



# US National Renewable Energy Laboratory - NREL

## *Romax Expertise and Technology Supports an Essential National Resource for Wind Energy*

### Client

The National Renewable Energy Laboratory (NREL) is the U.S. Department of Energy's primary national laboratory for R&D activity focused on renewable energy and energy efficiency. Romax' client is NREL's wind energy research and development division; the National Wind Technology Center (NWTC) near Boulder, Colorado.

### Challenge

The NWTC's challenge in the area of wind turbine drivetrains is to support the industry to minimize the cost of wind energy by maximizing efficiency and reliability, providing state-of-the-art testing facilities and investigating innovative solutions for future designs.

### Solution

Romax has provided local hands-on presence and flexible delivery of simulation, instrumentation and design expertise, including use of *RomaxWIND* software and consulting insights to support essential R&D activities across multiple areas.

### Benefits

Romax has contributed to the NWTC's activities by delivering innovative drivetrain designs, collaborating to understand gearbox failures and developing improvements in industry design practices.

With annual funding of more than U.S. \$270 million, a 327-acre main campus site and the 300-acre National Wind Technology Center near Boulder, Colorado, the National Renewable Energy Laboratory (NREL) is the U.S. Department of Energy's (DOE's) primary national laboratory for research and development into renewable energy and energy efficiency. With 1,600 full-time employees and almost 700 visiting researchers, interns and contractors, the laboratory has a successful history of partnering with other leaders in industry, academia and government to support its multiple research programmes. "We've been working with NREL for six years in key areas, notably the Gearbox Reliability Collaborative and the Next Generation Wind Turbine Drivetrain project," says Chris Halse, Romax's Head of Engineering Services. "For both projects Romax has provided gearbox design and instrumentation services, and supported tests carried out in NREL's dynamometer."

### Gearbox Reliability Collaborative

With gearbox failures having a significant impact on the cost of wind farm operations, NREL initiated the Gearbox Reliability Collaborative (GRC) in 2007. Funded by DOE's Office of Energy Efficiency and Renewable Energy, the GRC brings together manufacturers, owners, researchers and engineering experts to recommend efficient and cost-effective improvements in the gearbox lifecycle. As part of the GRC, NREL was running an extensive test campaign on a wind turbine gearbox, both in the field and using its dynamometer. The Romax simulation team contributed to the analysis group, comparing models with the test results. "We carried out a successful validation project comparing test data to a gearbox simulation model created using *RomaxWIND* software," says Chris Halse. *RomaxWIND* was specifically created to enable analysis, optimization and certification of wind turbine drivetrains. The model considers the interactions between all drivetrain components, with the aim of delivering Right First Time™ designs to minimize expensive prototype failures, either when beginning a design, or when required to redesign an existing gearbox that has not performed to expected standards. Halse continues, "We also led the redesign work for the GRC gearbox phase 3, based on lessons learned from the earlier phases, and to allow further testing. This included designing the instrumentation package and supporting the gearbox manufacture. The gearbox is due to be tested in the NREL dynamometer in mid 2015."

The extensive testing and comparison against design assumptions carried out during the GRC has led to a considerable improvement in the understanding of gearbox failures and corresponding design practices to address these failures. The redesign efforts on the phase 3 gearbox carried out by Romax will be used to demonstrate these design methodology improvements.

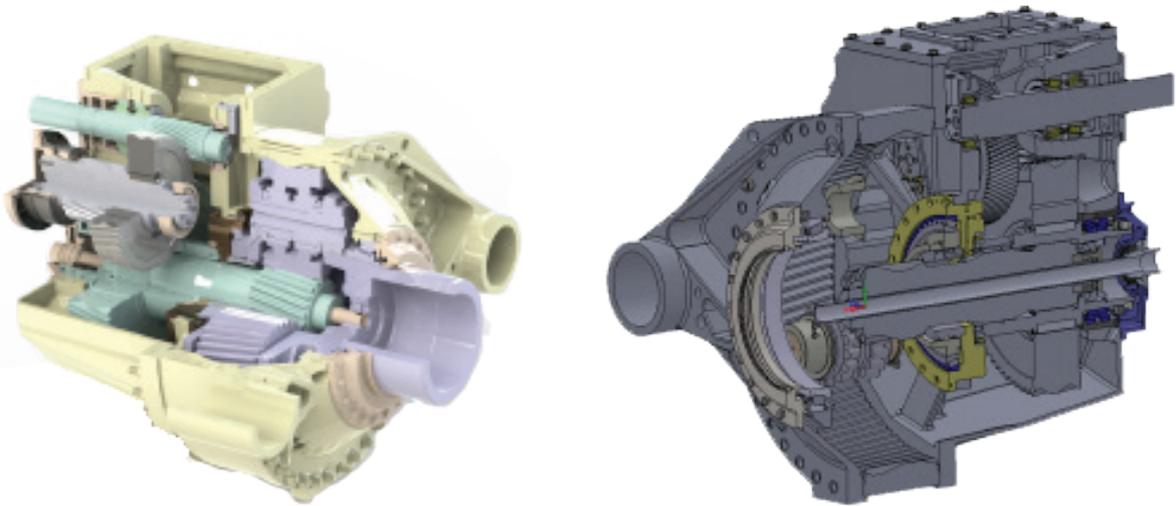


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**Dr. Ashley Crowther,**  
Global VP - Insight at Romax

### **Next Generation Drivetrain: Reducing the Cost of Wind Power**

Romax is also the mechanical engineering lead on a U.S. \$3 million project to develop an innovative new wind turbine drivetrain: the Next Generation Wind Turbine Drivetrain consortium. The team also includes CREE, DNV, and Vattenfall Windpower. "There have been reliability concerns with traditional high-speed gearbox designs resulting from the impacts of large and unpredictable loads imparted on the gears and bearings," says Jon Keller, Senior Engineer - Wind Innovation & Reliability Group, NREL. "These types of loads are caused both by the wind acting on the rotor and by utility faults acting on the wind turbine gearbox through the generator. We are striving to address these factors and others through the consortium. We have every confidence that all the parties involved will play a significant role in improving the drivetrain's overall efficiency and reliability."



Phase 3 Redesign of GRC Gearbox

The consortium initially studied advanced drivetrain technology that could be scaled up for large wind turbines and reduce the cost of wind power. The team's concept will scale to ratings as high as 10 MW whilst maintaining the lowest possible costs. The Romax gearbox design consists of a single planetary stage that reduces part numbers by eliminating higher speed gear stages, including the use of planet journal bearings to minimize planet stage size. "We've been involved since 2011, when we were chosen as part of an NREL team that competed against six other groups to conduct a study of advanced drivetrain technologies," says Halse. "Our team was one of only two awarded funding for a follow-on phase to build a prototype and demonstrate the commercialization of the technology. Phase 2 gives us the opportunity to fabricate and test a megawatt-scale prototype to prove our design innovations." The drivetrain will be tested in NREL's dynamometer, using a newly commissioned Controllable Grid Interface to replicate the loads wind turbines undergo in the field, followed by a commercialization plan to integrate the novel design features into commercial designs.

Speaking about their continued work with NREL, Dr. Ashley Crowther, Global VP - Insight at Romax, said, "We have been delighted to help NREL on a range of projects so far. Our long-standing collaborative working relationship over the years is a clear indication of Romax's commitment to driving innovation in the wind energy industry."



To find out more

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