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Experimental assessment of blade tip immersion depth from free surface on average power and thrust coefficients of marine current turbine ETHAN LUST, KAREN FLACK, LUKSA LUZNIK, US Naval Academy — Results from an experimental study on the effects of marine current turbine immersion depth from the free surface are presented. Measurements are performed with a 1/25 scale (diameter D=0.8m) two bladed horizontal axis turbine towed in the large towing tank at the U.S. Naval Academy. Thrust and torque are measured using a dynamometer, mounted in line with the turbine shaft. Shaft rotation speed and blade position are measured using a shaft position indexing system. The tip speed ratio (TSR) is adjusted using a hysteresis brake which is attached to the output shaft. Two optical wave height sensors are used to measure the free surface elevation. The turbine is towed at 1.68 m/s, resulting in a 70% chord based Rec=4 x 10^5. An Acoustic Doppler Velocimeter (ADV) is installed one turbine diameter upstream of the turbine rotation plane to characterize the inflow turbulence. Measurements are obtained at four relative blade tip immersion depths of z/D = 0.5, 0.4, 0.3, and 0.2 at a TSR value of 7 to identify the depth where free surface effects impact overall turbine performance. The overall average power and thrust coefficient are presented and compared to previously conducted baseline tests. The influence of wake expansion blockage on the turbine performance due to presence of the free surface at these immersion depths will also be discussed.

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