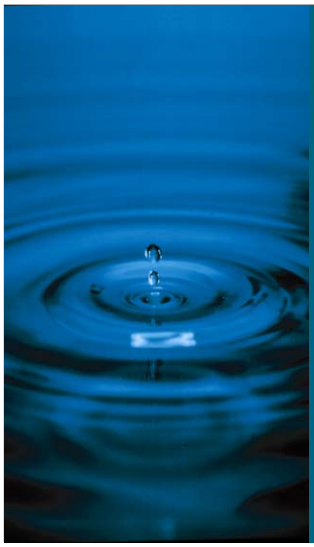


Grid Code and Engine driven generators

Situation in Germany

Gerd Krieger
Deputy Managing Director
VDMA Power Systems

Brussels, 22 September 2009

What is VDMA?

- Representing the machinery and plant manufacturers industry
- 3.000 member companies in Germany and Europe
- Engine and turbine manufacturers are part of VDMA
- Industry turnover approx. 200 billion €/year, nearly 1 Million employees
- Offices in Germany, Brussels, Beijing, New Delhi, ...

→ Biggest industry network in Europe

Agenda

- Starting point and participating companies
- Main problems and possible technical solutions
- Results of Discussion with Grid operators and their standardisation body Forum Netztechnik und Netzbetrieb (FNN) within VDE
- Special topic: Certification and Modelling (Technical Directives by FGW)
- Next steps

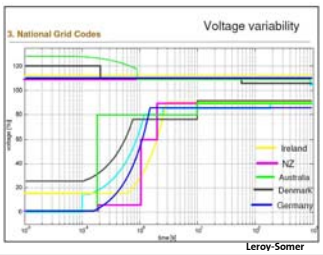
Documents: BDEW-MS-Directive (June 2008) and Exeption (January 2009, only German)

Starting point

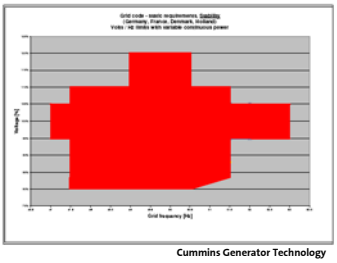
- Changes within „Richtlinien für den Anschluss und Parallelbetrieb von Erzeugungsanlagen am Mittelspannungsnetz“ (BDEW-Mittelspannungs-richtlinie) was discussed by Grid operators in Germany starting 2007 based on Transmission Code 2007 and rules for wind turbines. Also result of Dena-grid Study I.
- Decision June 2008, Implementation January 2009, only recommendation for nearly 700 grid operators in Germany, Trendsetter for Europe?
- Responsibility for Standardisation changed July 1, 2008 from BDEW to Forum Netztechnik und Netzbetrieb (FNN) within VDE, but we are still in a transition period
- Starting August 2008, we tried to find a solution. Creation of a mirror group within VDMA with additional international participants, discussions with Euromot, Europgen and Cogen Europe.
- In December 2008, we reached an exemption and in January 2009 a Working Group within FNN was created to find solutions. Participating companies (GE Jenbacher, MTU Onsite Energy, MWM, Cummins Generator Technology (AvK), Leroy Somer, RWE, EON,…)

International situation

- Problem:
  - Different requirements, no international harmonisation!
  - Focus on Transmission Grid
- Solutions:
  - UCTE: Requirements for Generating Units (9/2008)
  - ERGEG: Guidelines for Good Practice on Electricity Grid Connection (Public Consult.)
  - IEC/CENELEC SMB/4079/DC
- Stakeholders?
- Next Steps?



Leroy-Somer


Cummins Generator Technology

Engine, Generator and Packager must work together to find solutions!

Participating Companies

- **Engine manufactures:**
  - GE Jenbacher/AU
  - MAN Diesel/D
  - MTU Onsite Energy/D
  - MWM/D
  - Wärtsilä/D, Fi
- **Generator manufacturers:**
  - Cummins Generator/D, UK
  - Marelli/I
  - Leroy Somer/F
  - ABB/Fi
- **Packager:**
  - Pro 2/D
  - Köhler&Ziegler/D

Main problems and technical solutions

- Discussion with wind turbine manufacturers started 2003! All other generation technologies were not involved in this process.

  But: It is not only a wind problem! The grid code changed for all technologies, starting in a few countries (Germany, Danemark, France,…)

- Reduction of active power (Thermal problems < 50%, ramp up time)

- Static requirements (Power factor 0,95 lag and lead, in future 0,9 is expected)

  Minor technical changes, but extra cost appr. 3 to 5 % of the whole genset

- Dynamic requirements (Low Voltage Ride Through LVRT, U= 0 V, t > 150 ms)

  Major change, solutions do not exist for engine driven generators!!

- (New) protection devices and certification requirement (large number of variations!)

Evaluation of the different technical solutions

energynautics
solutions for a sustainable development

research | workshops & conferences
consultancy
project development

Comparison of different Fault-Ride-Through solutions for gas engine power plants based on simulations in DIgSILENT PowerFactory

Study will evaluate 5 different technical solution until April 2010.

Goals: - Support for argumenation in Germany and EU
- Guideline for possible solutions

Scope of investigation

The investigations will be carried out for four typical sizes of generating systems:

1. 500kW / 400V
2. 1.5MW / 400V
3. 3MW / 10.2kV
4. 5MW / 10.2kV

There are 5 types of possible solutions to be investigated:

1. Inertia: By introducing a higher inertia e.g. by installing a flywheel, the generator will not accelerate as fast and store the surplus power during a fault as kinetic energy.
2. Eddy current brake: An eddy current brake can be used to keep the speed of the generator during a grid fault within acceptable limits.
3. Serial Braking Resistor: These resistors are located between the terminals of the generator and the PCC (possible fault location) and normally are bypassed. During a fault they are activated to dissipate surplus power.
4. Parallel Braking Resistor with Inductor (FRT-Box): The inductor decouples the generator from the grid. Surplus power is dissipated by the braking resistor.
5. Full power converter: By using a full power converter, the grid and generator can be decoupled. This is a proven solution that has enabled wind turbines to fulfill most grid codes.

Results of Discussion with Grid operators (FNN)

- 3 meetings:
  - 4.2.2009
  - 12.5.2009
  - 3.9.2009
- Synchronous generators have many benefits for the grid!

  But: Grid operators understand our technical problem. They still insist that the new requirement are necessary!
- At our last meeting they promised to check if U could be above 0.
- Based on the study we will dicuss at our next meeting in April 2010 how long we need to fulfil the requirement. That this will last a few years is clear to the Grid operators.

  But: Until now there is no new target date and the BDEW-Directive is still unchanged!
- Furthermore the certification problem (exemption ends January 2010!) is not solved. Action is needed!

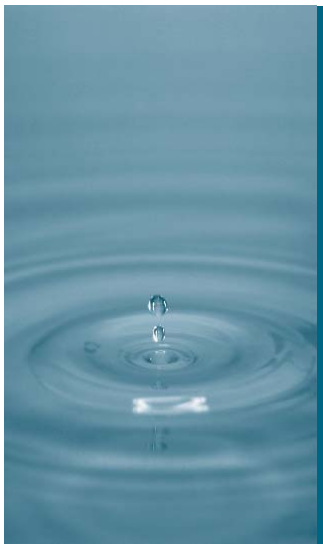
Special topic: Certification and Modelling

- Grid operators want oblig. Certificate, based on so called FGW-Directives.
- There are 3 different Directives:
  - TR8 – Certification (Described concept of certification of a single genset and the whole power plant)
  - TR3 – Details of Certifaction
  - TR4 – Modells and modell validation

  .
- Problem this Certification was only developed for Wind turbines and need to be changed for other generation technologies

Next steps

- Solution for certification problem (January 2010!)
- Discussion with manufacturers of protection devices
- Energynautics Study and next FNN-meeting in April 2010
- Discussion with stakeholders in Germany and Europe
  - Economic implications of new requirements
  - Role of FNN and FGW
  - Dena-grid Study II
  - Status of BDEW-Paper
- Goal: Reasonable, uniform requirements in Germany and abroad



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