

The Future of Main Bearing Technology not only for Multi MW applications

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Summary

Wind turbine generator sets for multi- MW applications become larger and larger. Further reduction of LCOE is closely linked to an increase of per unit size and enhanced industrialization based on a larger number of non-variety parts. This development directly influences the technology of main bearings of wind turbine generator sets, which also have to fulfil a number of application dependent technical requirements. Vice versus, the main bearing characteristics may significantly influence and interfere with the components of the drive train system.

This publication illustrates the determining factors of main bearing design of different drive train topologies and discusses the need for optimizing on concurrent requirements. Economic and technical comparisons assessing the pros and cons of the different designs are presented. Based on this evaluation, a novel main bearing concept has been created and developed in order to meet both, the economic and technical requirements of this industry. This technology may serve as an enabler for an enhanced industrialization of wind turbine designs providing a significant higher specific load capacity, having reduced statistical and early (e.g. white etching crack) failure possibilities and adding significant damping to the drive train system.

1. Economic and technical requirements

As fundamental technical requirements for main bearings, the forces and moments have to be transmitted reliably over a wide range of load occurrences. Normal and exceptional operation conditions have to be transferred and shall not jeopardize the expected life time of 20 or even 25 years. However, maintenance shall be minimized. The stiffness of the system shall be sufficiently high in order to minimize absolute and relative displacements and safely generate current. On the other hand, the bearing design shall be non-sensitive with regard to stiffness and stiffness variations of the companion structures.



Fig. 1: Taper roller main bearing (momentum bearing - tk Rothe Erde)

This publication gives an overview on the design characteristics and limiting criteria for different drive train topologies with special focus on large size components.

In addition, intensive cost analyses of different drive train topologies have been performed. A parametric model has been worked out which allow comparing different solutions and determine the most cost effective system layout for a given technical task.

2 Next generation main bearing technology

On the one hand, the main bearing size may become the limiting factor for ultra large wind turbine components. On the other hand, drive trains consisting of a larger number of non-variable parts may have significant advantages with regard to costs, logistics, development schedules and quality.

These arguments led to the development of a novel bearing concept. The combination of a fluid-film and a roller bearing is presented, which is designed to transmit very high loads. The solution is non-sensitive with regard to movements or displacements of large components. The combination of both, fluid-film and roller bearing add the advantages of both, stiffness and reliability and reduce or even exclude the disadvantages like limited life time, statistical probability of failure and susceptibility to damage e.g. in case of deficient lubrication or high component distortions. Based on this concept, the "mechanical" drive train layout could be kept constant within a wide range of load spectrum, assigning the variety of parts to the fluid film bearing only.

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3. References

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