

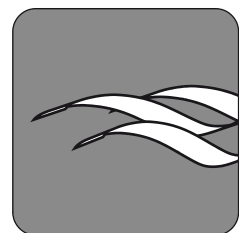
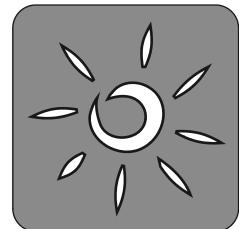
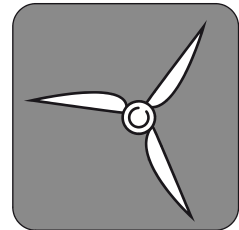
Technical Guidelines

for Power Generating Units and Systems

PART 3 (TG 3)

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

Revision 24
Dated 01/03/2016



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

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In the interest of easier readability, a gender-neutral differentiation is not used here. Any gender-specific terminology always refers to both genders.

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 – Attachment 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 aim 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 these Technical Guidelines and the associated test reports compiled by independent measuring institutes are widely recognised in their respective fields. Power curves form the basis for purchase agreements and finance commitments, measured noise emission values are adopted 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.

Compilation of these guidelines

The contents of the Technical Guidelines are the responsibility of the respective technical committees and working groups. This guideline is an English translation of a prior German version. In any case of distinction between both revisions of TG 3 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. 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 of power generating units (PGUs) and their components, grid operators, institutes and universities, engineering consultancies, Forum Netztechnik/Netzbetrieb (Forum network technology / network operation) im VDE (FNN), and Fördergesellschaft Windenergie und andere Erneuerbare Energien (FGW e.V.).

Measurements and their recognition

Measurements in accordance with the Technical Guidelines can be carried out by any qualified measuring institute. A test report shall be written documenting the measurements carried out, taking into consideration the requirements of these guidelines. Based on the test report, the results can be summarised in a test report extract applying the specifications provided in these guidelines (FGW master data sheet).

It should be noted that, over and above the specifications described in these Technical Guidelines, the agency requested to recognise the measurements may place further demands on the measuring institute. For example, certifiers of PGU measurements require measuring institutes accredited to ISO/IEC 17025.

FGW conformity

Independent measuring institutes can emphasise the quality of their work by the use of a conformity seal. The seal is applied at the bottom of the test report (or extract from the test report). After supplying a proof of certain quality characteristics, independent measuring institutes can apply for an entitlement to use the conformity seal. These quality characteristics are published on the FGW website.

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Abbreviations used

BDEW	Bundesverband der Energie- und Wasserwirtschaft e.V. (German Association for Energy and Water Supply)
CGP	Cogeneration plant: PGU with combustion engine, from which both electrical and thermal energy are utilised
DIN	Deutsches Institut für Normung e.V. (German Institute for Standardisation)
EMC	Electromagnetic compatibility
EN	European norm/standard
PGS	Power generating system
PGU	Power generating unit, individual unit for generating electrical energy, corresponds to [1].
FACTS	Flexible Alternating Current Transmission System
FGW	FGW e.V. - Fördergesellschaft Windenergie und andere Erneuerbare Energien
FNN	VDE Forum für Netzbetrieb/Netztechnik (Forum network technology/network operation)
FRT	Fault ride-through
HV grid	High-voltage grid
EHV grid	Extra-high voltage grid
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
LVRT	Low voltage ride-through
MPP	Maximum Power Point (solar modules are normally operated at the point of maximum performance)
MV grid	Medium-voltage grid
Neg. seq.	Negative phase sequence system
GCP	Grid connection point
GCR	Grid connection regulations
GO	Grid operator
OVRT	Overvoltage ride-through
PV	Photovoltaic system
Pos. seq.	Positive phase sequence system
RMS	Root mean square
TG	Technical Guidelines
UPS	Uninterruptible power supply
TS	Transformer substation
VDN	Verband der Netzbetreiber e.V. (Association of German Power Transmission System Operators)

CE	Combustion engine
WT	Wind turbine
ZVEI	Zentralverband Elektrotechnik- und Elektronikindustrie e.V. (German Electrical and Electronic Manufacturers' Association)