

## NREL Collaborates to Improve Wind Turbine Technology

NREL's Gearbox Reliability Collaborative leads to wind turbine gearbox reliability, lowering the cost of energy.

Unintended gearbox failures have a significant impact on the cost of wind farm operations. In 2007, the National Renewable Energy Laboratory (NREL) initiated the Gearbox Reliability Collaborative (GRC), which follows a multi-pronged approach based on a collaborative of manufacturers, owners, researchers, and consultants. The project combines analysis, field testing, dynamometer testing, condition monitoring, and the development and population of a gearbox failure database. NREL and other GRC partners have been able to identify shortcomings in the design, testing, and operation of wind turbines that contribute to reduced gearbox reliability. In contrast to private investigations of these problems, GRC findings are quickly shared among GRC participants, including many wind turbine manufacturers and equipment suppliers. Ultimately, the findings are made public for use throughout the wind industry. This knowledge will result in increased gearbox reliability and an overall reduction in the cost of wind energy.

Project essentials include the development of two redesigned and heavily instrumented representative gearbox designs. Field and dynamometer tests are conducted on the gearboxes to build an understanding of how selected loads and events translate into bearing and gear response. The GRC evaluates and validates current wind turbine, gearbox, gear and bearing analytical tools/models, develops new tools/models, and recommends improvements to design and certification standards, as required. In addition, the GRC is investigating condition monitoring methods to improve turbine reliability. Gearbox deficiencies are the result of many factors, and the GRC team recommends efficient and cost-effective improvements in order to expand the industry knowledge base and facilitate immediate improvements in the gearbox life cycle.

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**Reference:** Link, H.; LaCava, W.; van Dam, J.; McNiff, B.; Sheng, S.; Wallen, R.; McDade, M.; Lambert, S.; Butterfield, S.; Oyague, F. *Gearbox Reliability Collaborative Project Report: Findings from Phase 1 and Phase 2 Testing*. 88 pp; NREL Report No. TP-5000-51885.



*The GRC gearbox has a low-speed planetary stage and two parallel stages. Illustration by Ed Hahlbeck, Powertrain Engineering for NREL*

### Key Research Results

#### Achievement

NREL completed Phase 1 and Phase 2 testing in the GRC project and published the "Gearbox Reliability Collaborative Project Report: Findings from Phase 1 and Phase 2 Testing."

#### Key Result

NREL and other GRC partners have identified shortcomings in the design, testing, and operation of wind turbines that contribute to reduced gearbox reliability. Testing of the GRC gearboxes in the first two project phases has provided important data under real operating conditions for the development of test methods and processes for wind turbine dynamometer testing.

#### Potential Impact

Field and dynamometer data from the nonproprietary GRC gearbox design can be made publicly available, which is an unprecedented resource for industry. Results can be used by gearbox modelers for analyses and complex model validations to better define gearbox design processes and validate predicted fatigue loading.