Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Unsteady Flow in Different Atmospheric Boundary Layer Regimes and Its Impact on Wind-Turbine Performance IMAN GOHARI, Ph.D. Candidate, ARTEM KOROBENKO, Ph.D. , JINHUI YAN, Ph.D. Candidate, YURI BAZILEVS, SUTANU SARKAR, Professor — Wind is a renewable energy resource that offers several advantages including low pollutant emission and inexpensive construction. Wind turbines operate in conditions dictated by the Atmospheric Boundary Layer (ABL) and that motivates the study of coupling ABL simulations with wind turbine dynamics. The ABL simulations can be used for realistic modeling of the environment which, with the use of fluid-structure interaction, can give realistic predictions of extracted power, rotor loading, and blade structural response. The ABL simulations provide inflow boundary conditions to the wind-turbine simulator which uses arbitrary Lagrangian-Eulerian variational multiscale formulation. In the present work, ABL simulations are performed to examine two different scenarios: (i) A neutral ABL with zero heat-flux and inversion layer at 350m, in which the wind turbine experiences maximum mean shear; (2) A shallow ABL with the surface cooling-rate of -1 K/hr, in which the wind turbine experiences maximum mean velocity at the low-level-jet nose height. We will discuss differences in the unsteady flow between the two different ABL conditions and their impact on the performance of the wind turbine cluster in the coupled ABL-wind turbine simulations.

Iman Gohari
PhD Candidate

Date submitted: 28 Jul 2016 Electronic form version 1.4