



New in WindPRO 2.5:
Turbulence from WTGs

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Turbulence Models in WindPRO 2.5

Introduction

Turbines operating in wakes are subjected to higher turbulence loading than turbines operating in the free (ambient) wind. Thus - when turbines are erected as clusters of turbines - appropriate turbulence calculations should be made e.g. before selecting the proper IEC turbine design class. Different turbulence model are typically very different in detailing level – and possible also in accuracy. The models range is from simple engineering models to the more advanced computational fluid dynamic (CFD) models.

Ambient turbulence levels

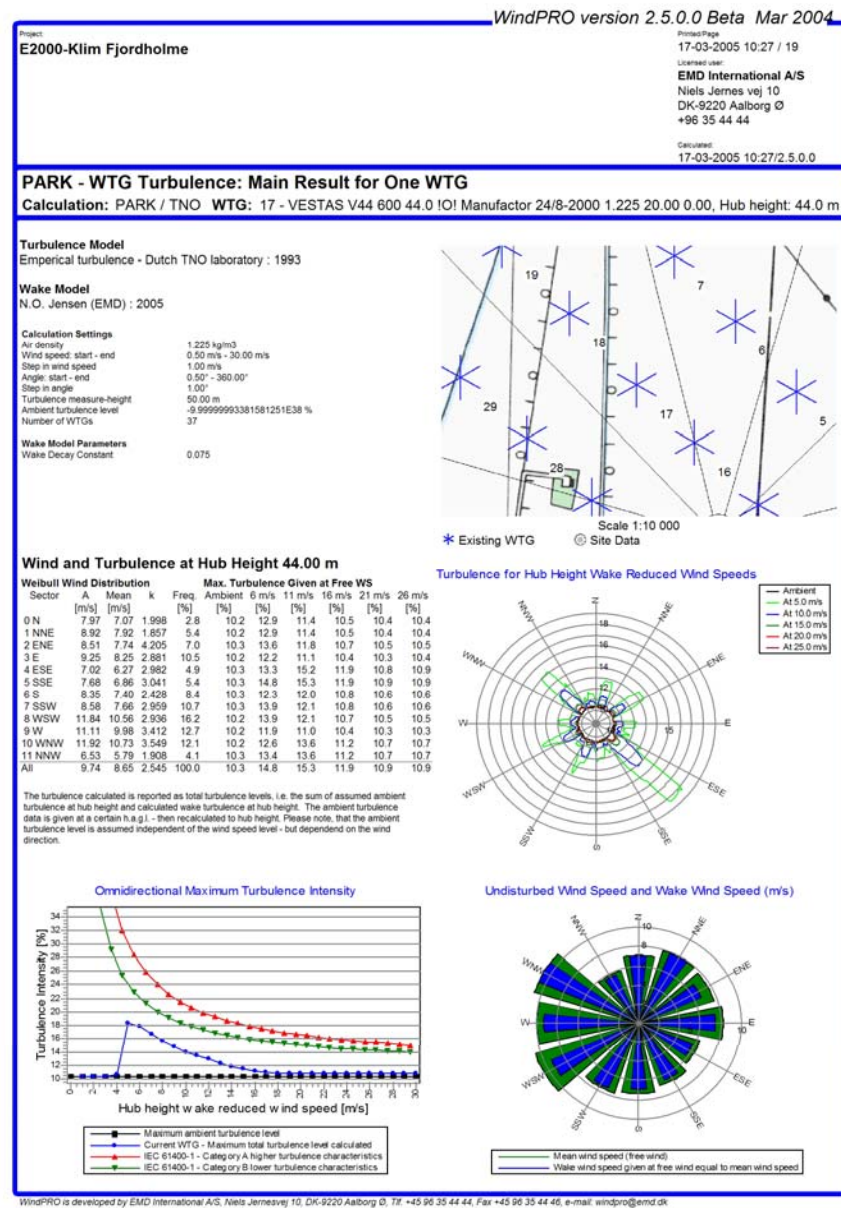
The ambient turbulence level is most appropriately estimated by actual on-site measurements of the turbulence. However, if measurements are not available, then WindPRO offers the option of estimating the turbulence from the roughness classification data available. A semi empirical model for vertical scaling of the ambient turbulence is also available, useful in the case of wind measurements in positioned not at hub height.

Wake (turbulence) models

The turbulence models are most used in combination with a wake velocity model, because wind speeds inside the wind farm must be determined in order to determine the right turbulence levels. However, also 'stand alone' turbulence models are available. In WindPRO 2.5, the following turbulence models are available:

- DR: 1992 (Danish Recommendation)
- Eddy Viscosity: 2003 (B. Lange)
- QA: 1996 (D.C. Quarton & J.F. Ainslie)
- G.C.Larsen: 1998 (European Wind Turbine Standards II)
- Dutch TNO Laboratory (EWTS II)
- S. Frandsen: 1999 (Efficient turbulence model)
- DIBt Richtlinie: 2004

Details on the implemented wake added turbulence models are available as online help and through the printed manual.



Turbulence estimation –
 WindPRO offers detailed turbulence data for individual WTGs.