Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Transition to bluff body dynamics in the wake of vertical axis turbines DANIEL ARAYA, California Institute of Technology, JOHN DABIRI, Stanford University — A unifying characteristic among bluff bodies is a similar wake structure independent of the shape of the body. We present experimental data to demonstrate that the wake of a vertical axis wind/water turbine (VAWT) shares similar features to that of a bluff body, namely a circular cylinder. For a fixed Reynolds number (Re $\approx 10^4$) and variable tip-speed ratio, 2D particle image velocimetry (PIV) is used to measure the velocity field in the wake of three different laboratory-scale turbines: a 2-bladed, 3-bladed, and 5-bladed VAWT, each with similar geometry. From the PIV measurements, the time-averaged and dynamic characteristics of the wake are evaluated. In all cases, we observe three distinct regions in the VAWT wake: (1) the near wake, where periodic blade shedding dominates; (2) a transition region, where blade vortices decay and growth of a shear layer instability occurs; (3) the far wake, where bluff body wake oscillations dominate. We further characterize this wake transition with regard to turbine solidity and examine its relation to the mean flow, an important metric for power production within a wind farm.

Daniel Araya
California Institute of Technology

Date submitted: 24 Jul 2015 Electronic form version 1.4