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Effect of Elevated Free Stream Turbulence on the Hydrodynamic Performance of a Tidal Turbine Blade Section ASHWIN VINOD, ANGELA LAWRENCE, ARINDAM BANERJEE, Lehigh University — The effects of elevated freestream turbulence (FST) on the performance of a tidal turbine blade is studied using laboratory experiments. Of interest for the current investigation is elevated levels of FST in the range of 6-24% that is prevalent in deployment sites of tidal turbines. A constant chord, no twist blade section (SG6043) is tested at an operating Reynolds number of 1.5×10^5 and at angles of attack ranging from -90^o to +90^o. The parameter space encompasses the entire operational range of a tidal turbine that includes flow reversal. Multiple levels of controlled FST are achieved using an active grid type turbulence generator placed at the entrance to the water tunnel test section. The hydrodynamic loads experienced by the blade section are measured using a 3-axis load cell; a Stereo-PIV technique is used to analyze the flow field around the blade. The results indicate that elevated levels of FST cause a delay in flow separation when compared to the case of a laminar freestream. Furthermore, the lift to drag ratio of the blade is considerably altered depending on the level of FST and angle of attack tested.

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