

Abstract Submitted
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Flow structure in the near wake of a horizontal axis marine current turbine under steady and unsteady inflow conditions LUKSA LUZNIK, ETHAN LUST, KAREN FLACK, US Naval Academy — Near wake flow field results are presented for a 1/25 scale, 0.8 m diameter (D) two bladed horizontal axis tidal turbine. The 2D PIV measurements were obtained in the USNA 380 ft tow tank for two inflow conditions. The first case had steady inflow conditions, i.e. the turbine was towed at a constant carriage speed ($U_{\text{tow}} = 1.68$ m/s) and the second case had a constant carriage speed and incoming regular waves with a period of 2.3 seconds and 0.18 m wave height. The underwater PIV system is comprised of two submersible housings with forward looking submersible containing laser sheet forming optics, and the side looking submersible includes a camera and remote focus/aperture electronics. The resulting individual field of view for this experiment was nominally 30x30 cm². Near wake mapping is accomplished by “tiling” individual fields of view with approximately 5 cm overlap. All measurements were performed at the nominal tip speed ratio (TSR) of 7. The mapping is accomplished in a vertical streamwise plane (x-z plane) centered on the turbine nacelle and the image pair captures were phase locked to two phases: reference blade horizontal and reference blade vertical. Results presented include distribution of mean velocities, Reynolds stresses, 2D turbulent kinetic energy. The discussion will focus on comparisons between steady and unsteady case. Further discussion will include comparisons between the current high resolution PIV measurements and the previous point measurements with the same turbine at different lateral planes in the same flow conditions.

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