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Tow tank measurements of turbulent flow in the near wake of a horizontal axis marine current turbine under steady and unsteady inflow conditions LUKSA LUZNIK, MAX VAN BENTHEM, KAREN FLACK, ETHAN LUST, US Naval Academy — Near wake measurements are presented for a 0.8 m diameter (D) two bladed horizontal axis tidal turbine model for two inflow conditions. The first case had steady inflow conditions, i.e. turbine was towed at a constant carriage speed and the second case had a constant carriage speed and incoming regular waves with a period of 1.6 seconds and 0.09 m wave height. The test matrix in the wake covered four radial positions from r/D=0.3 to 0.5 and five axial positions from x/D=0.19 to 0.95. All measurements were performed at the nominal tip speed ratio (TSR) of 7.4. The distribution of mean velocities for the steady inflow case exhibit significant spatial variability in the wake region. Normalized mean streamwise velocity show a decrease in magnitude with the axial direction for all radial locations ranging from U/Utow=0.55 at r/D=0.49 to 0.35 at r/D=0.3. Vertical and lateral mean velocities are small but consistent with counterclockwise fluid angular momentum for a clockwise rotor rotation. The Reynolds shear stresses consistently show elevated levels for measurements near the rotor tip (r/D=0.49) and are significantly reduced by x/D=0.6 downstream. This suggests low turbulence levels in the wake which is consistent with very low free stream turbulence. For the case with waves, evidence of enhanced turbulence intensities and shear stresses within spatial coverage of the experiment suggest increased in localized turbulence production in the blade tip region over the entire near wake region.

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