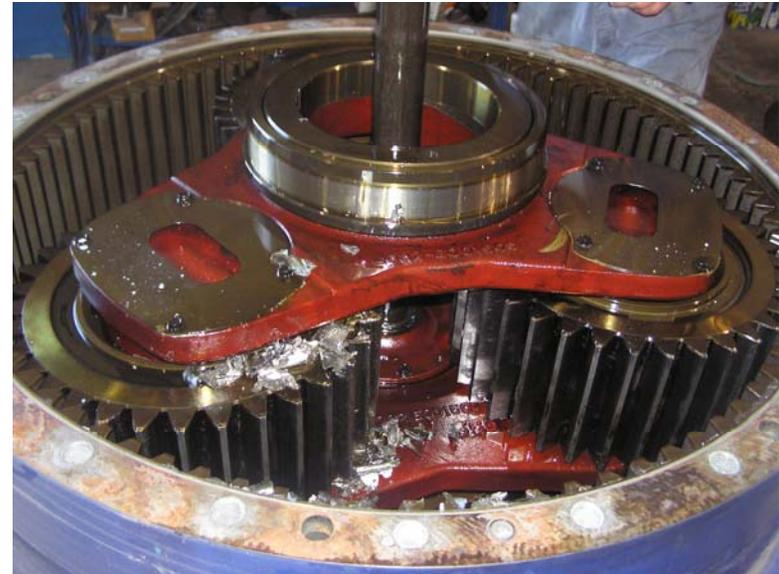
3DView: [Complex] 1 Hz





Maximize Gearbox Life

- Maintain alignment
 - Entire drive train and foundation
- Maintain all components
 - Cooling, torque arms, main bearing, generator, pitch control, PLC
- Maintain oil condition
 - Oil level, samples, filters





Allocating Resources Lifecycle Cost

- Proactive approach
- Early failure detection
- Early removal of failed units
- Spares
- More technicians
- Create and utilize best practices
- Ongoing training for technicians





How long can you to continue to operate after failure?



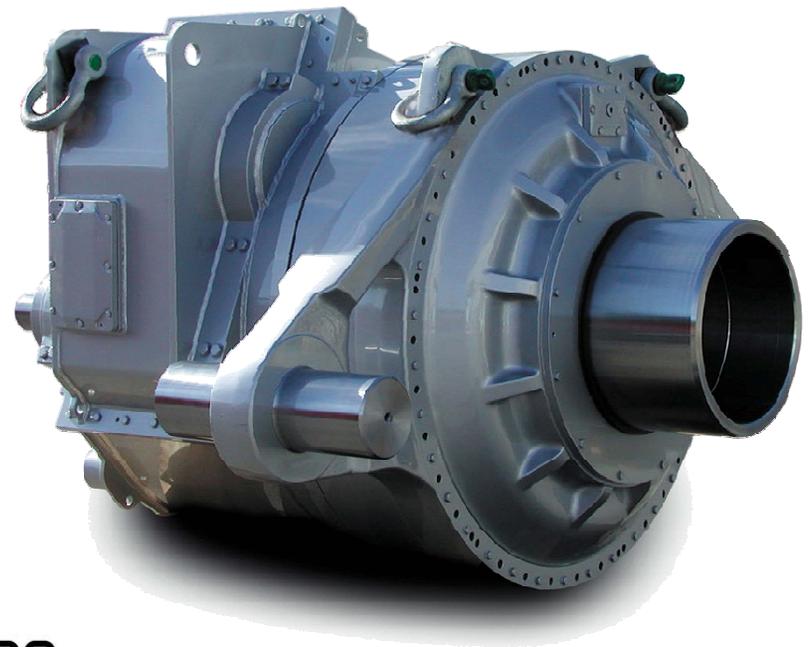
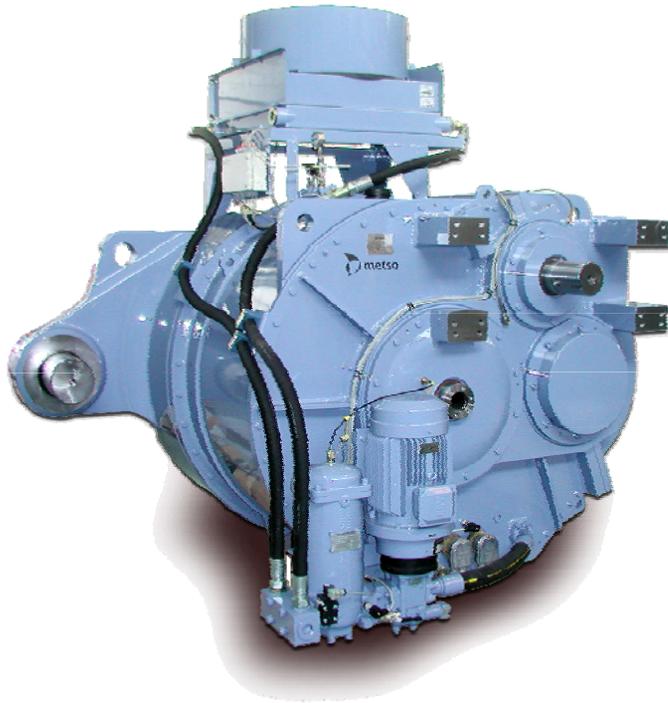
As long as you can afford to!





What's Next?

- Sign up for the AWEA on-line Ecommunity O & M Group
- Sign up for the AWEA O&M Group Gearbox subcommittee
- Post Ideas, Questions and Answers On-Line
- Next O&M Group meeting in conjunction with the AWEA Fall Symposium November 1st & 2nd 2007.



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Thank you for your time and attention!



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