



Konferenz „Energieversorgung und Klimawandel“

Stefan Franko, 15.05.2009



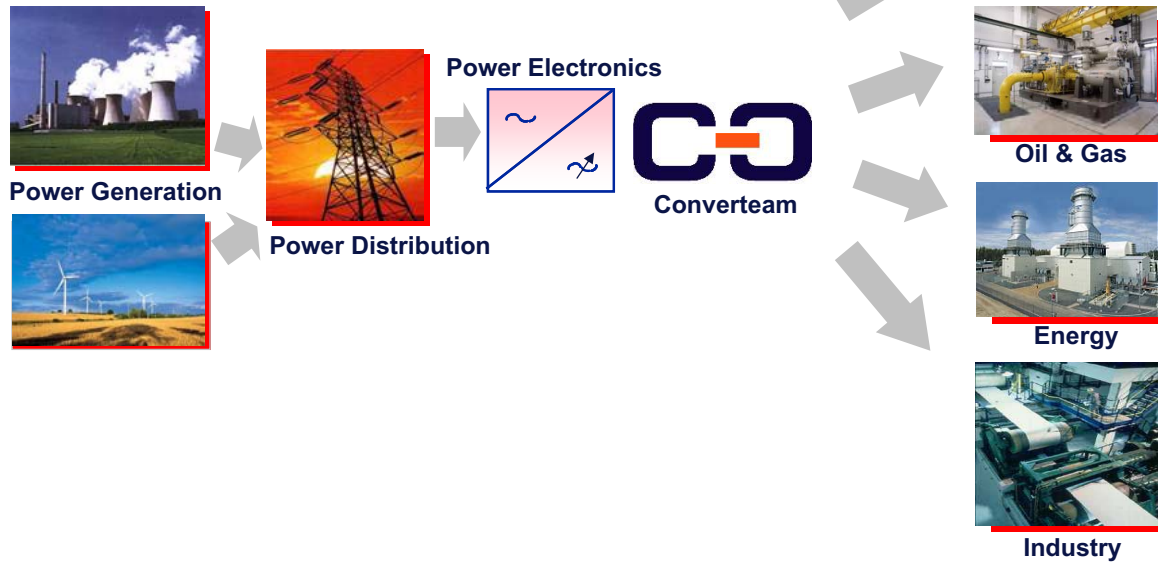
| Content



- New Grid Codes for Renewable Energy Sources
 - Why new Grid Codes ?
 - Solution for variable speed systems
 - Solution for fixed speed systems

- Questions and answers

- Converteam is an engineering company providing customized solutions and systems converting electrical energy into productive performance



These solutions are made of systems built around three core components:

- Motors & generators
- Variable speed drives
- Process automation & control

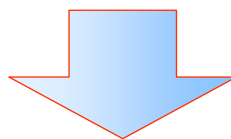


Experience

- Experience with industrial drives under rough conditions for decades, e.g. steel mills, offshore platforms
- Experience with converters of all kind and sizes up to 100 MW
- Experience with grid stabilisation and the control of power plants for decades, e.g. Power System Stabiliser (PSS)
- More than 4000 converters for doubly and fully fed generators for wind turbines in operation
- Present in several committees, e.g. FGW, VDN

Why Grid Codes?

- The Huge growth of wind power in the last years, further increase is expected
- Wind turbines have a significant impact on the grid that cannot be neglected anymore
- Wind turbines have to be included into the stability analysis of the grid



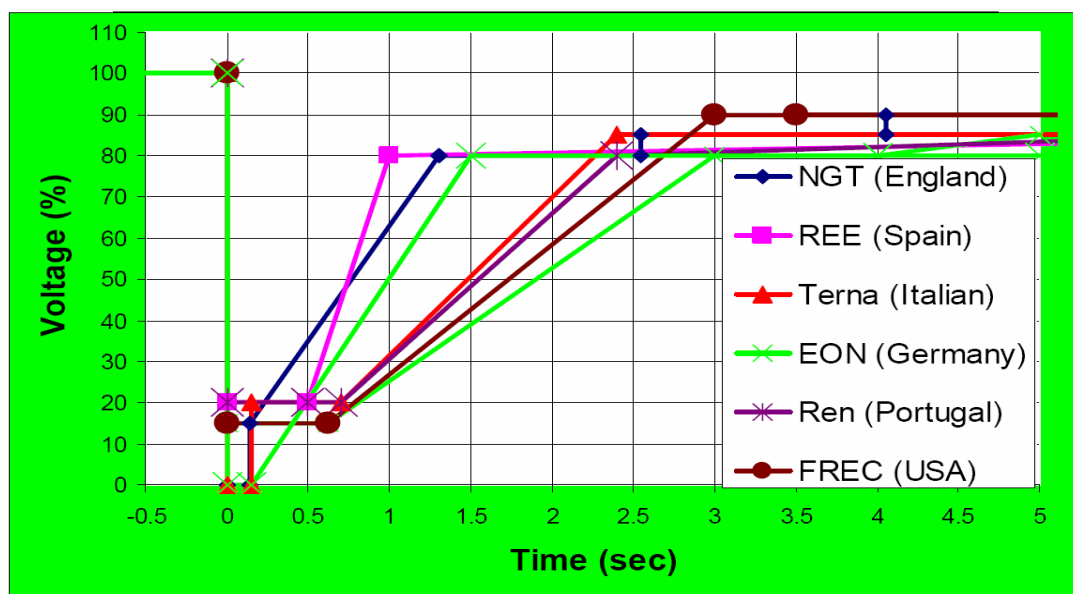
Mains operators demand new requirements

Example: e.on Grid Code

for the high voltage grid (01.04.2006),
to be observed at the grid connection point

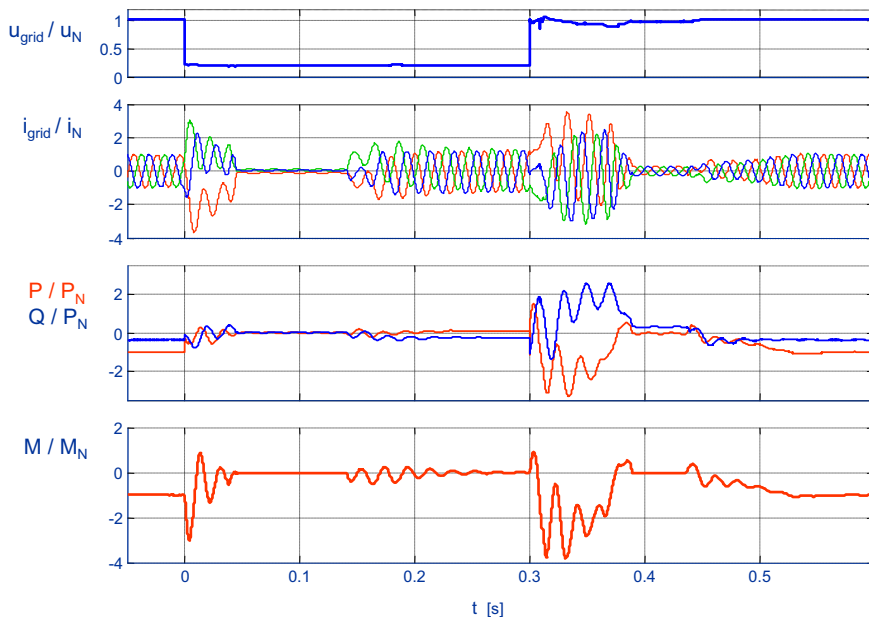
- Frequency range: 47,5 Hz - 51,5 Hz
- Voltage tolerance: +10% / -20%
- Operation with 80 % grid voltage
- Power factor: 0.95 ind. - 0.95 cap.
- Voltage buffering by reactive current ($I_q = I_N$) in dedicated time
- Ride trough capability

European & North American Grid Codes



© WINDTEST
Kaiser-Wilhelm-Koog GmbH

Simulations



Voltage dip down to 20 % UN

Solution for ProWind

- 1 Frequency
- Point 2 Voltage
- 3 Reactive power

Solved by new system management and software adaptations!

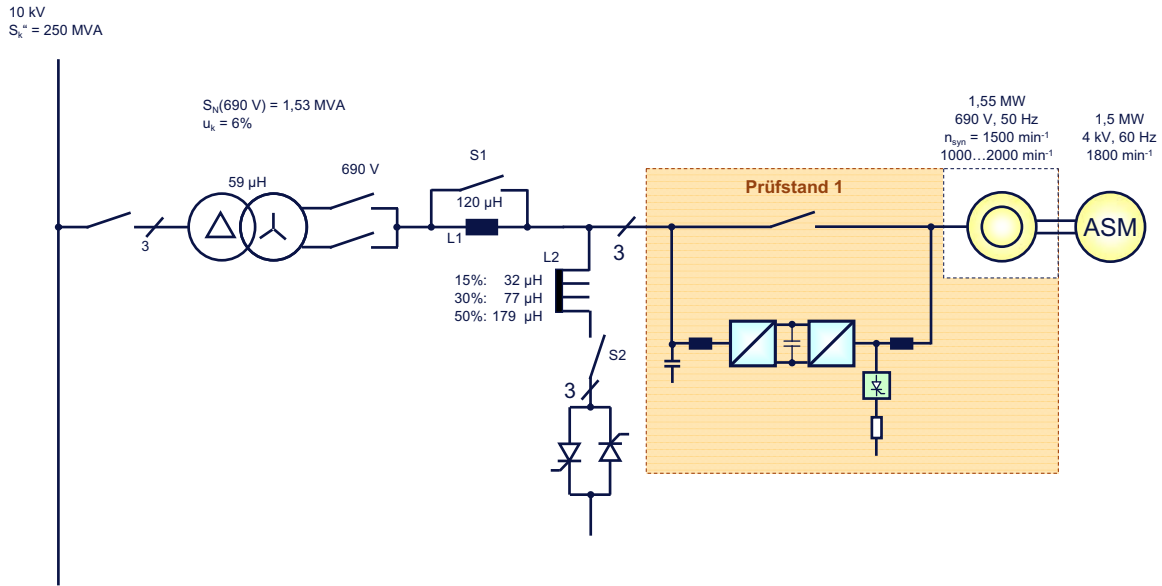


- Point 4 Voltage dip

Solved by Hardware adaptations!
Optional, retrofit possible!

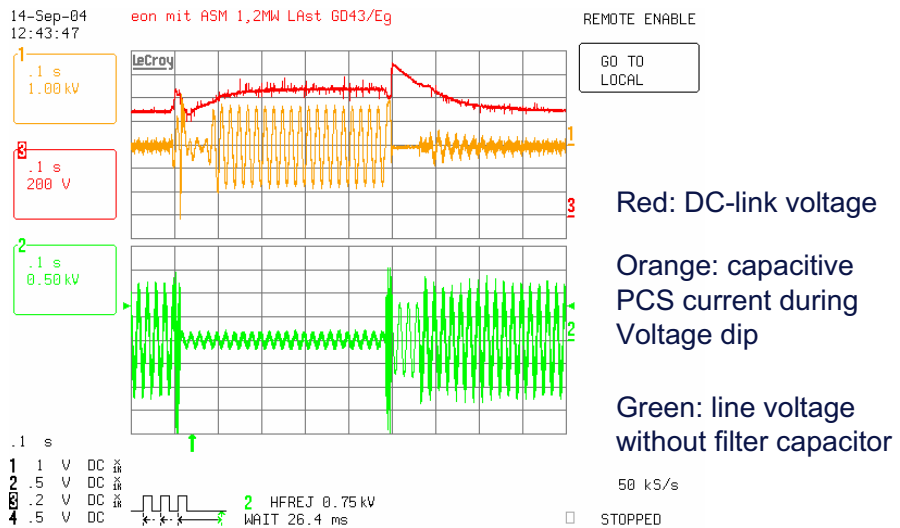


Grid Fault testing using a thyristor bridge



Special test-bench for FRT applications, incl. testfield WT generator

80% dynamic voltage dip of 400ms dip and simultaneous capacitive current generation of 1250A

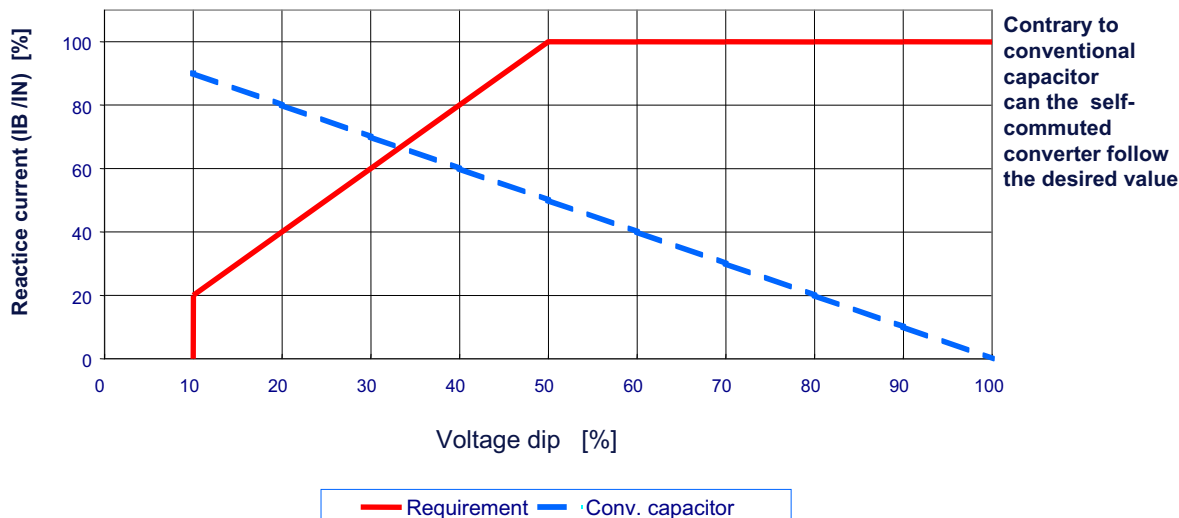


Key problem fixed speed Turbines

- Grid operators expect squirrel cage generator to behave like conventional synchronous generator:
- No switch-off during voltage dips
- Capacity power supporting during voltage dips
- Disadvantage of conventional compensation systems
- Capacitors or conventional dynamic compensation (SVC, with TCR, thyristor controlled reactor) delivers with dipping voltage and correspondingly reduced current

Key task

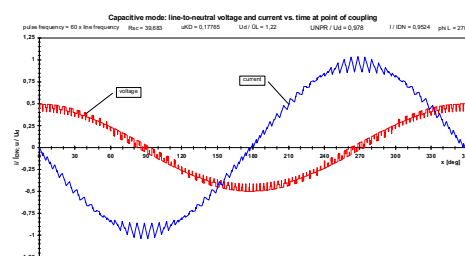
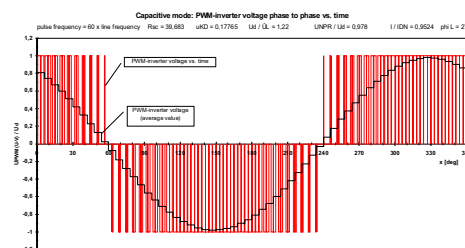
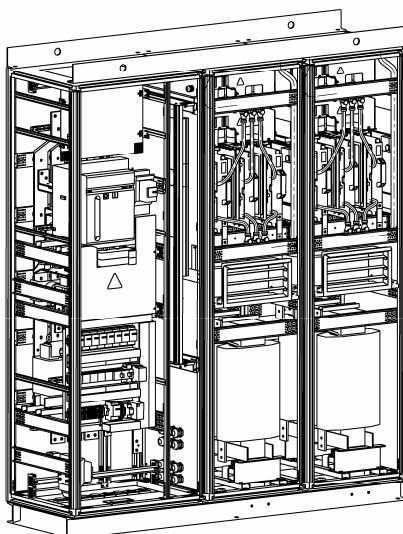
Reactive current (overexc.) supporting grid



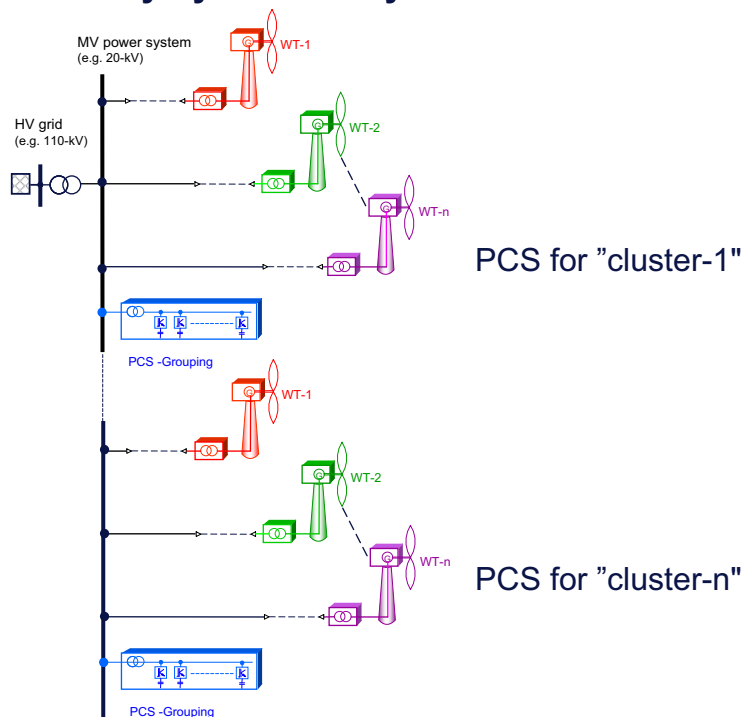
Technical solution for fixed speed application

- Self-commuted converter in PWM-inverter technology
 - Response like a synchronous machine for grid support
 - Electronic Synchronous machine (phase-shifter“
 - 4-Quadrant inverter PCS: Power Conditioning System
- Advantage of PCS in PWM-inverter technology
 - in spite of voltage dips constant reactive current output
 - grid support during voltage dips with PCS nominal current
- ideal for WT of type „constant speed/Stall control“
 - for new individual WT, for new clusters, for new wind-parks
 - for existing WT / cluster / wind-parks (upgrading)

PCS (Power Conditioning System) 1200 kvar unit - Convertteam ProWind®



PCS - Flexibility by modularity - Economic viable clustering



WT „Fixed Speed“ has inductive, load dependent reactive power demand, however

- Cosφ in wide range inductive/capacitive controllable
- Medium voltage (e.g. 20 kV) controllable ($\Delta U \approx \Delta(P+jQ) / Sk$)
- Reactive power input/output to grid controllable

Using Power Conditioning System, the objectives can be met

**First application: PCS cluster
8x 1200 kvar units - Converteam ProWind**



Windfarm, New Zealand,
September 2004

Fixed Speed / Stall controlled WT



THANK YOU