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Independent Test Facilities for Large Wind Turbine Gearboxes

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INTRODUCTION

The development of competitive wind turbines demands an optimized balance among cost, reliability and maximum power capture. Specific Wind turbine gearbox development has greatly contributed to pursue that objective, but the current trend towards more challenging operating conditions calls for effective validation processes, both for new prototypes and repaired systems.

CENER has focused in the development of test set ups and procedures for large wind turbine gearboxes in order to prove their robustness before commissioning.

In order to prove gearbox design robustness for determined operational conditions, customer specific validation methods may be implemented into the test plans. If realistic operation can be estimated, it is possible to establish progressive compressed life tests with synthetic duty cycles that may shorten product validation time considerably.

Our customers may also benefit from our support with full independent assessments on wind turbine loads, component strength calculations and insights from our past experience. This may allow more in-depth verifications than with standard test procedures.

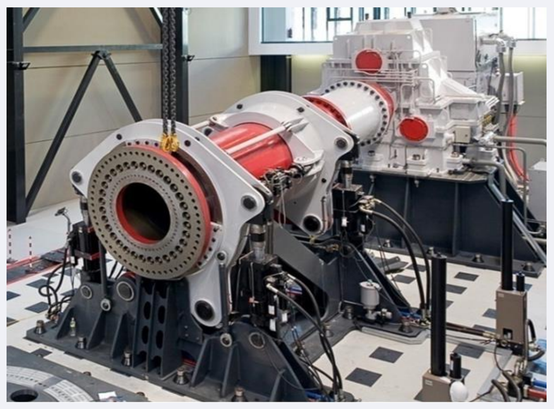
ANSWERING MARKET DEMAND

CENER objective is to provide the wind sector an independent verification of gearbox robustness both for realistic dynamic behaviours and extreme loading conditions. In our facilities, different subsystems may also be validated for challenging environments, e.g. oil distribution to bearings and gears.

Measurements of structure and projected noise may be continuously analyzed running at low load, nominal load and overload, proving different solutions for achieving no tonalities.

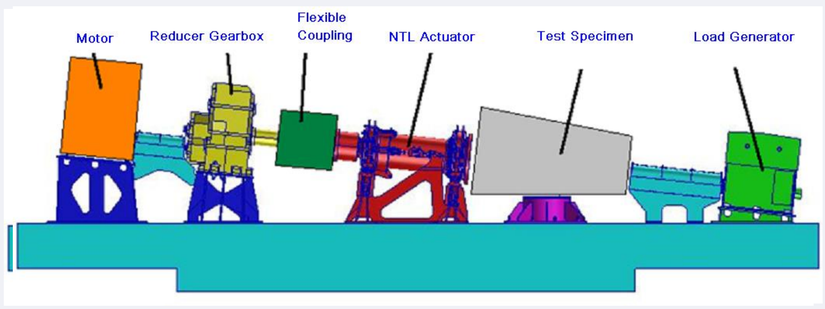
Multibody dynamic simulations of test rig and the specimens under test may be used for deeper understanding and better control of test executions.

Condition monitoring equipment and borescope inspections may be provided for helping develop effective preventative failure analysis..

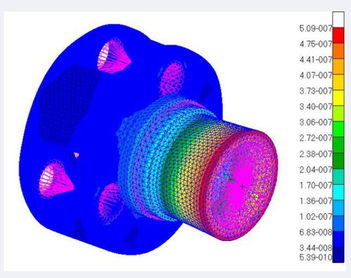


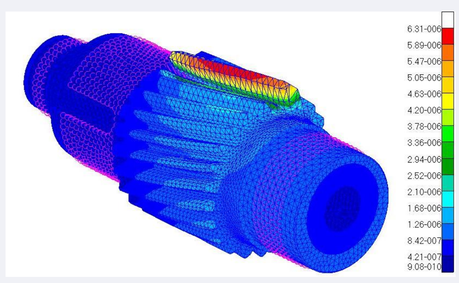
ADVANCED RIGS AND TEST METHODOLOGIES FOR GEARBOXES

CENER is committed to support the Wind Power Sector with a focused alignment of its laboratory facilities with the latest developments in tests methodologies that pursue the assurance of full component fucntionality during the whole operational life of a Wind Turbine.

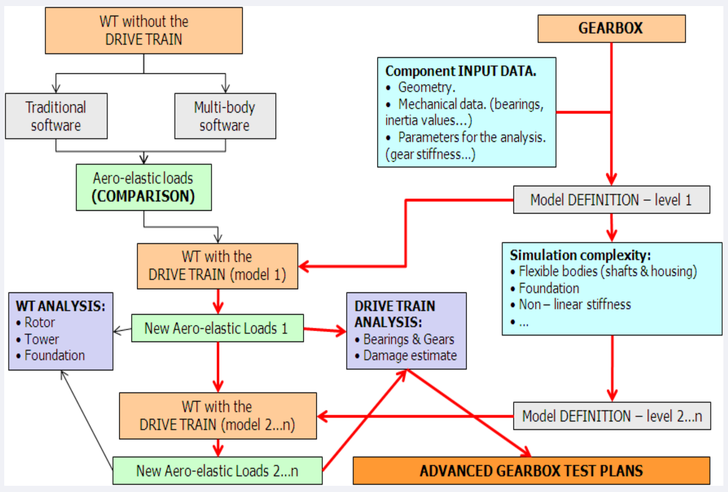


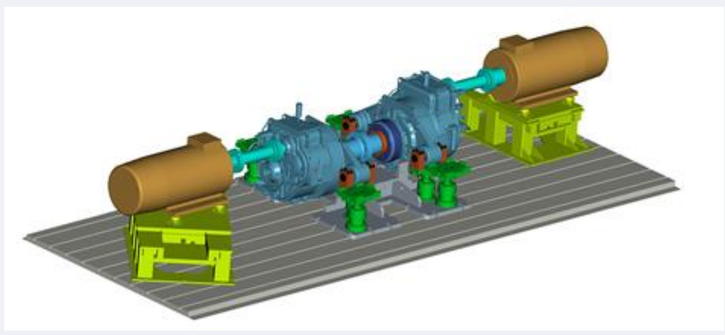
Pioneer in Drive Train test benches with 6 DOF and NTL Actuators, CENER has demonstrated the implementation of complex test cycles modelling aeroelastic loads calculated with non linear blade deflections, coupled torsion and bending modes, flexible transmission components made of complex elements, feed forward control strategies, and transient grid conditions.

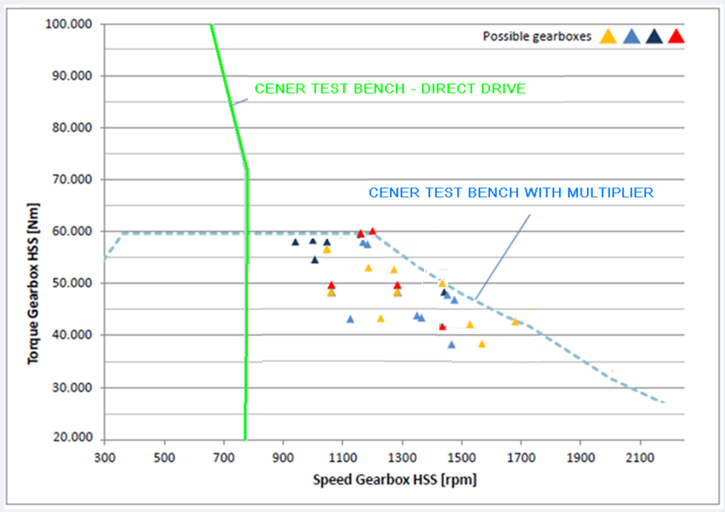




The results of testing mechanical transmissions in such test rigs with the appropriate methodology are of great value for development of meaningful condition monitoring, accurate estimations of accumulated damage ,and effective and component diagnosis.

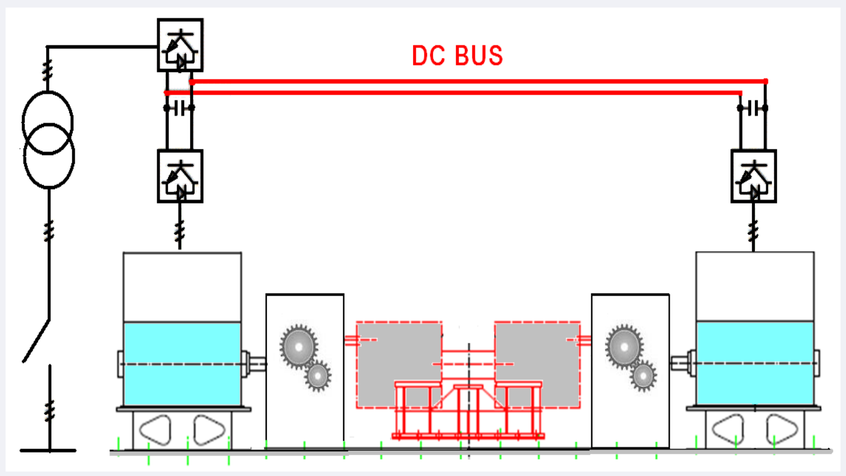






Lessons learned may also be applied to more conventional Back to Back testing of Gearboxes, which is a effective way of dealing with high load torque and allows testing two specimens simultaneously.

Nowadays test rigs with electrical close loop are not only energy efficient, but also the power electronic converters allow continuous regulation of motoring and load providing a wide range of test envelopes (T-S).



The flexibility to input a wide range of test performance settings may also enable in these rigs the implementation of complex test plans with synthetic duty cycles that may compress not only expected operating conditions, but also critical events such as start-stops, torque reversals, low voltage ride through or grid losses.

Also without any physical changes it is possible to revers the motor and generator roles to compensate evely the wear in the two gearboxes under test.

Summary

Independent test facilities that may flexibly apply a wide range of advanced test procedures can make an important contribution to product development , operational reliability and market competitiveness guaranteeing the robustness of both new and repaired gearboxes for large wind turbines.

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