Improved Grid Integration of Wind Farms by New Legal Measures in Germany

Outcomes from a BMU project in the scope of the Revised Renewable Energy Sources Act 2009

6th Workshop of the International Feed-in Cooperation
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Jens Bömer, Consultant Power Systems and Markets
Brussels, 4 November 2008

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Content

- Introduction
- Technical Requirements
- Verification of Requirements
- Transitional Arrangements
- Conclusions

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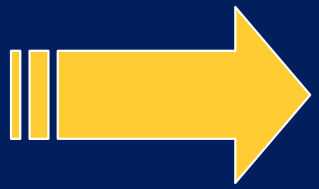
Content

- Introduction
  - Background
  - Scope and timeline of the consultancy project
  - New regulations within the EEG 2009
  - Overview on the outcomes of the consultancy project
- Technical Requirements
- Verification of Requirements
- Transitional Arrangements
- Conclusions

Introduction (I/V)
Background

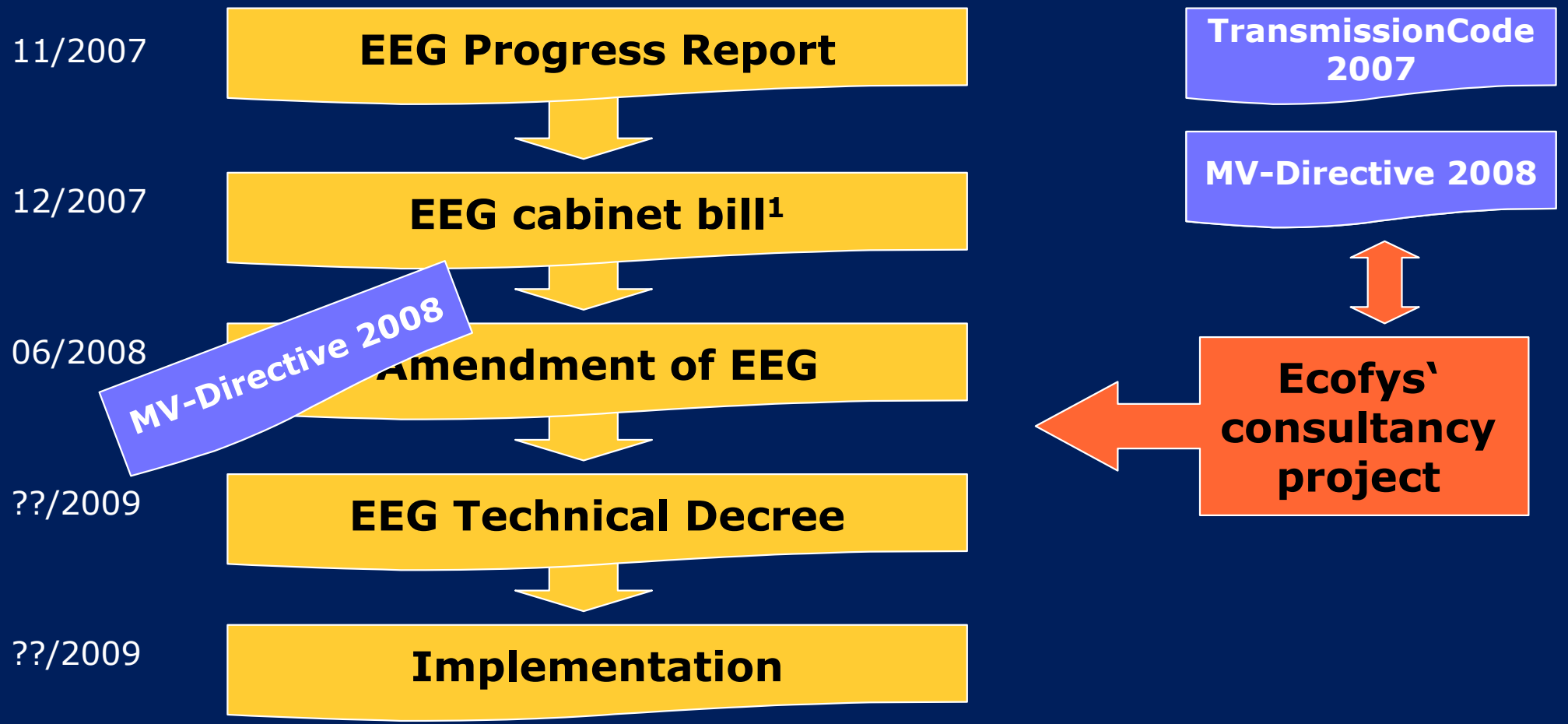
- Preservation of the security of supply in the long-term
- Performance of modern wind turbines
- Nationwide compliance with connection requirements
- Extra costs for new requirements



EEG 2009 -
System Services Bonus

Introduction (II/V)

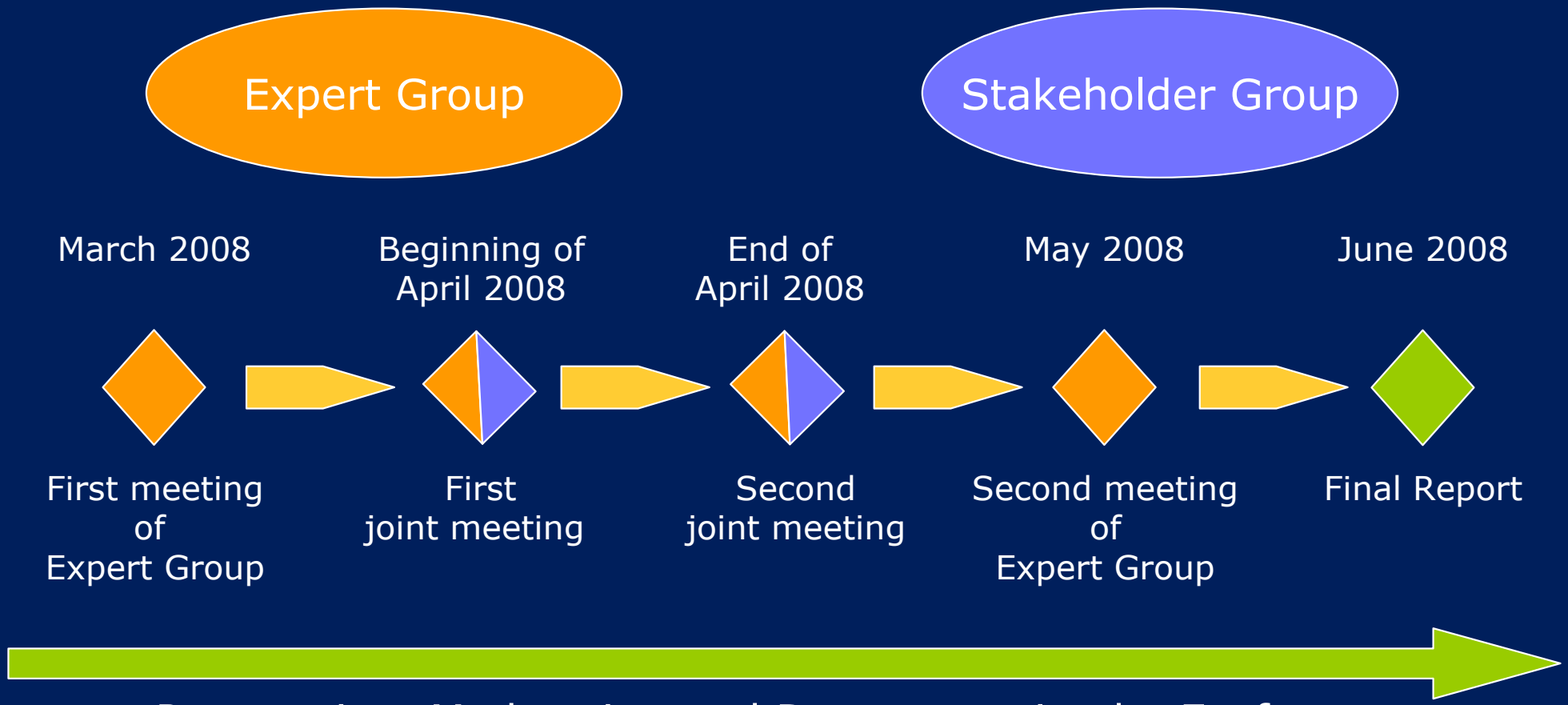
Scope and timeline of the consultancy project



[1] Cabinet bill relating to the Renewable Energy Sources Act

Introduction (III/V)

Scope and timeline of the consultancy project



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Introduction (IV/V)

New regulations within the EEG 2009

- Prerequisites for connection (from 1 January 2009) — § 6 Nr. 2
- System Services Bonus for new wind farms connected prior to 1 January 2014 → extra 0.5 ct/kWh, initial fee period — § 29 Abs. 2 Satz 4
- System Services Bonus for facilities commissioned 2002-2008 that are voluntarily retrofitted in 2009/2010 → extra 0.7 ct/kWh, 5 years — § 66 Nr. 6
- Power to issue statutory instruments — § 64 Abs. 1 Nr. 1

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Introduction (V/V)

Overview on the outcomes of the consultancy project

- Glossary

- Technical Requirements
  - New wind farms
    - MV-networks → **MV-Directive 2008**
    - HV/EHV-networks → **TransmissionCode 2007**
  - Retrofitted facilities commissioned 2002-2008

+ Specifications

- Main features of the verification procedure

- Transitional Arrangements

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Content

- Introduction
- Technical Requirements
  - MV-Directive 2008
  - TransmissionCode 2007 with specifications
  - Requirements for retrofitted facilities
- Verification of Requirements
- Transitional Arrangements
- Conclusions

Technical Requirements (I/III)
MV-Directive 2008

- Alignment with state-of-the-art and latest laws (EEG)
- Integration of lessons learned from EHV/HV-Guideline 2004
- Effective from 1 January 2009 (date of application for permit)

1998

Yesterday		Today
constant	**Active Power**	limitable
$0.98_{lagging}$ … 1.00	**Reactive Power cos(φ) =**	$0.95_{lagging}$ … $0.95_{leading}$
Dis-connection	**Network Fault**	FRT + Voltage Support
-	**Verification**	Certificates

2008

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Technical Requirements (II/III)
TransmissionCode 2007 with specifications

Special requirements

- In line with MV-Directive 2008
- Extended reactive power range, 3 variants
- Ride-Through of unsymmetrical faults

Analysis: TC2007 had to be specified!

→ Specifications among others:

- Active power generation
- Reactive power provision
- Behaviour during network faults

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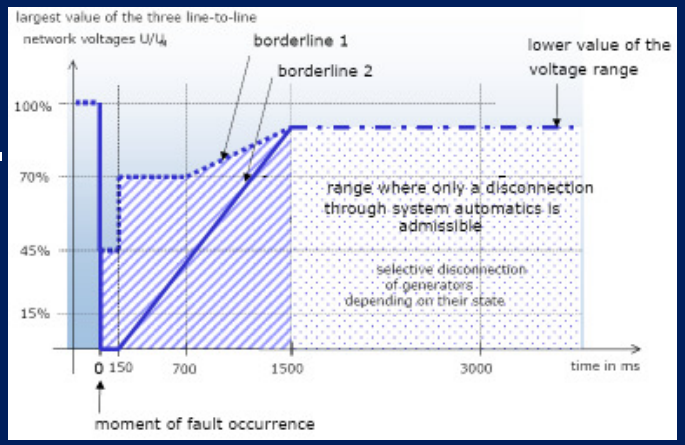
Technical Requirements (III/III)

Requirements for retrofitted facilities

- Ride-Through of network faults with voltage drops of not lower than borderline 1 (Fig. 3.5 in TC2007).

TC2007



- Reactive power – undervoltage protection (Q➔ & U<) must be installed.
- Disconnection from the network not allowed for frequencies between 47.5 Hz und 51.0 Hz.
- Active power reduction at over frequency.
- On request from grid operator, automatic reconnection to the grid after (regional) blackouts must be inhibited.

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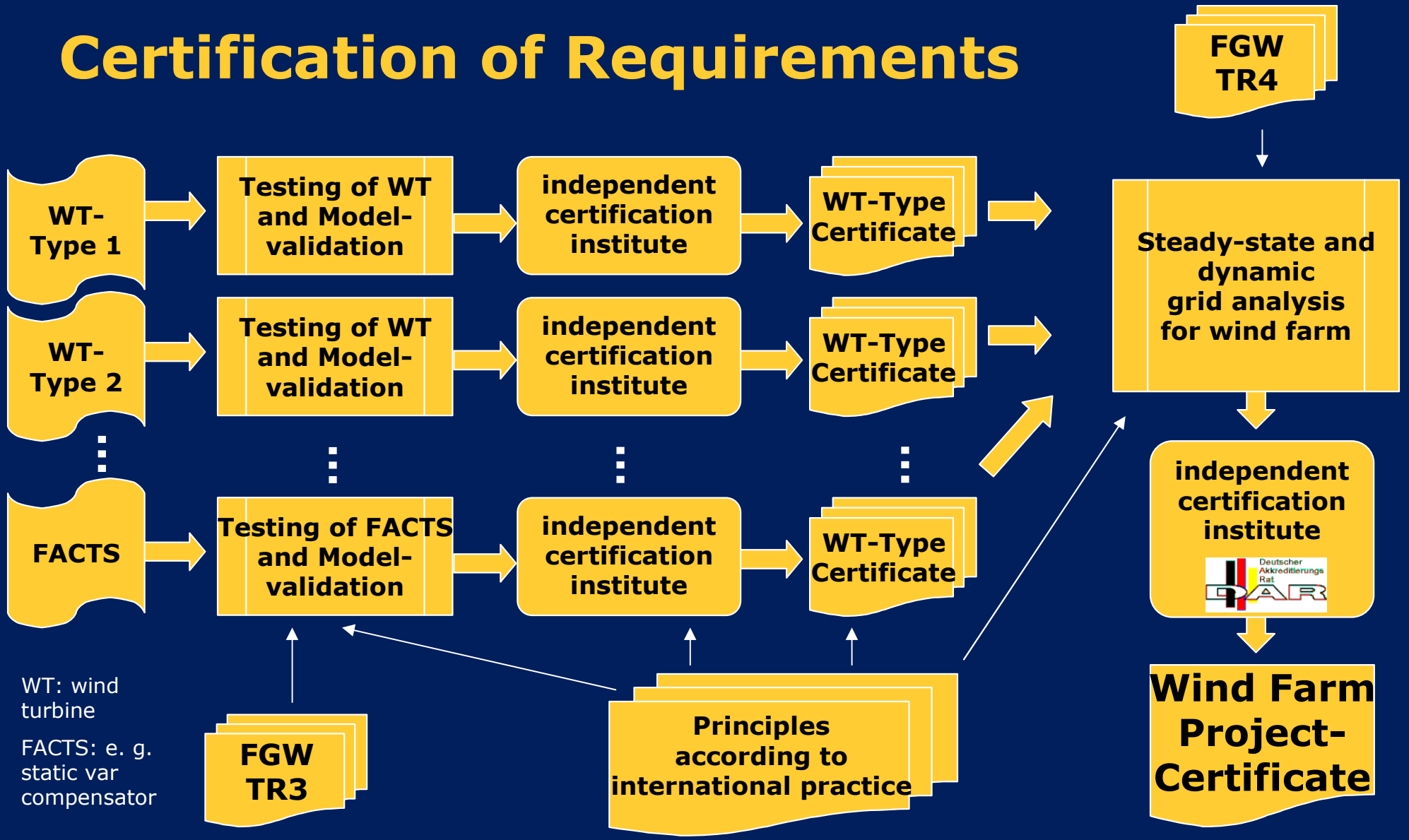
Certification of Requirements



WT-Type certificate + Grid Analysis = Wind Farm Project-Certificate

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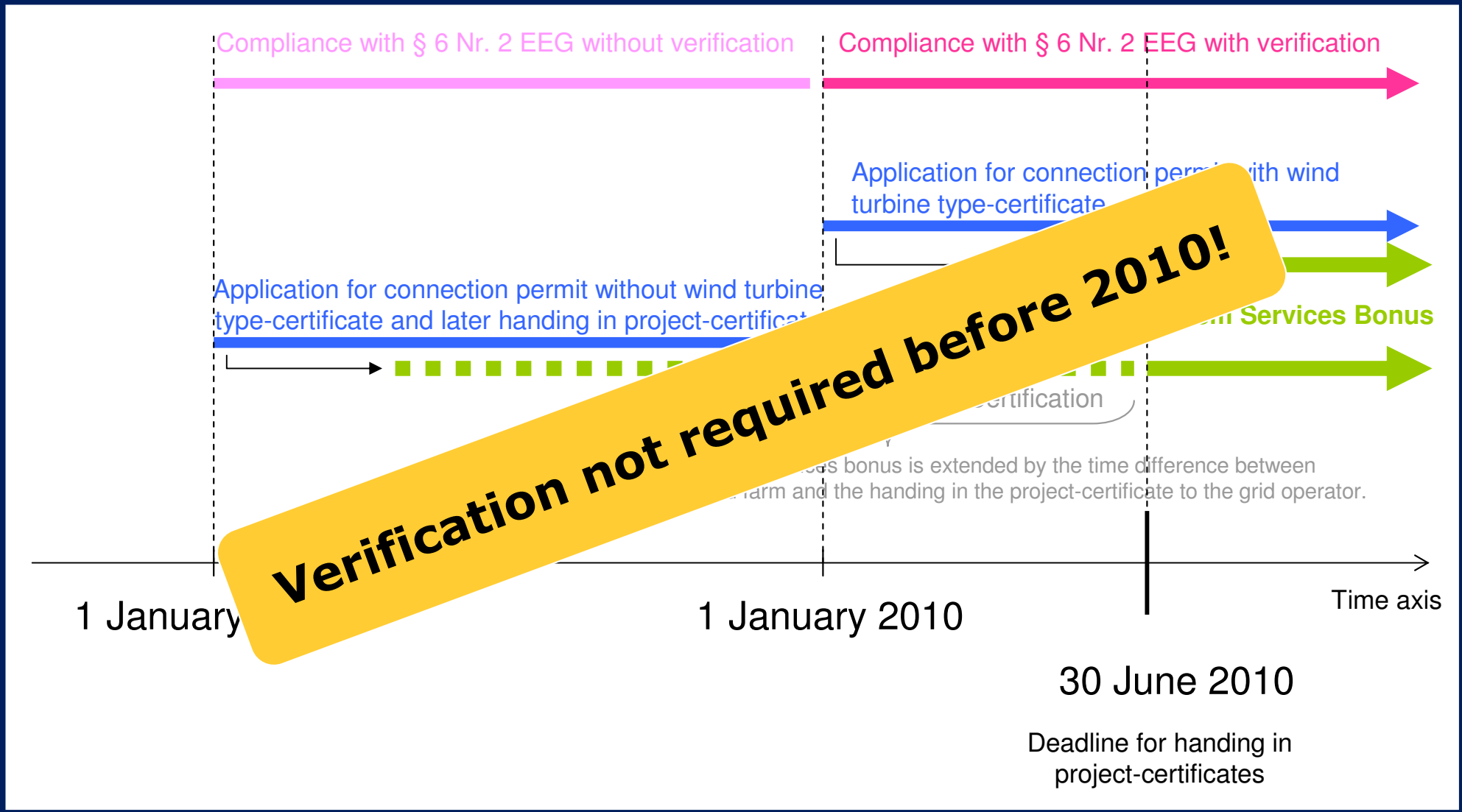
Transitional Arrangements



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Conclusions (I/II)

Core statements

- For the first time the EEG refers explicitly to grid connection requirements.
- Connection Requirements are consequently defined for the point of common coupling (PCC).
- Compliance with connection requirements is verified by type- and project-certificates.

The final report can be downloaded here:
http://www.erneuerbare-energien.de/inhalt/42327/4591/

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Conclusions (II/II)

Recommendations

- Adoption of the presented outcomes in the EEG Technical Decree by the German Government.
- Completion of the methodology for project-certificates → FGW e.V. in cooperation with FNN.
- Active participation in the recently established Forum Netztechnik/Netzbetrieb des VDE (FNN).
- Consideration of the specifications for the TransmissionCode 2007 in future revisions.
- Evaluation of the EEG technical requirements during the next EEE Progress Report.

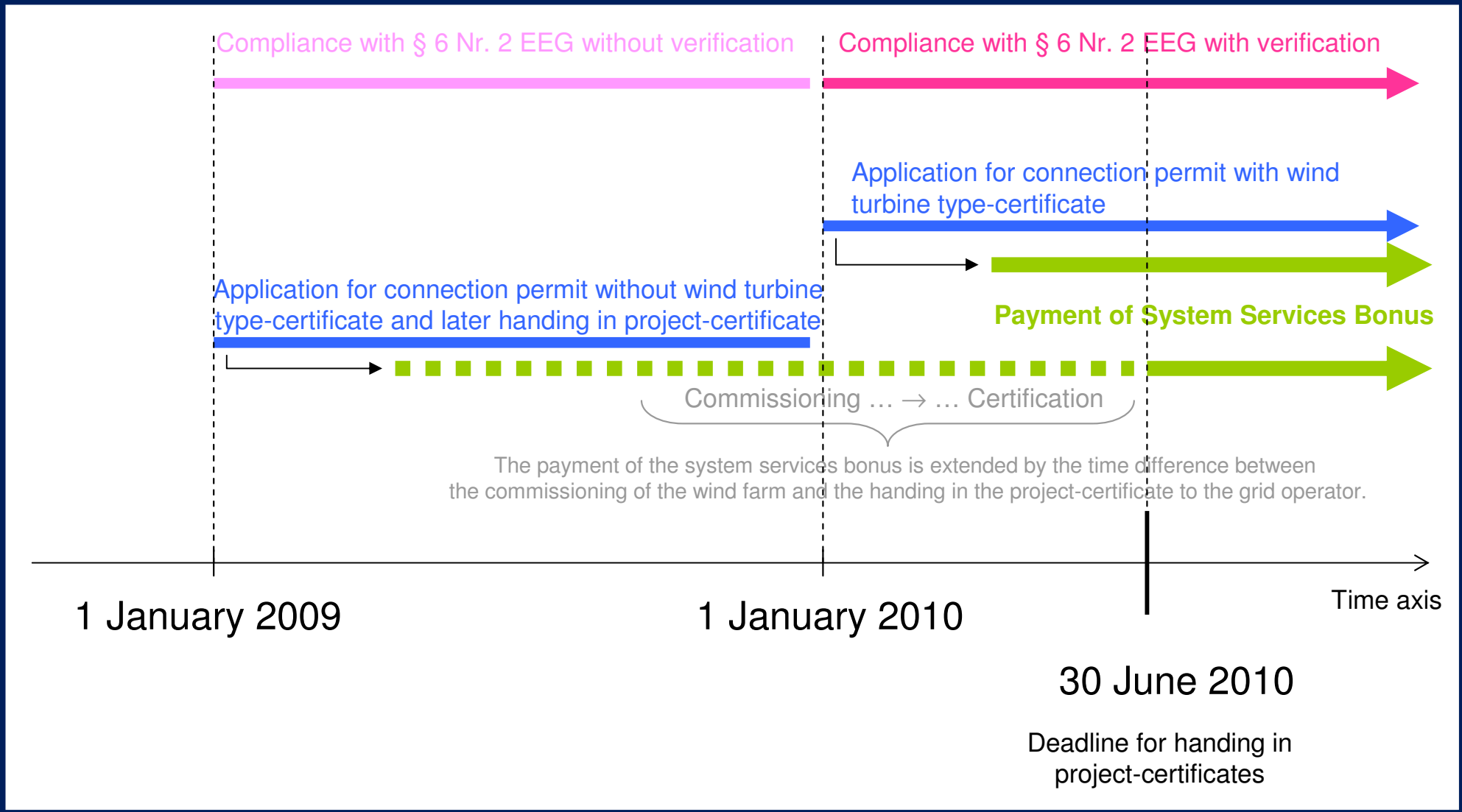
Thank you for your attention!

Dipl.-Ing. Jens Bömer
Tel. +49 (30) 2977 3579 14
j.boemer@ecofys.com

Ecofys Germany GmbH
Stralauer Platz 34
D-10243 Berlin
Germany

www.ecofys.com

Transitional Arrangements



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Technical Requirements

TransmissionCode 2007 with specifications

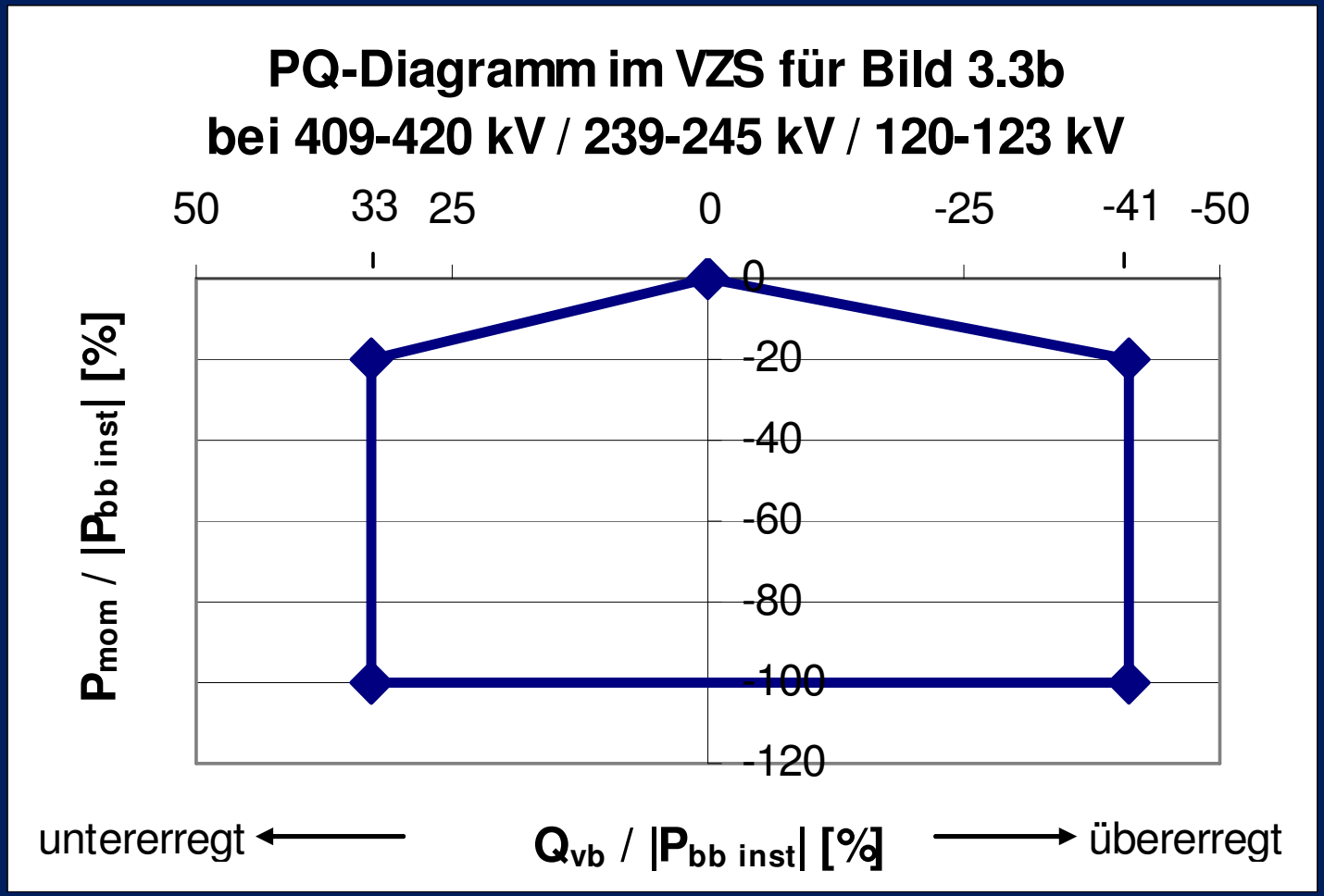
Analysis: TC2007 had to be specified!

→ Specifications among others:

- Active power generation
  - Generation of „available active power P_{vb}" during frequency drops
  - Active power reduction at over frequency relative to P_{vb}
- Reactive power provision
  - Slow reactive power control during normal operation (10 minutes)
  - Completion of Figures 3.3a to 3.3c with partial load operation
- Behaviour during network faults
  - Ride-Through of unsymmetrical network faults
  - Wording and Figure 3.6 for voltage support during faults by reactive current feed

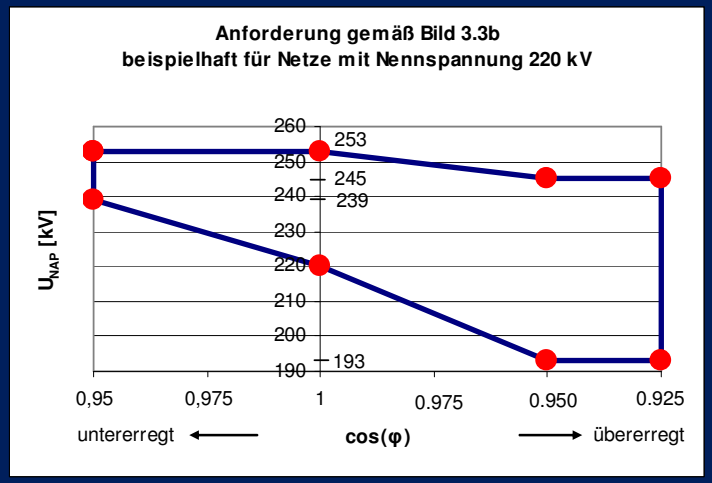
TransmissionCode 2007 with specifications

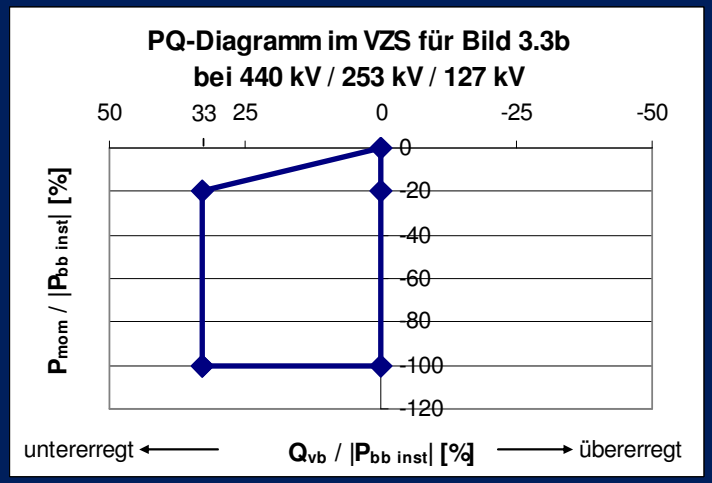
1st Example: Reactive power at partial load (Var. 2)

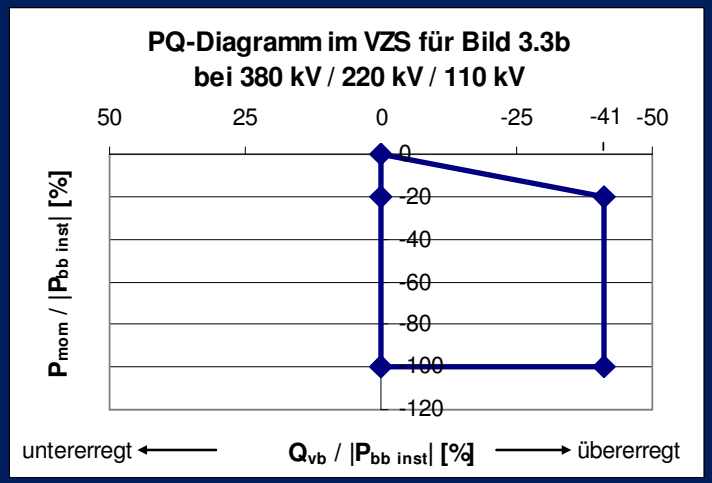


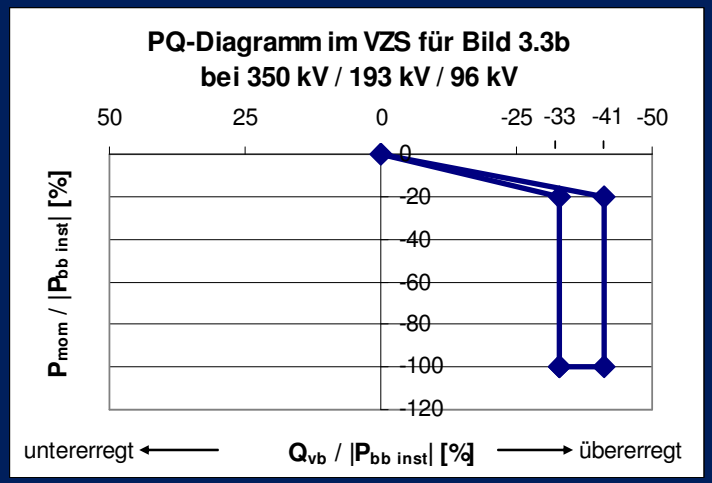
TransmissionCode 2007 with specifications

1st Example: Reactive power at partial load (Var. 2)



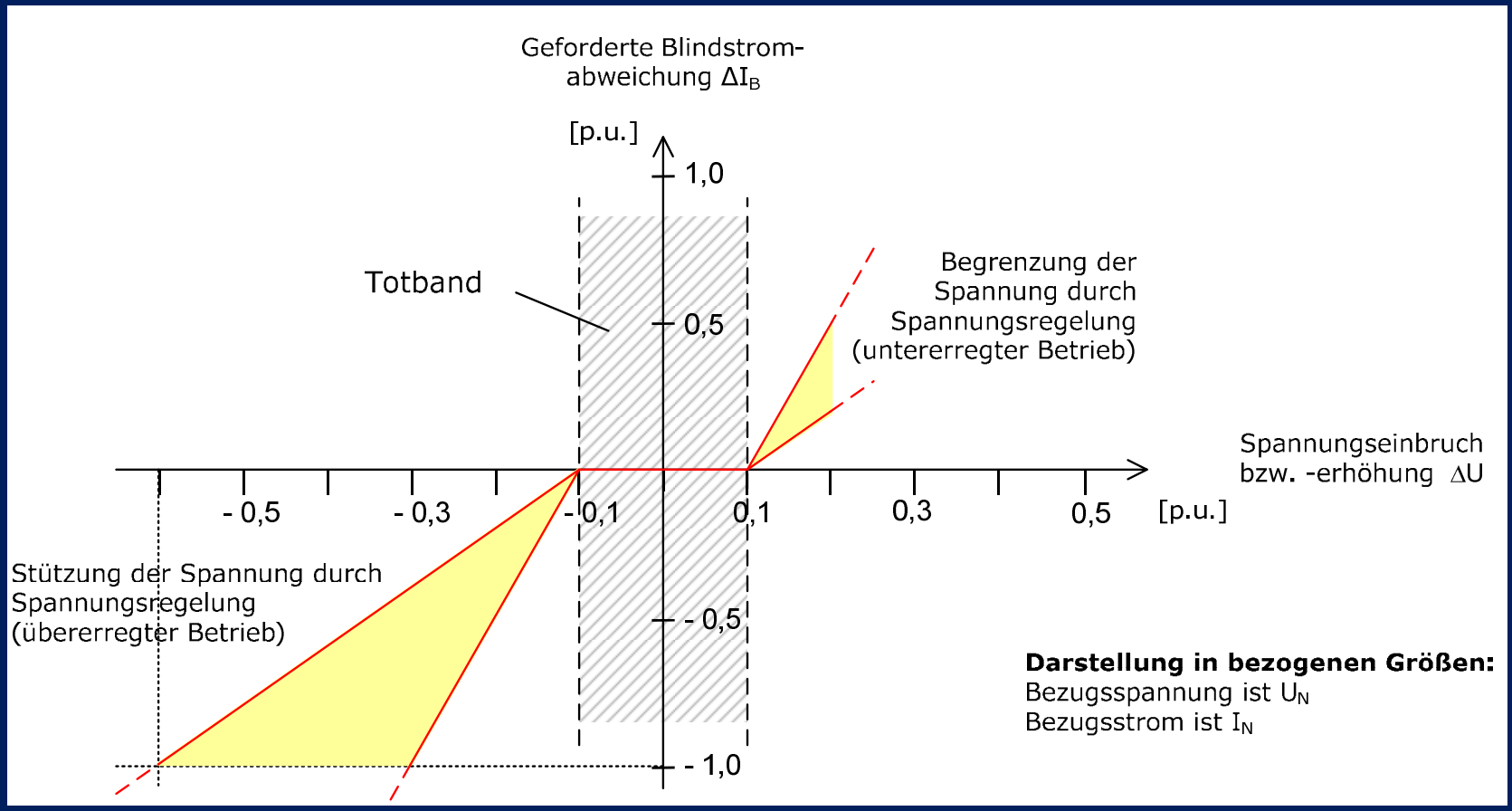






TransmissionCode 2007 with specifications

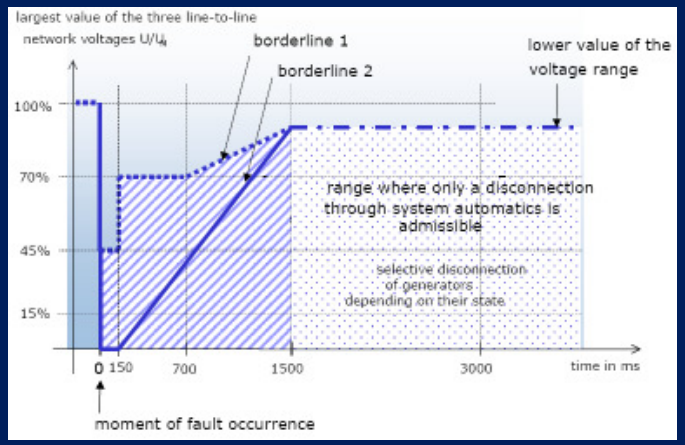
2nd Example: Reactive power feed during faults (Fig. 3.6)



Technical Requirements

Requirements for retrofitted facilities

TC2007



- FRT according to Fig. 3.5 in TC2007 above borderline 1:
  - 45% U_n for 150 ms
  - 70% U_n for 300 ms
- Reactive power – undervoltage protection (Q➔ & U<) must be installed.
- Disconnection from the network not allowed for frequencies between 47.5 Hz und 51.0 Hz
- Active power reduction at over frequency
  - 50,2 – 51,0 Hz: Reduction with 40% P_{vb}/Hz | $P_{vb} \geq 50\%\ P_{bb\ inst}$
  - 51,0 – 51,5 Hz: progressive disconnection by protection relays
- On request from grid operator, automatic reconnection to the grid after (regional) blackouts must be inhibited.