

## In this Issue

From the Research Department	2
Investigation into Electromechanical Loads on Wind Turbine Generators	2
News from the Test Bench	2
PRONOWIS – WEC research at CWD	2
Workshops	3
ZF Friedrichshafen Holds Development Management Meeting at CWD	3
6 <sup>th</sup> CWD Workshop	3
Events	3
Good Prospects for the Conference for Wind Power Drives	3
Spotlight	3
Wind Turbine System Test Benches Create Transatlantic Connection	3
CWD at Torque 2016	3

## Snap-Shot



The FVA nacelle is used amongst other things to investigate electromechanical loads on the generic wind turbine generator. The aim is to develop a structurally dynamic complete model of the generator (see page 2).

## Editorial

Dear partners and friends of CWD, dear readers,

we are happy to welcome you to the new issue of CWD News. As we announced in the last issue, the FVA nacelle has now been assembled and installed on our system test bench. Over the last few weeks it has started operating and the application and testing of measuring technology has also been carried out. Then, at the end of September 2016, the measuring campaign finally started. We are confident that we will be able to present initial results at the Conference for Wind Power Drives in Aachen in March 2017. The preparations for this CWD event are already in full swing. We look forward to being able to welcome you there personally.

The system test bench is furthermore used for developing and validating sensors for early detection of White Etching Cracks in wind turbine generators rolling bearings. This is carried out within the recently started project PRONOWIS.

The academic teaching activities at CWD are being met with much interest amongst the student population of the RWTH. This year we registered a large number of degree theses at the CWD institutes. So far, in the short time since the Center was founded, more than 50 final papers have been overseen.

We hope you find reading this current issue of the CWD News interesting.

Furthermore we hope to see you again soon in Aachen.

Yours,  
Kay Hameyer

PS: If you have not already subscribed to the newsletter and are interested in doing so, please click on the following link: [www.cwd.rwth-aachen.de/aktuelles/newsletter/](http://www.cwd.rwth-aachen.de/aktuelles/newsletter/).

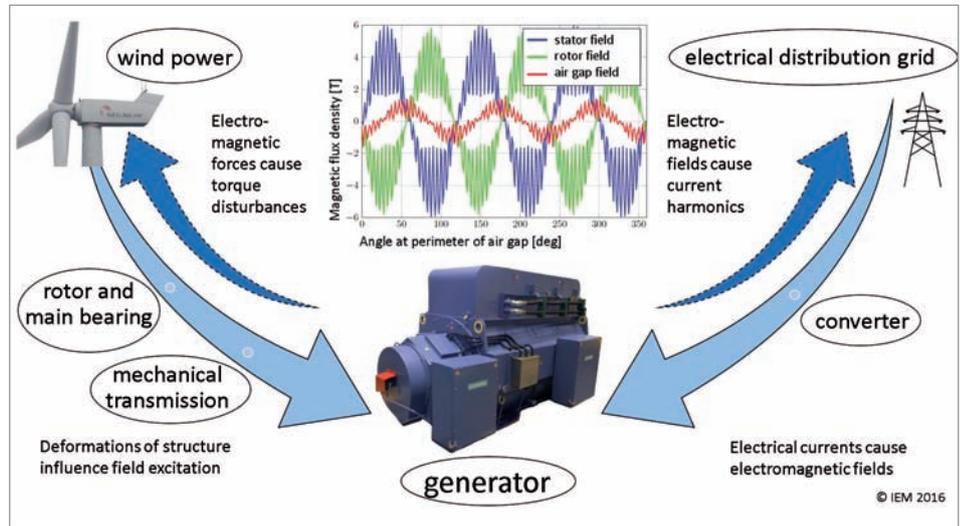
## From the Research Department

### Investigation into Electromechanical Loads on Wind Turbine Generators

Within the scope of current research at CWD the collaborating institutions are investigating the interaction of dynamic effects in the individual components of the overall wind turbine generators drive train. Various numerical models are being developed in order to evaluate the physical effects. The combination of these models generates a complete wind turbine model with which both mechanical and electrical questions, such as fault ride through scenarios (see CWD News 1/2016), can be investigated.

In order to answer questions on drive train dynamics, it is necessary to generate a detailed model of the generator with the respective upper field models, taking into account parasitic effects. The FVA nacelle project uses an asynchronous machine with slip ring rotor as the generator. It is connected to the supply grid by a full-scale converter. For the purposes of modelling, the rating plate data and design parameters of the generator – geometric data of the magnetic circuit, winding data and equivalent circuit diagram variables – are gathered and integrated into a two-dimensional analytical generator model. This generator model transfers the induced voltages from the stator and rotor windings into a system of differential equations. The solution of this system of equations provides the electrical and mechanical variables which have to be calculated for dynamic operation of the wind turbine.

The geometrical structure of the magnetic circuit, the electronic grid connection and the mechanical properties of the wind turbine can create unwanted force excitations which cause vibrations in the overall system. A complete structurally dynamic model of the generator developed at CWD illustrates these forces. Electromagnetically excited mechanical vibrations can thus be detected and evaluated early. The aim is to minimise these types of vibrations and the



associated noises in the drive train. The results of the test bench measurements

are used to check and successively refine the generator model.

## News from the Test Bench

### PRONOWIS – WEC research at CWD

We are proud to announce that once again a project developed within our biannual CWD-Workshop started with a kick-off event on the 3rd of November. PRONOWIS, a project for holistic wind turbine generator optimization by utilizing innovative sensors was introduced.

In addition to the Chair for Wind Power Drives, the companies Schaeffler GmbH, Hydac International GmbH, Fuchs Lubritech GmbH, Qass GmbH, Qiagen GmbH and the Central Facility for Electron Microscopy



are involved. Within PRONOWIS the phenomenon of White Etching Cracks (WEC) is further investigated under the leadership of Schaeffler GmbH. The term WEC refers to a premature rolling bearing failure mechanism that manifests itself as white cracks detected by etching.

In order to identify damage-relevant operating conditions for rolling bearings within wind turbine gearboxes a big data approach is used to analyse field data. To be able to assess WEC-bearing failures from a material perspective, bearing test-benches are equipped with new sensor systems. Consequently sensor signals can be related to damage-relevant structural changes. Finally the developed sensors are applied to the FVA nacelle on the 4 MW system test bench in order to validate it in real application. Thereby sensors for early detection of WEC critical operating conditions are developed and validated.

## Workshops

### ZF Friedrichshafen Holds Development Management Meeting at CWD

At the beginning of October the company ZF Friedrichshafen held its development management meeting on CWD premises in Aachen. Alongside intensive internal coordination measures, a consolidation of cooperation with CWD was on the agenda. Current developments with CWD projects in which ZF is involved as an industrial partner were presented and debated as the basis. Furthermore, subjects for the future combined research and development work, on which CWD and ZF can collaborate, were identified.



### 6<sup>th</sup> CWD Workshop

The large number of attendees at the 6<sup>th</sup> CWD workshop, which once again sold out, underlines how well this biannual gathering has already established itself in the sector. A good 50 experts from academia and business got together at CWD to debate current technical issues and possible solutions, and identify potential research activities. The main themes of rotor/light-weight construction, furthermore system simulation of wind turbines and certification of system test benches were eagerly discussed and debated. The event was held for the first time with the close cooperation of the Institut für Strukturmechanik und Leichtbau (Institute for Structural Mechanics and Lightweight Construction (SLA)) of the RWTH Aachen in order to bring the expertise of the Aachen institution of higher education in the field of wind energy further together.

## Events

### Good Prospects for the Conference for Wind Power Drives

On 7<sup>th</sup> and 8<sup>th</sup> March 2017 the wait will finally be over: Aachen hosts top-class academics from Germany, Europe and the USA where they will converge to get to grips with the latest developments in the use of wind energy. Within the scope of the Conference for Wind Power Drives (CWD 2017) current research knowledge and demands will be presented and debated. Focus is on the drive train of wind turbines. Furthermore, renowned OEMs, bearing and gear unit manufacturers as well as businesses with a focus on structural mechanics and material engineering will be contributing to an interesting programme with their own presentations.

CWD 2017 is an excellent platform for the international exchange between industry and research. The evening event at the historical coronation room of the Gothic Aachen town hall will no doubt also offer numerous opportunities.

There is still a chance to appear as sponsor of CWD 2017. Interested parties can also reserve an attractive location for their presence at the trade exhibition which accompanies the conference. Conference attendees who register by 16.12 will receive an early bird discount.

## Spotlight

### Wind Turbine System Test Benches Create Transatlantic Connection

Dr. Andrei Mander (in the middle of the picture) of the Energy Innovation Center of the Clemson University in the USA has taken advantage of his visit to Germany to share experiences in the handling of wind turbine

system test benches. Just like the CWD, the Energy Innovation Center also has two wind turbine system test benches.



### CWD at Torque 2016

The Center for Wind Power Drives was represented at this year's TORQUE – the world's largest wind conference 2016 – with seven contributions. Presentations and posters on the themes of drive trains, testing, aerodynamics and turbine control show how the Center has already positioned itself.

## Disclaimer

### CWD | Center for Wind Power Drives

ACS | Institute for Automation of Complex Power Systems  
Prof. Dr.-Ing. Antonello Monti

AIA | Institute of Aerodynamics  
Prof. Dr.-Ing. Wolfgang Schröder

CWD | Chair for Wind Power Drives  
Prof. Dr.-Ing. Georg Jacobs

IEM | Institute of Electrical Machines  
Prof. Dr.-Ing. habil. Dr. h. c. Kay Hameyer

IRT | Institute of Automatic Control  
Prof. Dr.-Ing. Dirk Abel

PGS | Institute for Power Generation and Storage Systems  
Prof. Dr. ir. Dr. h. c. Rik W. De Doncker

WZL | Laboratory for Machine Tools and Production Engineering  
Prof. Dr.-Ing Christian Brecher

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