CONTRACTUAL ISSUES DEALING WITH ENERGY PRODUCTION WARRANTIES

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Wind Farm Financing: Lessons learned from Contractual Issues dealing with Energy Production Warranties

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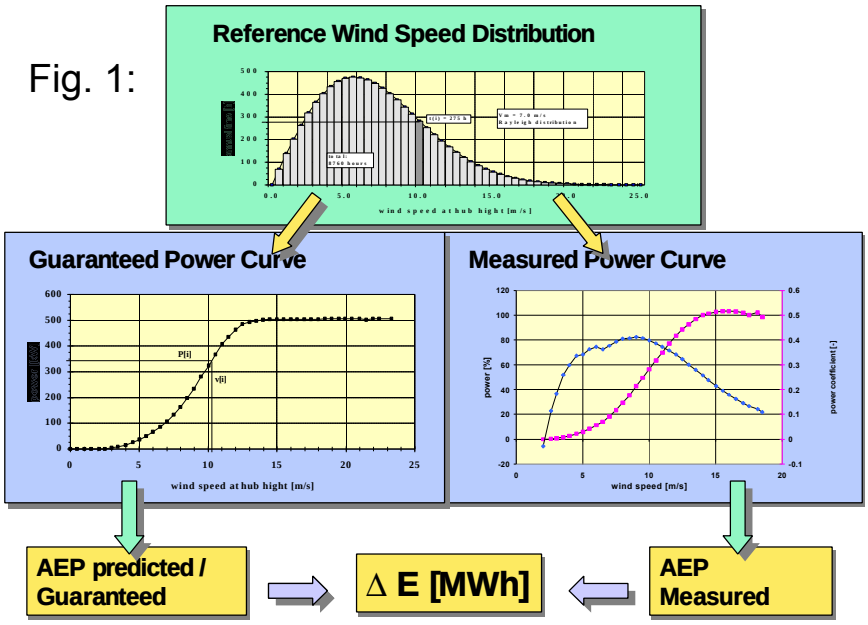
A crucial point for the economy of a wind farm are the contractual issues dealing with energy production warranties. These performance warranties guarantee that the turbines produce the energy expected from the existing wind conditions (see fig. 1). In terms of risk management or risk assessment the difficulty lies in the split of the risk 'wind conditions' normally taken by the owner and the risk 'wind farm performance' or 'individual turbine performance' normally taken by the manufacturer. Another difficulty is which measurement procedure can be used for the verification of the guaranteed performance and which terms of payment can be agreed upon if the verification shows that the turbines don't pass the acceptance test.

Fig. 1:



There are several ways of testing the performance of a wind farm. The IEC 61400-12 working group on Power Performance currently works on three different documents covering that scope:

- IEC 61400-121: Wind Turbine Power performance testing (Revision)
- IEC 61400-122: Wind Farm Performance Testing
- IEC 61400-123: Power Performance Verification

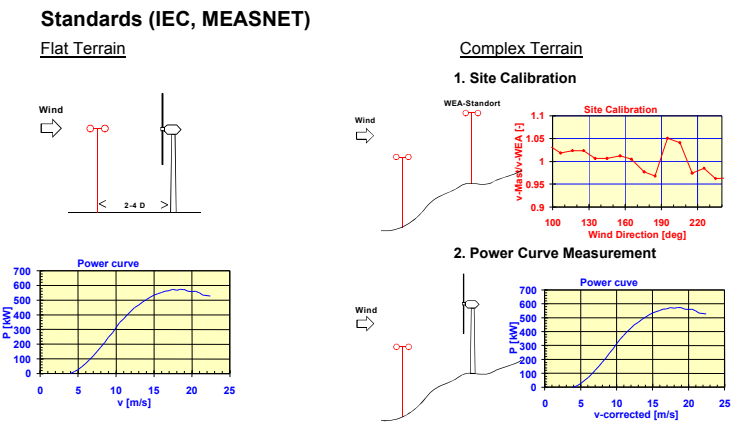
Doc. 121 is a revision of the existing standard which allows to measure the power performance of individual wind turbines. A meteorological mast at hub height is required close to the turbine (appr. at a distance of 2.5 D: D: rotor diameter of the turbine). For complex terrain a site calibration has to be performed before the erection of the wind turbines with two met masts (see fig. 2).

Doc. 122 will focus on alternative methods for power performance testing of individual wind turbines like nacelle anemometry, use of SODAR systems, extrapolation of wind speeds from a certain height to hub height, numerical site calibrations etc (see fig. 3).

In Doc. 124 the wind farm will be treated as a single power station and a method is proposed for testing the performance of a complete wind farm in relation to a reference point (location of a met mast) or several reference points (see fig. 4). This warranty covers in a simple way of measuring the performance testing of individual wind turbines, micro siting, wind farm efficiency and availability of the turbines. On the other hand the balance in the risk management is shifted partially from the owner to the manufacturer or to the developer of the wind farm (depending on the contract).

To negotiate a contract based on document 121 is the easiest job but an expensive and time consuming measurement campaign has to follow. The main points to be agreed upon are the number of turbines to be measured, which anemometer type is accepted by both parties (very important point!,

Fig.2: Verification of Power Curves



see /1/,/2/), how to treat the measurement uncertainties and which payment conditions are agreed upon if also a repeated test is below the warranties.

Fig.3: Verification of power curves by nacelle anemometry

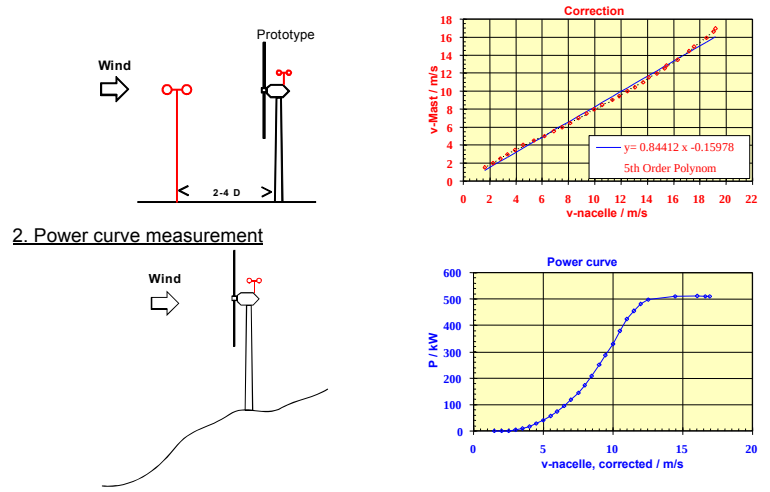
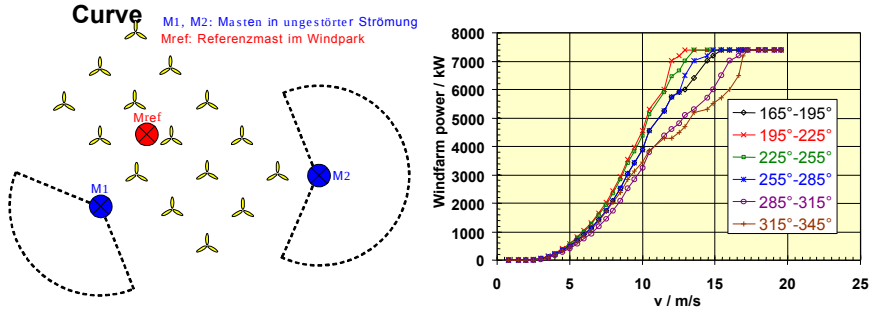


Fig. 4: Wind Farm Power Curve



- Wind Farm Power Curve for different wind direction sectors (30°)

The advantages and limits of the power performance verification based on nacelle anemometry was described in /3/. This method is often used in combination with the method above. That means the performance of one turbine is verified by means of the existing IEC standard, the other turbines (or a defined number of them) in the wind farm are verified by means of the nacelle anemometry.

The most difficult part is the risk assessment when comparing the warranties from different manufacturers. The manufacturer normally guarantees the energy output up to 100% minus x. When comparing the predicted energy yield from different types of turbines the decision has to be based on the probability that a turbine fails the acceptance criteria. The plausibility check of a guaranteed power curve is a very complex task within the due diligence work. Questions have to be answered like: according to which standard and which quality assurance system the guaranteed power curve is measured. Is the turbine planned in the project technically identical to the measured power curve (use of stall strips or vortex generators, contamination of blades, changes in the blade angle, noise reduction measures which influence the performance of the turbine) ?

References:

/1/ A. Albers, H. Klug, D. Westermann: Cup Anemometry in Wind Engineering, Struggle for Improvement, DEWI Magazin 18, 17-28, 2001. Available on http://www.dewi.de.

/2/ Albers, Klug:. Open Field Cup Anemometry, Proceedings of EWEC 2001, Copenhagen, 276-279.

/3/ Albers, Klug, Westermann: Power Performance Verification, Proceedings of EWEC 99, Nice, 657-660.