Experimental Study of Flow Augmenters on Flow and Drag in Marine Hydrokinetic Research

Kellen Paulsen[1], M. Laura Beninati PhD[1], Nicholas A. Jaffa PhD[2], Christian Wodtke[1], My Ly[1], Ellix Sandhu[1], and Price Wilson[1]

[1] Mechanical Engineering Department, Bucknell University, Lewisburg PA 17837

[2] Penn State University, State College PA 16802

1.1 Background/Objectives

This study is intended to investigate flow augmentation that escapes from the power to weight scaling of horizontal axis turbines (HATs) for applications in marine hydrokinetics (MHK) research. Researchers will establish laboratory scale relationships between flow augmenters combinations and the power to weight ratio based on drag and flow measurements. Flow augmenters are of broad interest in the field of marine hydrokinetics for their ability to increase flow through a turbine relative to the same non-augmented turbine and therefore enable higher power extraction. Power extraction for turbines often follows a scaling ratio where to extract larger amounts of power, an increase in size and mass of the turbine is required. This increase then requires higher manufacture cost, more associated support infrastructure, as well as deployment costs and limitations.

1.2 Approach/Activities

Researchers will simultaneously measure flow rate and drag force for a given flow augmenter assembly. This is a lab-based study, with data being taken in a small water flume using a combined drag sled and flow measurement device assembly, that is compatible with all different flow augmenter assemblies. Primary work is dedicated to fabricating the assembly, ensuring compatibility with flume, and data acquisition and analysis.

1.3 Results/Lessons

Obtained values for flow rate and drag force will be used to calculate coefficients of power and drag. These nondimensional performance metrics will enable relative comparisons using a lab-scale parametric study to provide data on power to weight scaling of flow augmenters. Comparing the power to weight scaling between different flow augmenters will provide insight as to which flow augmenters have potential to escape from the traditional power to weight scaling ratio and by extension mitigate the drawbacks of larger turbines.