



Electrical Certification of Wind Turbines at DyNaLab

WIND ASSURING CONFIDENCE
THROUGH COMPETENCE

Torben Jersch, Dr. Christian Mehler, Bernd Tegtmeier

3rd Annual International Workshop on
GRID SIMULATOR TESTING
OF

ENERGY SYSTEMS AND WIND TURBINE POWERTRAINS

November 5-6, 2015 - Tallahassee, Florida, USA





Short profile of Fraunhofer IWES North-West

Managing Director:

Prof. Dr.-Ing. Andreas Reuter

Research spectrum:

Wind energy from material development to grid connection

Operational budget 2014:

around 13,2 million €

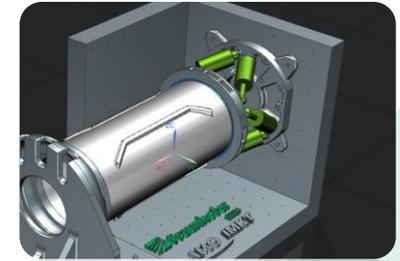
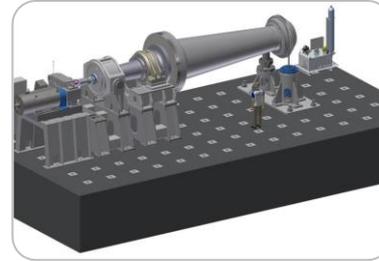
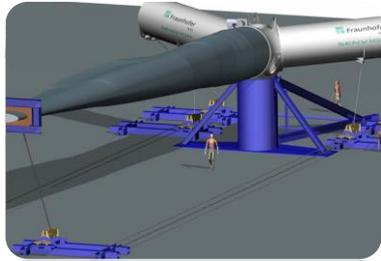
Staff:

150 employees

Previous investments in the

establishment of the institute: € 60 million

Strategic Association with ForWind and the German
Aerospace Center (DLR)



Short profile of Division Wind Turbine and System Technology

Division Manager:

Prof. Dr.-Ing. Jan Wenske

Research spectrum:

Structural durability, mechatronics,
power electronics and control
in the area of entire wind turbines
Large scale test benches for mechanics,
electronics and Power mechatronics

Staff:

30 employees

Division locations:

Bremerhaven – Hannover

DyNaLab – 10 MW full nacelle testing



Hydraulic load application unit

- Simulation of mechanical wind loads
- 1.2 MW Hydraulic Power
- Thrust: ± 1900 kN
- Radial loads: ± 2000 kN
- Bending moments: ± 20000 kNm (rotating y-, z-axis)
- Dynamic: 0-2 Hz
- 0-G System



Drive

- 5° inclined Drivetrain
- 10 MW (15 MW Overload) Direct drive
- 8.600 kNm (13.0000 kNm Overload) Torque
- Flexible Coupling
- Hydraulic safety clutch

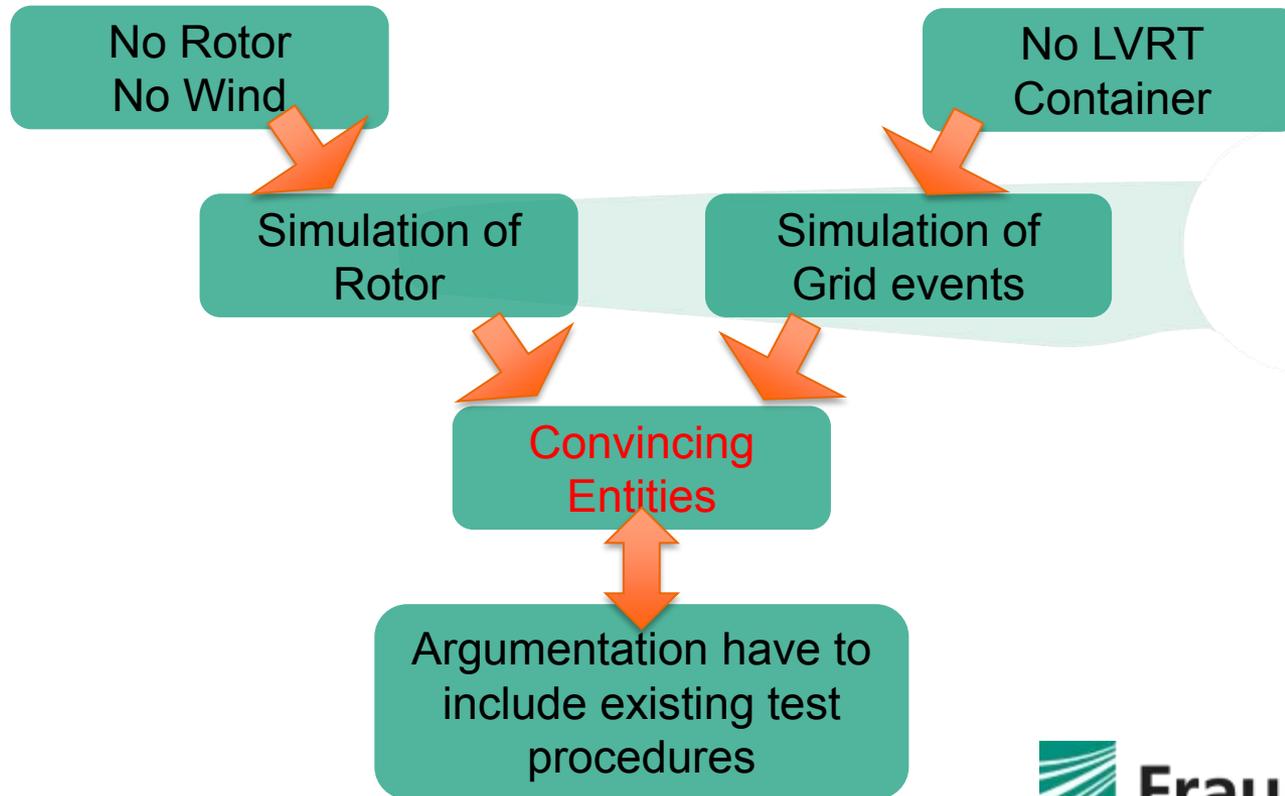


Gridsimulator

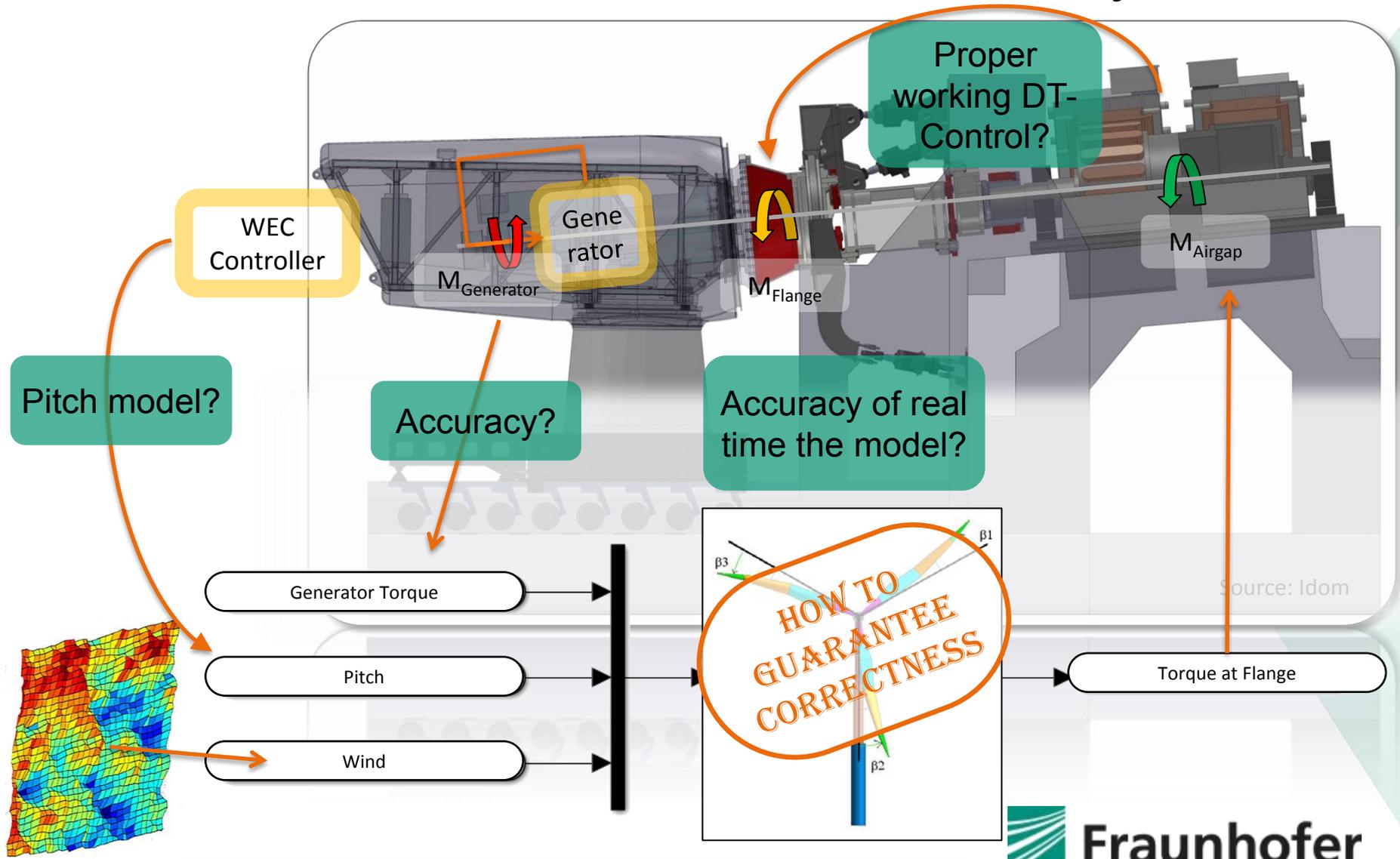
- 10/20/36 kV nominal voltage levels
- 44 MVA installed converter power
- LVRT & HVRT Simulation
- < 2% THD at 50 Hz

Electrical Certification of WECs on test benches – Acceptance?

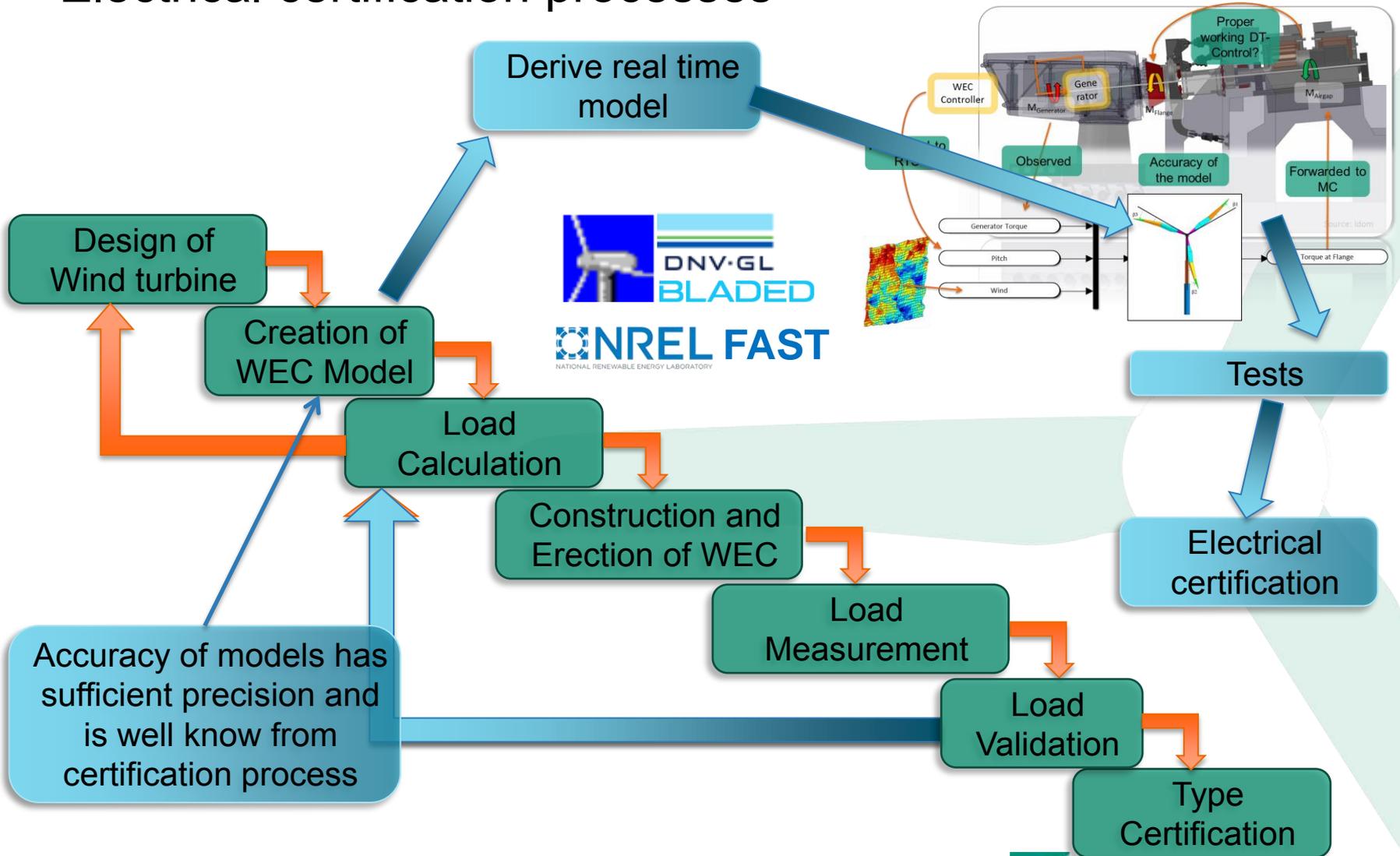
- < How to introduce a new technology?
- < What is different at test bench certification?



Simulation of realistic rotor behavior at DyNaLab



Electrical certification processes

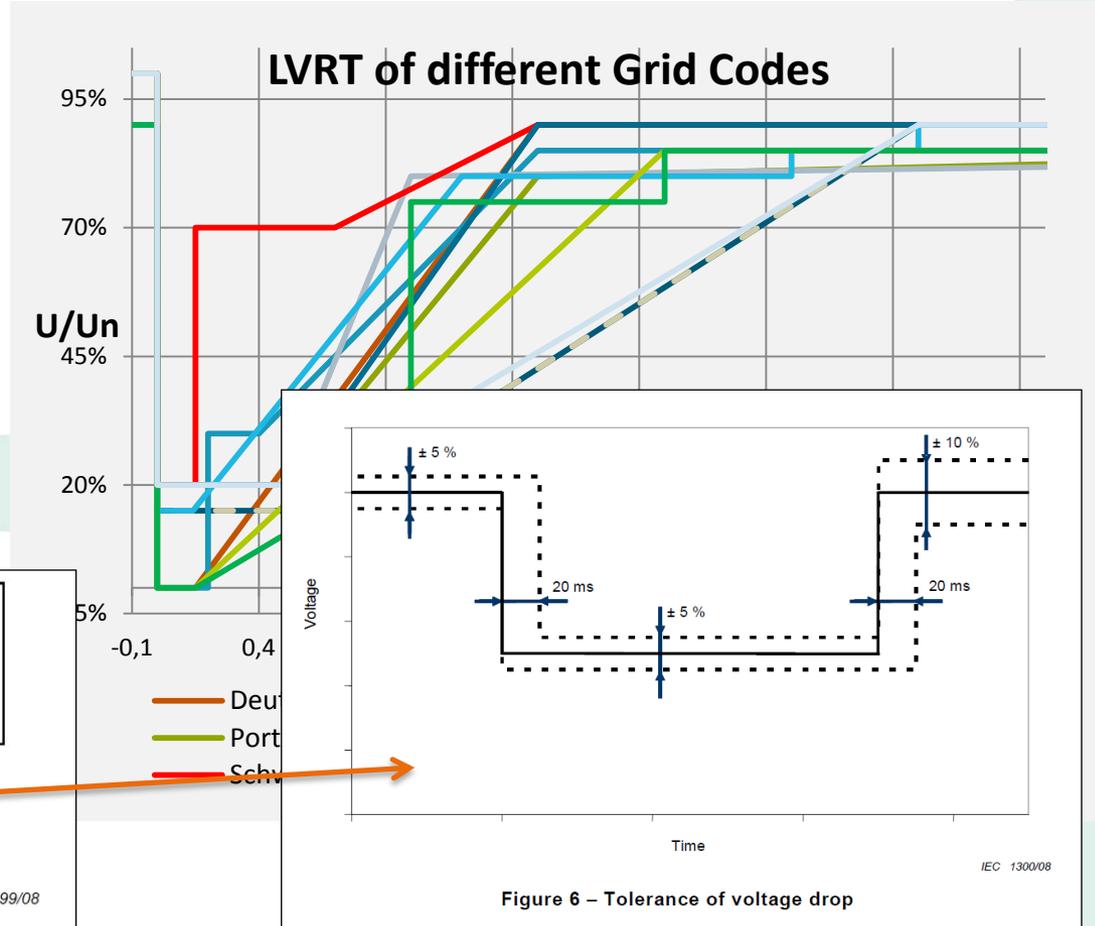
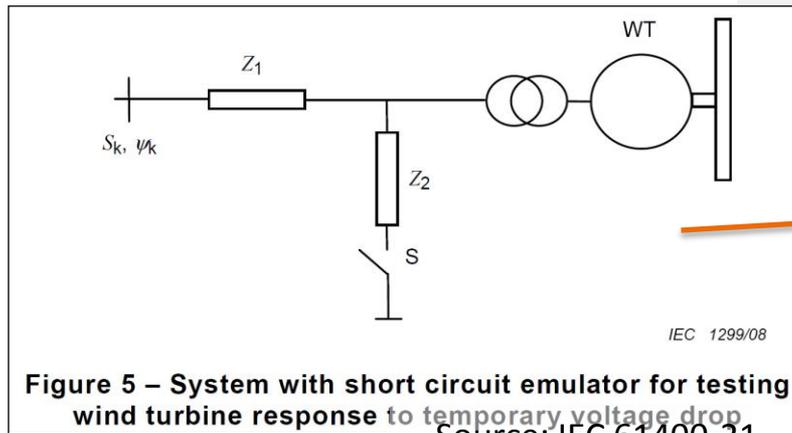


Accuracy of models has sufficient precision and is well known from certification process



LVRT-Container Testing

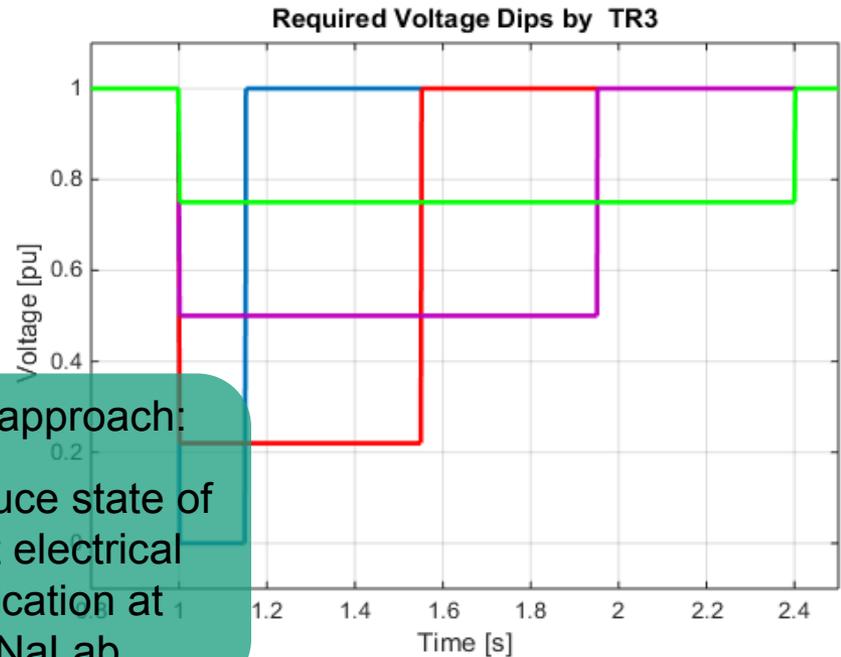
- Grid Codes: Triangle voltage sags
- Typical LVRT-Container can only provide rectangular voltage sags
- Also shown in IEC 61400-21 (unprecise sketch)



Source: IEC 61400-21

Emulation of LVRT - Dynamic slope of voltages

- ↪ Reproducing voltage sag triangle within several tests
- ↪ High dynamic voltage slope to receive rectangular voltage curves



DNV-GL TN 066
Required slope of
1 ms

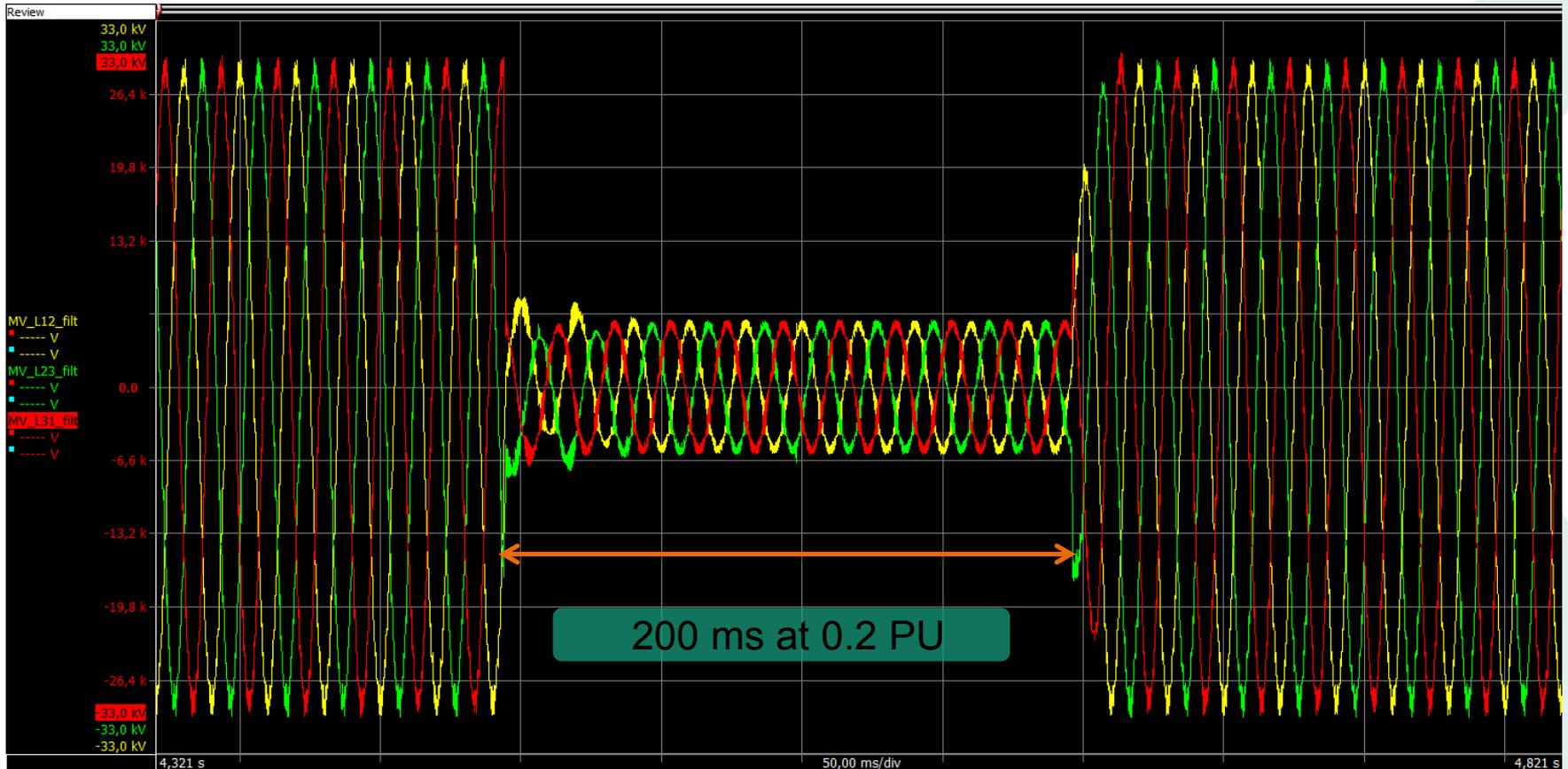


IWES approach:
Reproduce state of
the art electrical
certification at
DyNaLab

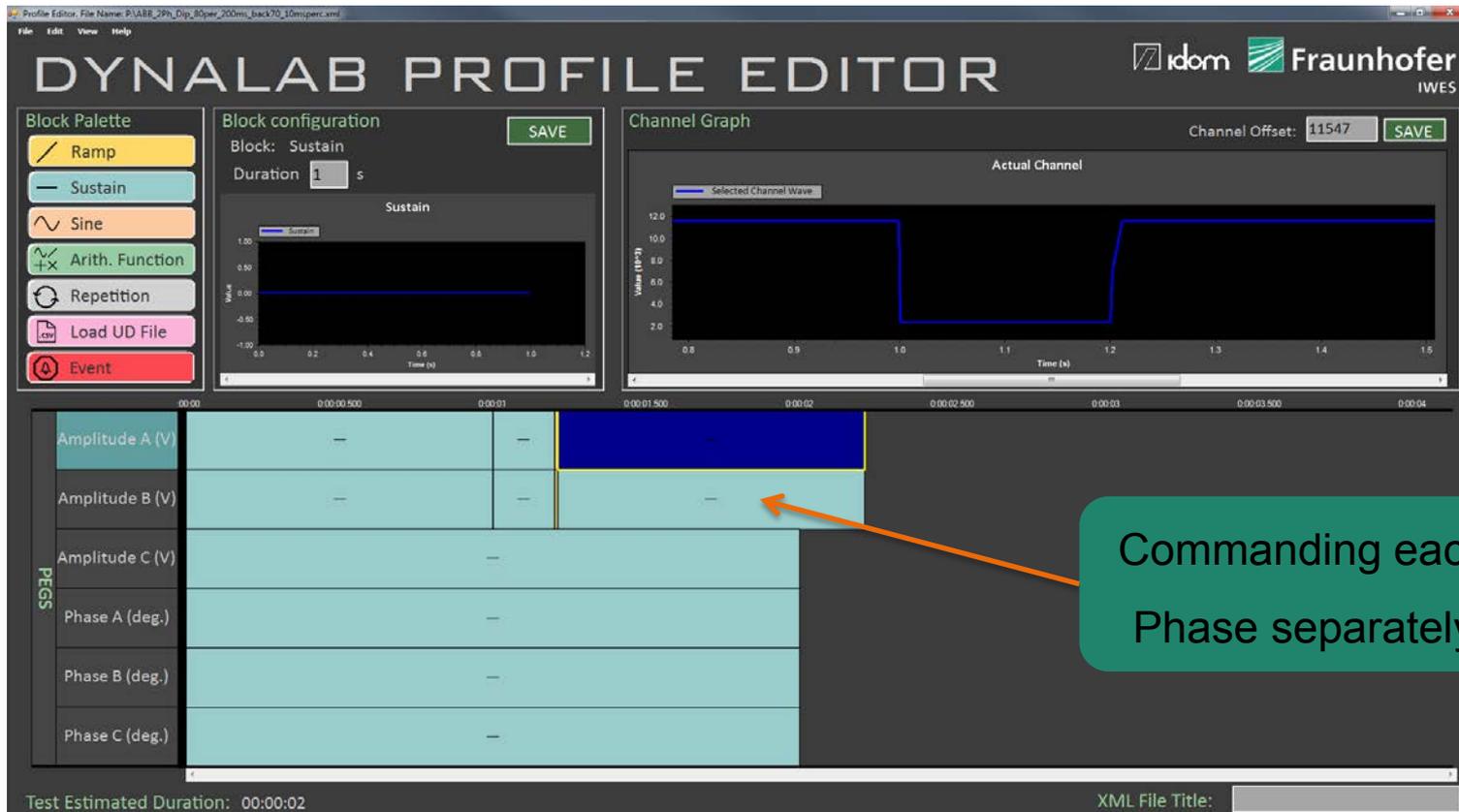
The voltage drop can be achieved with a reactor by short-circuiting of two and three phases at the turbine side of the impedance. The test set up according to IEC 61400-21 /4/, section 7.5 can be used (two reactors Z1 and Z2 as a voltage divider). The voltage drop should be accomplished in 1 ms fall time of the signal from U_n down to User at the beginning of the drop – otherwise as fast as possible – so that a short circuit in the grid is reproduced close to reality.

Source: TN066, DNV-GL

Reproducing Voltage Sag of LVRT-Container

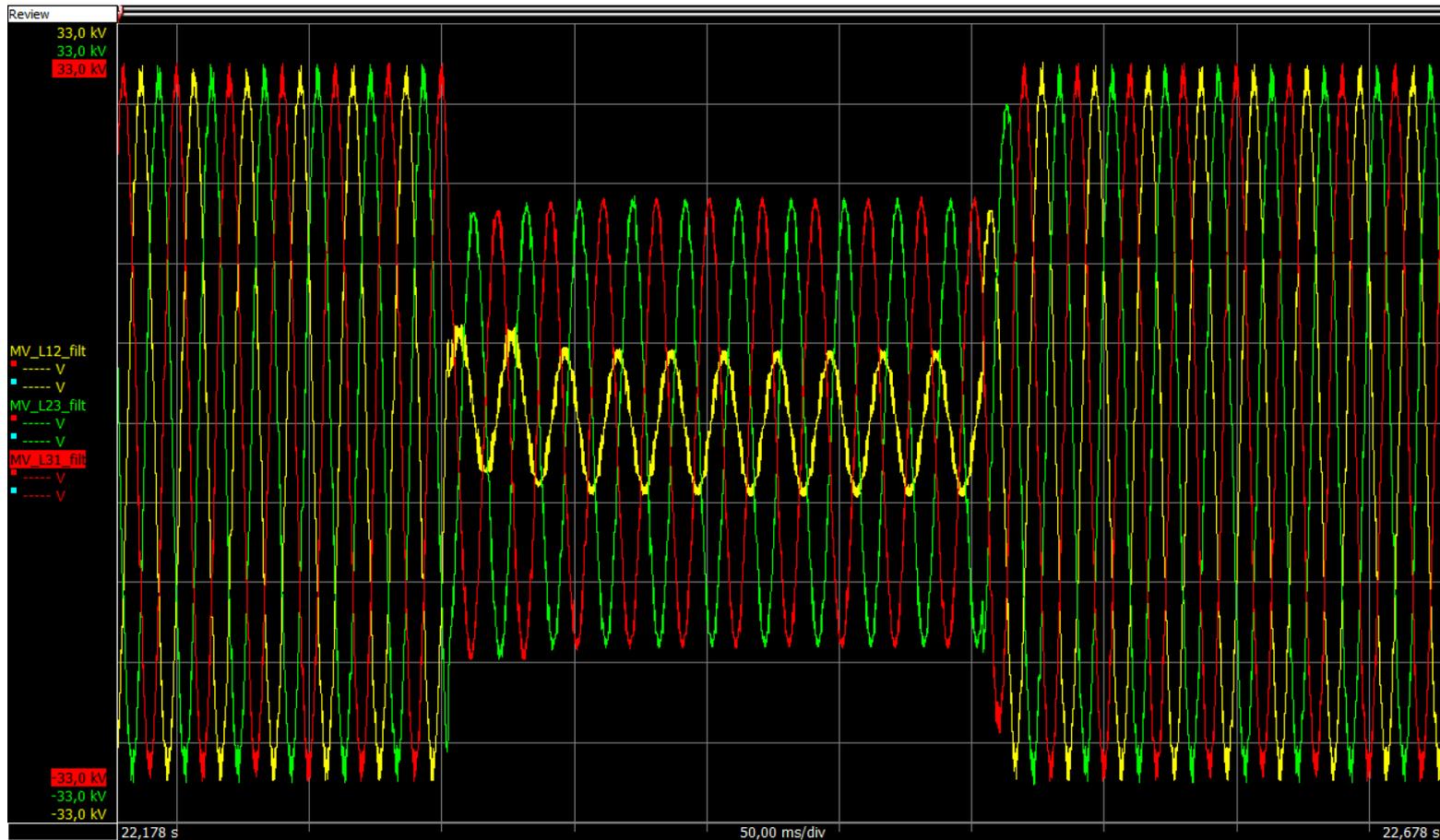


Reproducing Voltage Sag of LVRT-Container 2 Phase – Profile editor



Commanding each Phase separately

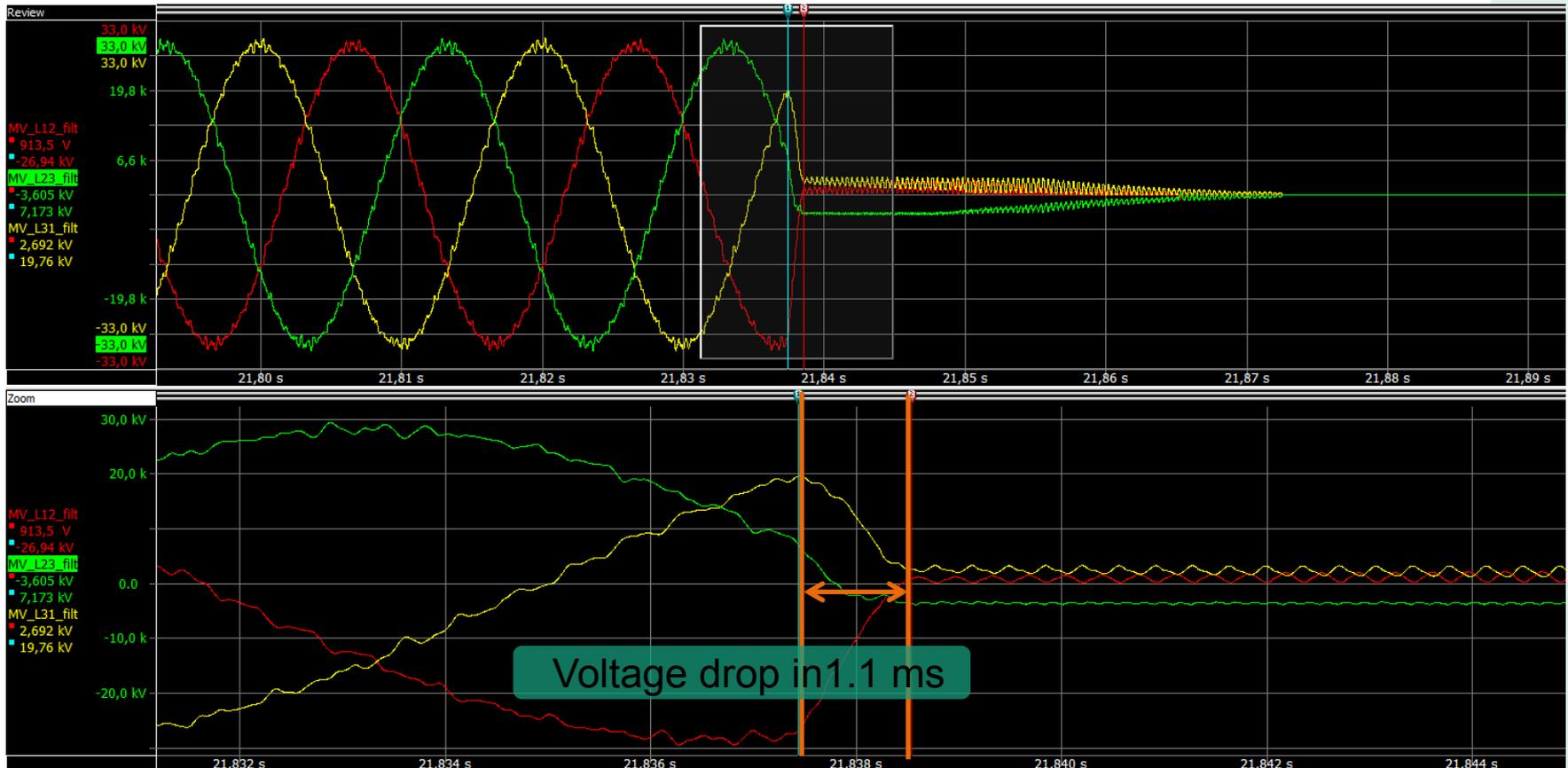
Reproducing Voltage Sag of LVRT-Container 2 Phase



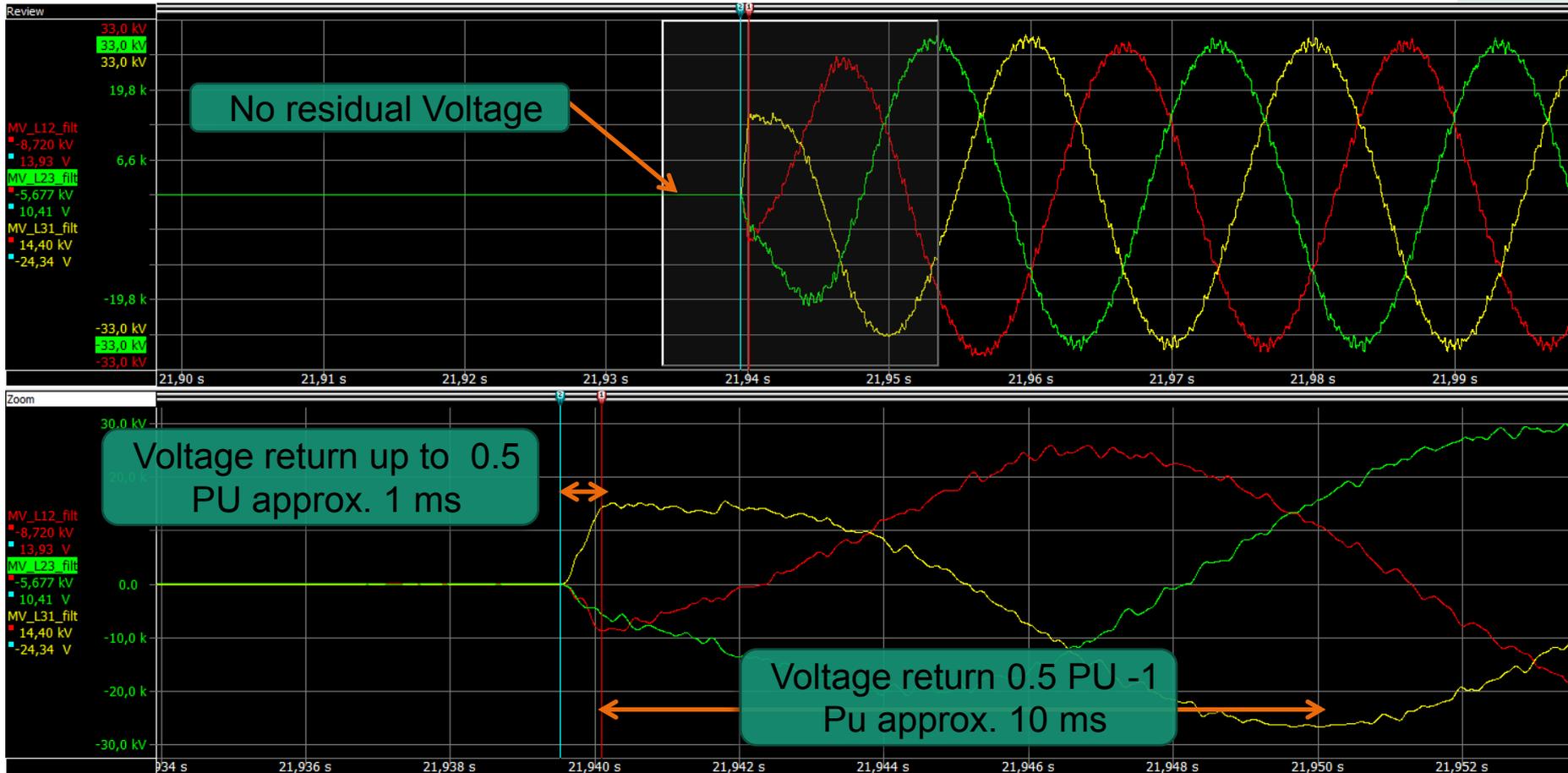
Voltage Sag to 0V



Detailed view on voltage drop

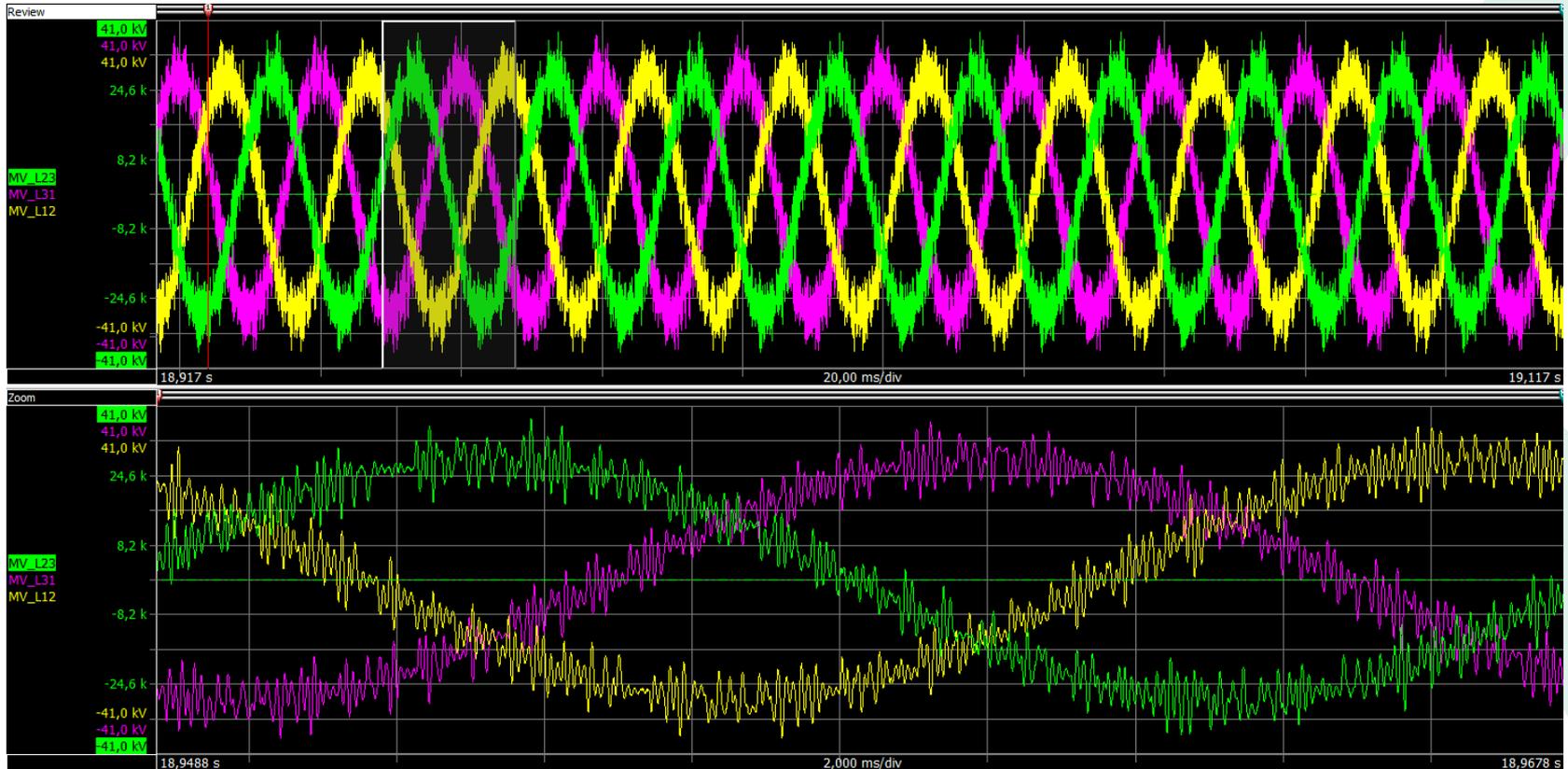


Detailed view on voltage return



Outline – Improvement of Voltage quality

Design of a small HF-Filter



Increase Acceptance of Electrical certification on Test Benches

Technical Guideline FGW TR3 - Technical Committee electrical certification on test benches

- ↪ Objective: Defining the process of electrical certification on test benches and write them down in national standard
 - ↪ Defining the requirements of Wind Turbine
 - ↪ Defining the requirements for test benches
- ↪ Participants: Manufacturer of Wind Turbines, Measurement Institutes, Certification Companies, Research Institutes

Presentation and discussion on international workshops



THANK YOU FOR YOUR ATTENTION

Any questions?

Torben.Jersch@iwes.fraunhofer.de

Christian.Mehler@iwes.fraunhofer.de

Bernd.Tegtmeier@iwes.fraunhofer.de

Acknowledgements

Fraunhofer IWES North-West is funded by the:

Federal State of Bremen

- > Senator für Umwelt, Bau, Verkehr und Europa
- > Senator für Wirtschaft und Häfen
- > Senatorin für Bildung und Wissenschaft
- > Bremerhavener Gesellschaft für Investitions-Förderung und Stadtentwicklung GmbH

Federal State of Lower Saxony

Federal Republic of Germany:

BMWi Federal Ministry for Economic Affairs and Energy

BMBF Federal Ministry of Education and Research

with support of the European Regional Development Fund (EFRE)

Supported by:



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