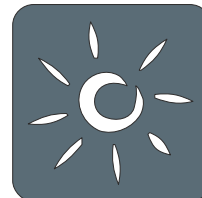


# Technical Guidelines

## for Power Generating Units

**Part 8:**  
**Certification of the Electrical**  
**Characteristics of Power Generating**  
**Units and Systems in the Medium-,**  
**High- and Highest-voltage Grids**

**Revision 2**  
**18.12.2009**



**Published by:**  
**FGW e.V.**  
**Fördergesellschaft Windenergie**  
**und andere Erneuerbare Energien**

# **Certification of the Electrical Characteristics of Power Generating Units and Systems in the Medium-, High- and Highest-voltage Grids**

**Revision 0  
18.10.2009**

## **Published by**

FGW e.V.

Fördergesellschaft Windenergie und andere Erneuerbare Energien

Stresemannplatz 4, 24103 Kiel

Phone +49 431 66877-64

Fax +49 431 66877-65

Email [info@wind-fgw.de](mailto:info@wind-fgw.de)

Internet [www.wind-fgw.de](http://www.wind-fgw.de)

## **The following parts are available:**

Part 1	Determination of Noise Emission Values
Part 2	Determination of Power Curves and Standardised Energy Yields
Part 3	Determination of the Electrical Characteristics of Power Generating Units in the MV, HV and HiV Grid
Part 4	Demands on Modelling and Validating Simulation Models of the Electrical Characteristics of Power Generating Units and Systems
Part 5	Determination and Application of Reference Yield
Part 6	Determination of Wind Potential and Energy Yields

Reprints, reproduction, or similar processes only with written permission of the publisher.

Part 7	Maintenance of Wind Farms
Part 8	Certification of the Electrical Characteristics of Power Generating Units and Systems in the Medium, High and Highest-voltage Grids

## Foreword

The preparation of these Technical Guidelines for Wind Turbines (also known, since 1998, as FGW Guidelines) began in 1992 with the objective of presenting measuring methods allowing determination of reliable and comparable data for wind turbines (WTs) based on state-of-the-art technology. The measurements from these three fields - power curve, noise emissions and electrical characteristics - should serve as the foundation for assessment of WTs, e.g. in permit issues, when assessing grid connection options or for reliable yield calculations.

In the meantime, the individual Technical Guidelines and the test reports compiled by independent measuring institutes are widely recognised in their fields. Power curves form the basis for purchase agreements and finance commitments, measured noise emission values are adopted both for sales contracts and in the course of approval procedures. Measurements of electrical characteristics in accordance with this Technical Guideline are required by the transmission system operators for the purpose of calculations with regard to connections to their grids.

The demands on power generating units and systems are formalised with the publication of the BDEW medium voltage guideline (Technical Guideline: Generation Systems in the Medium-voltage Grid) in June 2008. The medium voltage guideline is aimed at any type of generating unit, i.e. including photovoltaic systems or cogeneration plant, beside wind turbines. The conformity verifications for the generating units and systems must be provided in the shape of unit or system certificates.

The BDEW medium voltage guideline also represents a basis for the demands placed on the electrical characteristics of wind turbines with a connection to the medium-voltage grid introduced by statutory ordinance (System Services Ordinance – *SDLWindV* – draft dated 02.03.2009; Source: <http://www.erneuerbare-energien.de/inhalt/43342/>) in the course of the revision of the Renewable Energy Sources Act (*EEG*) dated 01.01.2009. The System Services Ordinance refers to the Transmission Code 2007 for the corresponding demands in terms of the high- and highest-voltage levels and defines a number of specifications. These demands resulting from the *EEG* generally apply to all new systems. In addition, the ordinance introduces a verification procedure for operating wind turbines, which can lead to the payment of what is called the system services bonus even for these previously operating systems.

This Guideline aims to provide common ground between manufacturers, system and grid operators, testing institutes and certification agencies and a coordinated framework for the corresponding inspection and/or certification procedures and specifications.

### Compilation of these guidelines

The contents of the Technical Guidelines are the responsibility of the respective technical committees and working groups. The following bodies were involved in the compilation of this Guideline by the working groups: Independent measuring institutes, emission protection agencies of the Federal Republic of Germany, manufacturers of power generating units (PGUs) and their components, grid operators, institutes and universities, engineering consultancies, Forum Netztechnik/Netzbetrieb im VDE (FNN), and Fördergesellschaft Windenergie e.V. (FGW).

Contents	2
----------	---

## Contents

1	Introduction	4
2	Scope	5
3	General Information	7
3.1	Abbreviations	7
3.2	Definitions	7
4	Certification procedure	11
4.1	General provisions	11
4.1.1	Applying for and initiating the certification procedure	11
4.1.2	Assessment of conformity	11
4.1.3	Model validation in the PGU certificate	12
4.1.4	Certification decision	12
4.1.5	Certificate issuing	12
4.1.6	Period of certificate validity	12
4.1.7	Alteration and modifications	12
4.1.8	Monitoring	13
4.1.9	Certificate extension	13
4.2	Unit certificates (new generating units)	14
4.2.1	Scope	14
4.2.2	Specific procedure instructions	14
4.2.3	Evaluation of test reports	14
4.2.4	Model validation	15
4.2.5	Reporting and recommendation	16
4.2.6	Certificate issuing	16
4.3	System certificates and reports	17
4.3.1	Scope	17
4.3.2	Verification process and scope	18
4.3.3	Procedure instructions	19
4.4	Old systems in accordance with section 5 SDLWindV	20
4.4.1	Scope	20
4.4.2	Specific procedure instructions	20
4.4.3	Evaluation of test reports	20
4.4.4	Reporting and recommendation	21
4.4.5	Certificate issuing	21
5	Scope and specification of evaluation	22
5.1	General specifications	22
5.2	Active power provision	22
5.2.1	Active power	22
5.2.2	Active power reduction by defined setpoint	23
5.2.3	Active power reduction for overfrequency	23

Reprints, reproduction, or similar processes only with written permission of the publisher.

Contents	3
5.2.4 Active power gradient (restarting after disconnecting)	23
5.3 Reactive power provision	24
5.3.1 Verification of reactive power data	24
5.3.2 Q-step response	24
5.4 System perturbations	25
5.5 Verification of cut-in conditions	25
5.6 Performance during line faults	25
5.6.1 Low-voltage ride-through (LVRT)	25
<b>Table 1: LVRT measurements before 01.01.2009 for new systems</b>	<b>25</b>
5.6.2 Reactive power profile and determination of the proportionality constant K	26
5.6.3 Determination of short-circuit current contributions	27
5.6.4 Power enhancement after fault rectification	28
5.7 Protective devices	28
5.7.1 General information	28
5.7.2 Over- and undervoltage protection	28
5.7.3 Over- and underfrequency protection	28
5.8 Unit certificate for old systems according to SDLWind, §5	29
5.8.1 Ride-through symmetrical and asymmetrical faults (number 2)	29
5.8.2 Reactive power undervoltage protection (number 3)	29
5.8.3 Frequency change behaviour (number 4)	29
5.8.4 Active power reduction for overfrequencies (number 5)	30
5.8.5 Blocking automatic recoupling (number 6)	30
<b>6 Unit model requirements</b>	<b>31</b>
6.1 General requirements	31
6.2 Models for a fault situation	31
6.2.1 Model validation	31
6.2.2 Examining models for plausibility	32
<b>7 Specific provisions for the assessment of wind turbines under the terms of the SDLWindV</b>	<b>33</b>
7.1 General information	33
7.2 Quality requirements for experts	34
7.3 Assessment of old systems	35
7.3.1 Assessment principles	35
7.3.2 Scope of evaluation	35
7.3.3 Contents of the expert report	39
7.4 New systems	39
<b>8 Cited standards and guidelines</b>	<b>40</b>
<b>9 Annex A – PGU certificates (templates)</b>	<b>41</b>
<b>10 Annex B – Questionnaires</b>	<b>42</b>

# 1 Introduction

Representatives of the following groups were involved in the compilation of this FGW Guideline, Part 8: Certification of the Electrical Properties of Power Generating Units and Systems in the Medium-, High- and Highest-voltage Grids (TG8):

grid operators;

manufacturers of power generating units and their components;

recognised institutes and universities;

certifications agencies of power generating units and their components.

All parties involved have expressed the desire that this Guideline should be viewed as a common working basis for answering questions concerning the certification of the electrical characteristics of PGUs and PGS'.

The aim of this Guideline is to improve application of the regulations issued by the grid operators, in particular the guideline for the connection and parallel operation of generation systems in the BDEW medium-voltage grid /1/ (hereafter referred to as the "BDEW Medium-voltage Guideline) and the unit and system certificates required therein by issuing a uniform implementation regulation for certification procedures, their areas of application and for determining measurement results as well as for validation of PGU models and the simulation of system performance and by introducing a standardised formal treatment of these certification procedures. In addition, the Guideline aims to provide a common basis for the verification procedures with regard to the electrical characteristics for connecting these systems to the medium-, high- and highest-voltage grids and for remuneration of the system services bonus for previously operating systems in accordance with Section 6 No. 2 and Section 29(2) Sentence 4 of the Renewable Energy Sources Act (*EEG*), as demanded in the Wind Turbine System Services Ordinance (System Services Ordinance – *SDLWindV*) /2/.