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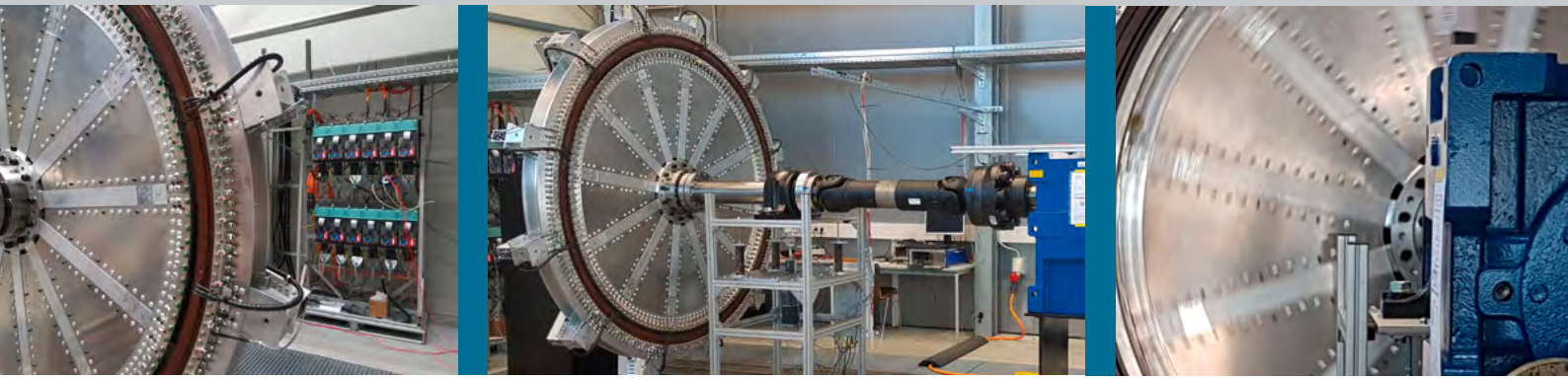

RING-GENERATORS FOR HIGH POWER APPLICATIONS

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New concepts for Ring-Generators

Lightweight Ring Generators can be used for several applications. A highlight is the construction and electromagnetic layout of the generator for gearless wind turbines >10 MW. For the proof of concept we set up a test bench to test our scaled demonstrator generator and its control. Improving the lifetime and reducing maintenance are taken into account.

The Challenge

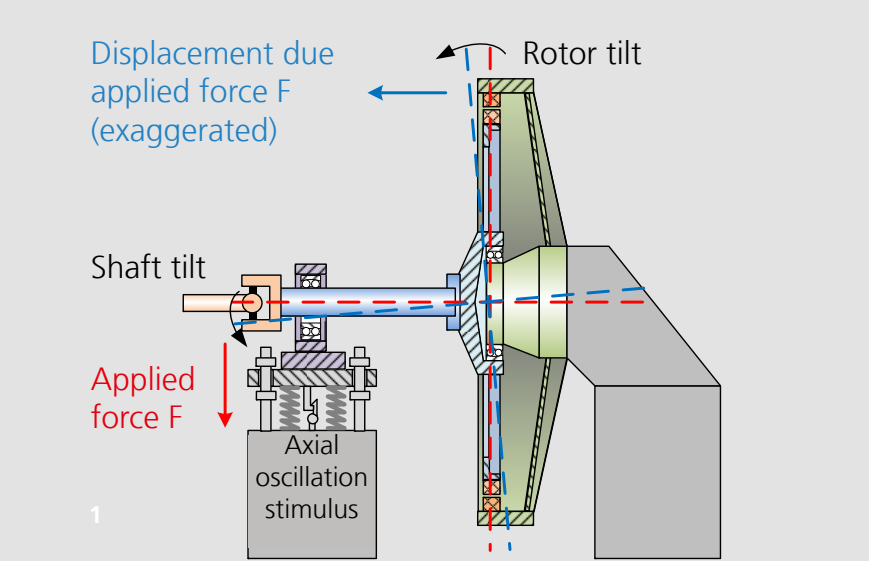
One of the challenges for high power wind applications is to reduce the weight of the nacelle related to constructional issues. One option is to increase the diameter of the generator and the pool-pairs [1]. So a high torque by low speed can be reached. To enlarge maintenance intervals the generator was segmented.

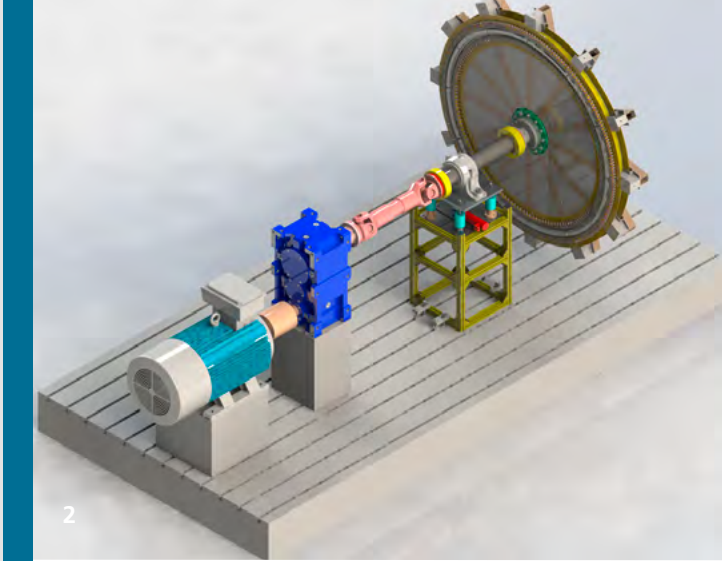
This approach is realized by a distributed converter concept and control [2] to manage malfunctions by upholding most of the power generation.

A distributed power electronic converter design put us also in the position to enlarge the systems lifetime by damping axial oscillations of the generator which are triggered e.g. by gusts of wind [3].

Highlights

- Lightweight design
- Gearless high power applications
- Extended maintenance intervals due to distributed electrical design and control
- Extended lifetime due to axial oscillation control





Technical Data	10 MW Generator	Demonstration Generator
Diameter	15 m	2 m
Air gap length	15 mm	5 mm
Rated output power	10 MW	175 kW
Current density	5 A/mm²	5 A/mm²
Number of identical stator segments	48	12
Air gap flux density (fundamental wave amplitude) at no-load operation	0.82 T	0.82 T
Rotational speed	10 rpm	50 rpm
Active mass / inactive mass	34,1 t / 62 t	428 kg / 185 kg

1 *Generator with oscillation table for axial displacement*

2 *Components of the test bench*

The test bench

We can test up to 250kW machines and generators in our test bench. The clamping plate has a 3 m x 6 m surface where we can set up several test and measurement equipment.
Further we installed an accessory in the drive train to displace the machine shaft. Additionally springs are installed to stimulate oscillations of the shaft.
For safety reasons we operate the whole test in a separate control room remotely.

Benefits

For companies we offer engineering services in simulation, development and tests. Electrical generator/machine layout, the complete converter development including programming as well as the simulation of systems are our portfolio.

Ask for further information to benefit from our experience!

Literature

[1] C. Stuebig, A. Seibel, K. Schleicher, L. Haberjan, M. Kloepzig, and B. Ponick, "Electromagnetic design of a 10 MW permanent magnet synchronous generator for wind turbine application," in International Electric Machines and Drives Conference, Coeur d'Alene, ID, USA, 2015

[2] A. Seibel, C. Stübig, M. Wecker, J. Steffen, K. Kandasamy, A. Mertens, S. Nielebock, "Distributed Control of a Multi-Pole Permanent Magnet Synchronous," 18th European Conference on Power Electronics and Applications (EPE'16 ECCE Europe), Karlsruhe, Germany, 2016.

[3] C. Stuebig, L. Haberjan, A. Seibel, J. Steffen, F. Thalemann, M. Wecker, B. Ponick, "Segmented Permanent Magnet Ring Generator with Active Damping of Axial Oscilla-tions," XXII International Conference on Electrical Machines (ICEM), Lausanne, Switzerland, 2016