Wake topical workshop 25.may 2011

1 Presentation of participants

Hans, Søren Ott (FUGA 3D), Andrey, Mark, Gunnar (Top Farm), Niels Troldborg (Actuator line, k-omega CFD), Robert Mikkelsen (actuator line), Niels Sørensen, Helge Aagaard (DWM model for merging wakes, wake turbulence, boundary layer equation), Flemming Rasmussen, Alfredo (stability dependence of adjusted park model),

Kurt S. Hansen (analyses of data), Jens Nørkær (acutator line acivities at Mech institute, Lyngby; adapted LES methods),

Tilman Koblitz (PhD stud.), Patric Volker, Thomas Buhl, Jakob Mann (data), Ole Rathmann ("Fuga-light"),

Pierre (Actuator Disc Model in EllipSys, problems when including ambient turbulence).

2 Overview of Available Data – Kurt S. Hansen (Topfarm)

Turbine-mast interactions: 9 different cases available – both on- and off-shore.

Turb.-Turb. Interaction: 11 cases, on-shore (incl. complex terrain) and off-shore.

Wake measurements: lidar measurements of wake profiles. Very impressing data when referring to the centre of the "moving frame" (meandering picture) – the centre position is determined from the measured lateral profile itself.

2 data sets available (single wake) – 1 double wake measurement planned.

3 Other set of experimental data

Helge Aagaard Madsen: 2003 tjæreborg data. Pitot tube on blades. Measured data of local inflow angle and yaw angular moment display fluctuations indicative of meandering. Measurements of blade surface pressure fluctuations display only minor dependence on inflow angle and hence on meandering. But inflow angle fluctuates clearly much more in a wake than in "free wind".

Measurements show a clear power deficit dependence on inlet turbulence intensity.

4 Related Wake Activities

4.1 Flow center (Jens Nørkær Sørensen).

Tasks in:

- Rotor/ABL aerodynamics,
- wakes and clusters,

- wind farms park-to-park effects,
- Siting in forested and complex terrain
- Amospheric boundary layers, e.g. temperature inversion implementation in Ellipsys.

Can sponsor guest stays at DTU (2days .. 2 months) and travels by DTU-staffs (e.g. to NREL)

4.2 PSO Nysted 2 (Gunnar C. Larsen)

Identification and modeling mechanisms of increased tower loading due to presence in offshore wind farm. Partners: E.ON, Grontmij-Carl Bro, Risø-DTU.

Strain gauge measurements in top and bottom of towers; temperature and pressure measurements.

4.3 Stability and Wake (Gunnar)

Stability effects on turbine structural loading and production losses in wind farms; control system load alleviation.

4.4 Carbon Trust (Hans)

OWA (offshore wind accelerator) – Carbon Trust

We have managed to get 1½ mill DKK.

4.5 MEXNEX

IEA-annex 29: turbine rotor data from wind tunnel measurements are analyzed in a coordinated way

(Ends 2011).

4.6 NREL-CRADA

Collaboration NREL – Risoe-DTU regarding - among others - wake modeling, e.g. using OpenFoam.

5 Future work planning

Hans: Benchmark model comparisons to selected data set of our own?

Kurt & Niels prepares some flow cases for a wake model benchmark.

The upcoming IEA WakeBench data (managed by NREL and CENER) might not be adequate for this purpose. Pierre and Kurt will prepare a proposal for funding the Risoe-DTU and DTU-MEK participation.

Scientific subjects:

Gunnar: Effect of wake meandering on large-scale turbulence.

The minutes have been prepared by Ole Rathmann.