Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Boundary Layer Effects on Wind Turbine's Tip Vortices using PIV Measurements[1] DAVID GREEN, Dept. of Aerospace Engineering and Mechanics, UMN, LEONARDO CHAMORRO, FOTIS SOTIROPOULOS, ROGER ARNDT, Dept of Civil Engineering, UMN, JIAN SHENG, Dept. of Aerospace Engineering and Mechanics, UMN — Understanding the complex interactions between vortical flow structures of the Horizontal Axis Wind Turbine (HAWT) and the atmospheric boundary layer is crucial to optimize blade design and turbine spacing in a wind farm. Tip vortices shed by the blades often play a key role. This paper focuses on the boundary layer flow interacting with a single turbine and multiple turbines in an in-line configuration using Particle Image Velocimetry (PIV) technique. The model has three blades with a span of 6.4 cm and 1.5 cm chord length. The tip speed ratio is set at roughly 5. The models are roughly within one fourth of the boundary layer. PIV measurement is phase locked on the position as the blade is passing through the measurement plane. Flow fields are captured up to 10 diameters or 87 chord lengths downstream. The effects on the turbine-generated vortical structures in a turbulent boundary layer are analyzed. Comparison to tip vortices produced in a free-stream mean flow will also be presented.

[1]Funded by NSF and DoE

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Date submitted: 05 Aug 2011 Electronic form version 1.4