

Quick Facts

In 2007, NREL initiated the Gearbox Reliability Collaborative (GRC), which brings together wind turbine manufacturers, owners, researchers, and consultants to develop improved processes for the design, testing, and operation of wind turbines to increase gearbox reliability.

The GRC includes such major wind turbine manufacturers as Gamesa, GE Wind, and Vestas Wind Systems, as well as wind project developers such as AES Wind Generation, EDP Renewables, Iberdrola Renewables, and Terra-Gen Power.

Wind farm operators have reported that the general level of gearbox reliability has grown since the GRC was established, with the mean time between failures increasing from 5 years to 8–10 years today.

The GRC has led to improvements in gearbox design standards and bearing analysis methodology, resulting in better gearbox designs.

The latest iteration of the GRC gearbox design, based on a representative wind turbine gearbox, is projected to triple the operating lifetime of the gearbox from 3.5 years to 12 years.

NREL Collaborative Improves the Reliability of Wind Turbine Gearboxes

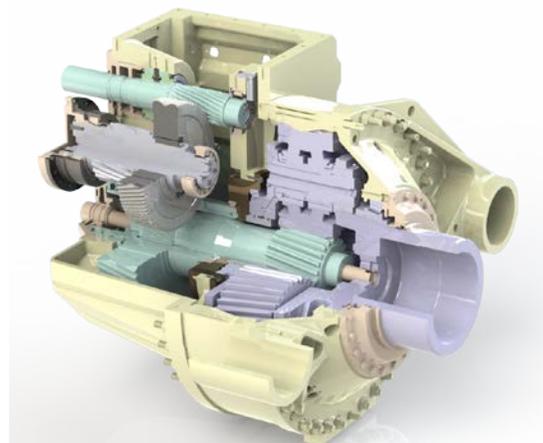
Gearbox failures have a significant impact on the cost of wind farm operations. To help minimize gearbox failures, in 2007 the National Renewable Energy Laboratory (NREL) initiated the Gearbox Reliability Collaborative (GRC), which consists of manufacturers, owners, researchers, and consultants. The GRC was funded by the Office of Energy Efficiency and Renewable Energy at the U.S. Department of Energy.

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. The GRC 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 develop improved processes for the design, testing, and operation of wind turbines to increase gearbox reliability. In contrast to private investigations of these problems, the GRC quickly shares its models, data, and findings among its participants, including many wind turbine manufacturers and equipment suppliers. Ultimately, the findings are made public for use throughout the wind industry. This knowledge is resulting in increased gearbox reliability and an overall reduction in the cost of wind energy.

The GRC started with a representative gearbox design, which was then redesigned to the best industry standards as of 2007. Two heavily instrumented gearboxes were built based on this design. One was mounted in a wind turbine and tested in the field, while the other was tested on a dynamometer, which simulates the loads experienced by a typical wind turbine, but on a compressed time scale. This effort built an understanding of how selected turbine loads and operational events translate into bearing and gear responses.

Based on all the lessons learned from the past five years, the GRC has now produced a new and improved design, which is projected to yield an operating lifetime of 12 years, more than triple that of the previous redesigned gearbox. This new design, shown in the illustration below, will be built and tested in the same way as the previous iteration, and again, all results will be shared first with the GRC members and eventually made public.



To demonstrate improvements in gearbox designs, the GRC chose a representative gearbox design consisting of a low-speed planetary stage and two parallel stages. This gearbox has now been redesigned twice, and the latest version, shown here, is projected to triple the average operating lifetime
Illustration from Romax Technology

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