

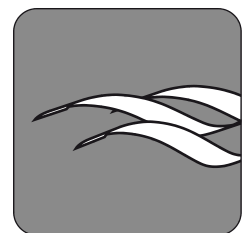
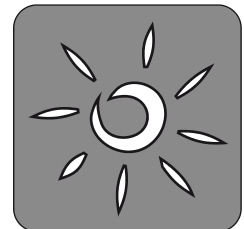
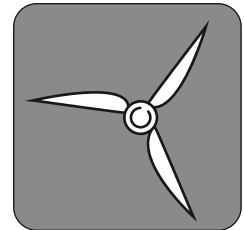
Technical Guidelines

for Power Generating Units and Systems

PART 8 (TG 8)

**Certification of the Electrical
Characteristics**
of Power Generating Units and
Systems in Medium-, High-
and Extra-High Voltage Grids

Revision 07
Dated 01/03/2016



Published by
FGW e.V.
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und andere Erneuerbare Energien

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There is no distinction between genders so that the text is easier to read. The corresponding terms apply in principle to both genders within the meaning of equality.

Following Parts of FGW Technical Guidelines 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 and Systems in Medium-, High-, and Extra-High Voltage Grids

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 Yield

Part 7: Operation and Maintenance of Power Plants for Renewable Energy

Category A: Miscellaneous Section

Category B3: Specialist Application Notes for Monitoring and Testing Foundations and Supporting Structures for Wind Turbines

Category D2: State-Event-Cause Code for Power Generating Units (Zustands-Ereignis-Ursachen-Schlüssel, ZEUS)

Category D3: Global Service Protocol (GSP)

Category D3 – Annex A: XML-Schema Documentation

Part 8: Certification of the Electrical Characteristics of Power Generating Units and Systems in the Medium-, High- and Extra-High Voltage Grids

Part 9: Determination of High Frequency Emissions from Renewable Power Generating Units

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 the three fields of 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 increasingly recognised in their fields. Power curves form the basis for purchase agreements and finance commitments, measured noise emission values are applied both for sales contracts and are used in the course of approval procedures. Measurements of electrical characteristics in accordance with these Technical Guidelines are required by the transmission system operators for the purpose of calculations with regard to connections to their grids.

With the publication of the BDEW guideline 'Generating plants connected to the medium-voltage network' (in short: BDEW MV guideline) [1] in June 2008, the requirements for power generating units and systems were formalised. The BDEW MV guideline is aimed at any type of generating unit, i.e. including photovoltaic systems or cogeneration plants, beside wind turbines. Verification for the generating units and systems must be provided in the form of unit or system certificates.

With the BDEW MV guideline, the Renewable Energy Sources Act [2] and the Ordinance on System Services by Wind Energy Plants (in short: SDLWindV) [3] a framework of requirements was created for the electrical characteristics of WTs connected to the medium-voltage grid, which has been modified again and again in the years after 2009 by supplements, revisions and amendments. For the corresponding requirements and in terms of the high- and extra-high voltage levels, SDLWindV refers to the Transmission Code 2007 (in short: TC 2007) [4] and defines a number of specifications. These requirements resulting from the EEG generally apply to all new systems. The VDE application guide VDE-AR-N 4120 (in short: TCC High-Voltage) [5] came into force on 01/01/2015, the requirements of which may be met by newly commissioned infeeders by 01/01/2017 and must be met after that date. The scope of the TCC High-Voltage aims to override the TC 2007 and Chapters 3 and 5 concerning grid connections at the high-voltage level of the VDN Guideline 'EEG-Erzeugungsanlagen am Hoch- und Höchstspannungsnetz' of 2004 [6].

These guidelines provide a framework for the corresponding certification procedures and specifications which has been agreed jointly by manufacturers, system and grid operators, testing institutes and certification bodies, electrical planners and installers.

This guideline is an english translation of a prior german version. In any case of distinction between both revisions of TG 8 the german version is valid. In case of the use of non-gender neutral language, it is not the aim of the technical committee to discriminate against any gender.

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 these guidelines by the working groups: independent measuring institutes, emission protection agencies of the Federal Republic of Germany, manufacturers and certification bodies of power generating units and their components, grid operators, institutes and universities, engineering consultancies and FGW e.V. - Fördergesellschaft Windenergie und andere Erneuerbare Energien (FGW e.V.).

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Abbreviations used

| | |
|-------------------|--|
| AC | Alternating Current |
| BDEW | Bundesverband der Energie- und Wasserwirtschaft e.V. |
| BDEW MV guideline | BDEW medium-voltage guideline 'Generating plants connected to the medium-voltage network' [1] |
| BMS | Battery management system |
| CE | Combustion engines |
| CGP | Cogeneration plant |
| CISPR | Comité International Spécial Des Perturbations Radioélectriques |
| DIN | Deutsches Institut für Normung e.V. (German Institute for Standardisation) |
| EEG | Erneuerbare-Energien-Gesetz (Renewable Energy Sources Act) [2] |
| EHV grid | Extra-high voltage grid |
| EMC | Electromagnetic compatibility |
| EN | European norm/standard |
| FACTS | Flexible AC Transmission System |
| FGW | FGW e.V.-Fördergesellschaft Windenergie und andere Erneuerbare Energien |
| FNN | Forum network technology/network operation in the VDE |
| FRT | Fault ride-through |
| GCP | Grid connection point |
| GCR | Grid connection regulations |
| GenSet | Combination of generator and prime mover, used for CEs |
| GO | Grid operator |
| HV grid | High-voltage grid |
| IEC | International Electrotechnical Commission |
| ISO | International Organisation for Standardization |
| LV | Low voltage |
| LVRT | Low voltage ride-through |
| MV | Medium voltage |
| MV grid | Medium-voltage grid |
| PCC | Point of Common Coupling |
| PGS | Power generating systems (in accordance with BDEW MV guideline) |
| PGU | Power generating units: individual units for generating electrical energy (in accordance with BDEW MV guideline) |
| PVS | Photovoltaic system |
| SDLWindV | Ordinance on System Services by Wind Energy Plants [3] |
| SMT | Standardized Manufacturer Tests |

| | |
|------------------|---|
| SS | Busbar |
| STATCOM | Static Synchronous Compensator |
| SVC | Static Var Compensator |
| TC 2007 | Transmission Code from 2007 [4] |
| TCC | Technical Connection Conditions |
| TCC High-Voltage | Technical requirements for the connection and operation of customer installations to the high-voltage network (VDE-AR-N 4120) [5] |
| TG | Technical Guidelines |
| TG 3 | Technical Guidelines 3 by FGW [7] |
| TG 4 | Technical Guidelines 4 by FGW [8] |
| THC | Total Harmonic Current Distortion |
| TS | Transformer substation |
| VDE FNN | Forum network technology / network operation in the VDE (FNN) |
| VDN | Association of German Power Transmission System Operators (Verband der Netzbetreiber e.V.) |
| WT | Wind turbine |
| ZVEI | German Electrical and Electronic Manufacturers' Association |