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Experimental characterization of marine hydrokinetic (MHK) turbine array performance NICKOLAS STELZENMULLER, ALBERTO ALISEDA, University of Washington — Three scale model horizontal axis MHK turbines (1:45) were tested in a flume at various array spacings. The scale rotors are based on the full-scale Department of Energy Reference Model 1, modified to reproduce the hydrodynamic performance of the full-scale turbine at the reduced experimental Reynolds number (10^5 vs 10^6, based on chord length). Flow incident on the turbines and in the wakes was characterized via PIV and ADV measurements. Tip speed ratio (TSR) similarity of the turbines is achieved by controlling the applied load with magnetic particle brakes. Single turbines were characterized at various mean freestream velocities to explore the effect of Reynolds number on turbine performance. Measured turbine efficiencies of $\sim$40% are similar to efficiencies predicted from full-scale simulations, indicating similar energy extraction at scale. Wake characteristics and turbine efficiencies have been investigated at a range of TSRs, with the goal of determining array spacing and operating conditions that maximize overall array efficiency. Free surface deformations were measured near the rotor plane for various vertical positions of the turbine relative to the free surface and compared to numerical simulation results.

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