IEC-News: Power Performance

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Die IEC Norm 61400-12 (deutsche Fassung: DIN EN 61400-12, Juli 99, Windenergieanlagen, Teil 12: Meßverfahren zur Bestimmung des Leistungsverhaltens bei Windenergieanlagen) wird zur Zeit im Rahmen einer Revision dem neuesten Stand der Technik angepaßt. Die existierende Norm ist bei der Beurteilung der Komplexität des Geländes von Nabenhöhen in der Größenordnung von 30 bis 40 m ausgegangen. Kleine Steigungen oder Hindernisse im Gelände führen dazu, daß vor Errichten der Anlage eine Standortkalibrierung des Standortes mit zwei(!) Meßmasten durchgeführt werden muß, um eine Leistungskurvenvermessung durchführen zu können. Die revidierte Fassung wird den Einfluss der Nabenhöhe berücksichtigen, da bei den jetzt üblichen Nabenhöhen zwischen 60 und 80 m die Einflüsse von Hindernissen und Geländesteigungen geringer sind, und somit eine Standortkalibrierung nur in wirklich komplexem Gelände notwendig ist.

Ein weiteres Problem stellt das Verhalten unterschiedlicher Anemometertypen im Freifeld dar. Es hat sich im Rahmen eines EU-Forschungsprojektes (JOR3-CT98-0257) gezeigt, dass selbst nach MEASNET im Windkanal kalibrierte Anemometer im Freifeld zunächst unerklärliche Abweichungen um bis zu 4 % aufweisen können. Ein möglicher Erklärungsversuch ist das Anströmverhalten der Anemometer. Einige Anemometer messen tendenziell die momentane Horizontalkomponente der Windgeschwindigkeit, andere Anemeometertypen messen tendenziell die Vektorwindgeschwindigkeit des turbulenten Windfeldes. Dies führt zu Unterschieden in Leistungskurven, die bis zu 10 % des Energieertrages betragen können. Das ist für den Windenergiemarkt natürlich nicht akzeptabel und führt zu großen Schwierigkeiten bei der Vergleichbarkeit von Anlagen und bei der Formulierung von Leistungskurvengarantien in Kaufverträgen. Möglich ist auch, z.B. in MEASNET, die Einführung eines geeigneten Standardanemometers, was auch das Ziel eines anderen EU-Projektes (ClassCup) ist. Der Markt verlangt auf jeden Fall nach einer raschen Klärung des Problems, noch bevor in einigen Jahren die neue Revision der IEC erscheint. Daher ist hier MEASNET ein geeignetes Gremium schnell auf die Anforderungen des Marktes zu reagieren und in der MEASNET-Richtlinie für Leistungskurvenvermessungen eine Harmonisierung der Vermessungsvorschriften herbeizuführen, um wieder vergleichbare und belastbare Leistungskurvenvermessungen zu erhalten.

The IEC 61400-12 Power Performance Measurement standard is at present being revised to incorporate the latest developments in technology. The existing standard is defining the complexity of the terrain in relation to hub heights in the range 30 to 40 m which were most common at the time when this standard was issued. If there are slopes in the range of only a few per cent or small obstacles with heights in the range of a few metres the terrain is defined as complex so that a site calibration with two (!) masts is required before the erection of the turbine. This is obviously overdone for hub heights of about 60 to 80 m where such small distortions of the wind field are negligible. The revision will take this into account so that the complexity is defined in relation to the hub height of the turbine. A site calibration therefore is only necessary in really complex terrains.

Another problem is the behaviour of different types of anemometers in the free field. Results of anemometer comparisons in the free field within an EU-project (JOR3-CT98-0257) showed that there can be unexplainable significant differences in the wind speeds measured with different types of anemometers even if the anemometers were calibrated in the same wind tunnel according to high quality standards (MEASNET/IEA). One of the possible reasons seems to be that some cup anemometer types tend to measure only the horizontal wind speed component while others tend to measure the wind vector. Depending on the height of the measurements the differences can be up to 4 % resulting in power curve measurements differing up to 10 % in energy production. Such differences are of course unacceptable within the wind energy market so that there is a strong need for a definition of the requirements for wind speed measurements. As the revision of the IEC standard will not be issued before 2002 the market requires a faster agreement based on a classification system for cup anemometers and possibly the definition of a reference anemometer in order to get consistent results. As the market cannot wait several years a recommendation could be given within MEASNET. The MEASNET guideline for power curve measurement could bring about a harmonisation of measurement regulations in order to obtain once more comparable and reliable power curve measurements.

Other topics of the revision are for example Site Calibration, Extrapolation of wind speeds for

Weitere Themen der Revision sind Extrapolation von Windgeschwindigkeiten für Nabenhöhen über 70 oder 80 m, Definition der Anlagenverfügbarkeit und der Einfluß von Windscherungen und Turbulenz auf das Leistungsverhalten.

very large hub heights, definition of availability, Influence of wind shear and turbulence.

International Standard (IEC) for the Measurement of Mechanical Loads of Wind Turbines.

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The IEC recently circulated the “voting version” of an International Standard (to be more precise: a Technical Specification) on the subject of mechanical load measurements of wind turbines (CDV of IEC 61400-13). This document is the creation of Working Group 11 of TC 88, which got the task to make a recommendation how to measure mechanical loads on wind turbines for the purpose of design verification. Working Group 11 consists of members from Denmark, Germany, United Kingdom, Greece, Japan, USA and The Netherlands, all strongly involved and with long experience in the practice of load testing both from industry and research centre point of view.

Methods for measuring power curves and acoustic noise of wind turbines already have been standardised within IEC and the same can now (almost) be said of load measurements. The new recommendation will be useful as well for designers and testers as in the process of wind turbine certification. If the IEC

Recommendation on Wind Turbine Certification (IEC 61400-22, of which a CDV is circulating now as well) is followed, one will have to measure loads according to IEC 61400-13. Moreover, the WG 11 document has been set up in such a way that it can be used as the basis for protocols for high quality wind turbine measurements such as used in Measnet, the Network of European Measuring Institutes.

What can be found in the document? The recommendations essentially are organised in the following three main chapters:

- Load measurement programmes;
- Load measurement techniques;
- Processing of measured data.

As for the load measurement programmes, the report gives guidance how to set up measurement programmes that enable to check the compliance of the wind turbine design with IEC 61400-1 requirements. The conditions in which to measure are standardised with the help of so called Measurement Load Cases. A basic tool for organising the measurements is introduced i.e. with the Capture Matrix. Finally in this chapter the relevant physical quantities to be measured are specified and classified into load quantities, meteorological quantities and wind turbine operation quantities. It is indicated which quantities are mandatory for measurement programmes in compliance with the standards ultimate objectives (design verification) and which quantities are just recommended to be measured.

In the chapter about measurement techniques, most of the attention is given to the load quantities, although the document gives recommendations for all quantities to be measured. For each fundamental load quantity it is recommended where to install the instrumentation and how to undertake calibration. For the meteorological quantities basically it is recommended to follow IEC 61400-12.

A specific chapter is devoted to processing of the measured data. Subjects discussed are data validation (a/o. rejection/selection criteria), check of time series and the use of load statistics, the determination of load spectra (rain flow counting and extrapolation to other turbulence conditions) and determination of equivalent loads.

Some very specific subjects are elaborated in annexes (co-ordinate systems, evaluation of uncertainties involved with the measurements and extrapolation to other turbulence conditions). Also sample presentations of measurements are given in a specific annex as guidance.

Summing up all the previous, it can be said that the co-operation between wind turbine manufacturers, designers and leading wind turbine test centres under the umbrella of IEC TC88 has resulted in a new technical specification that by specifying uniform methodologies for "reality check" on wind turbine loading provides the basis for improved wind turbine design methods.

Due to the very lengthy procedures within IEC, the document will only get the status of IEC Publication at the earliest in September 2001 and is then available at the National Standardisation Committee. For Germany this will be the DKG, Deutsche Elektrotechnische Kommission in DIN and VDE.