Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

A numerical investigation of the role of the turbine rotor scale and the nacelle on wake meandering[1] DANIEL FOTI, University of Minnesota, XIAOLEI YANG, Stonybrook University, LIAN SHEN, University of Minnesota, FOTIS SOTIROPOULOS, Stonybrook University — Recent analysis of a hydrokinetic turbine (Kang et al. J. Fluid Mech., 2014) and laboratory scale wind turbine (Foti et al. Phys. Rev. Fluids, 2016) reveal that the turbine nacelle has a considerable effect on the turbulence kinetic energy and wake meandering. However, the role of the nacelle on wake meandering for utility-scale wind turbines has not been fully investigated. In this work, a numerical investigation using large eddy simulations of four wind turbines with rotor diameters ranging from laboratory to utility scale reveals similar turbulent structures in the far wake and a comparable wake meandering Strouhal number regardless of rotor size. By reconstructing the wake meandering with three dimensional spatio-temporal filtering process, first proposed in Foti et al. (Phys. Rev. Fluids, 2016), the statistics of the dynamics of the wake meandering are quantified in terms of amplitude and wavelength. Results indicate that the wavelength of wake meandering can be properly scaled by rotor diameter of the turbines for both simulations with and without a nacelle model. The meandering amplitude, on the other hand, is larger for the simulation with a nacelle. This is further quantitative evidence that a nacelle model is imperative to accurately capturing wake meandering.

[1]This work was supported by Department of Energy (DE-EE0002980, DE-EE0005482 and DE-AC04-94AL85000), and Sandia National Laboratories

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Date submitted: 22 Jul 2016 Electronic form version 1.4