Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

The Influence of Waves on the Near-Wake of an Axial-Flow Marine Hydrokinetic Turbine ETHAN LUST, LUKSA LUZNIK, KAREN FLACK, US Naval Academy — Flow field results are presented for the near-wake of an axial-flow hydrokinetic turbine in the presence of surface gravity waves. The turbine is a 1/25 scale, 0.8 m diameter, two bladed turbine based on the U.S. Department of Energy's Reference Model 1 tidal current turbine. Measurements were obtained in the large towing tank facility at the U.S. Naval Academy with the turbine towed at a constant carriage speed and a tip speed ratio selected to provide maximum power. The turbine has been shown to be nearly scale independent for these conditions. Velocity measurements were obtained using an in-house designed and manufactured, submersible, planar particle image velocimetry (PIV) system at streamwise distances of up to two diameters downstream of the rotor plane. Phase averaged results for steady and unsteady conditions are presented for comparison showing further expansion of the wake in the presence of waves as compared to the quiescent case. The impact of waves on turbine tip vortex characteristics is also examined showing variation in core radius, swirl velocity, and circulation with wave phase. Some aspects of the highly coherent wake observed in the steady case are recognized in the unsteady wake, however, the unsteady velocities imposed by the waves, particularly the vertical velocity component, appears to convect tip vortices into the wake, potentially enhancing energy transport and accelerating the re-energization process.

Ethan Lust
US Naval Academy

Date submitted: 01 Aug 2017 Electronic form version 1.4