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Investigation of Helical Cross-Flow Axis Hydrokinetic Turbines, Including Effects of Waves and Turbulence PETER BACHANT, MARTIN WOSNIK, University of New Hampshire — A new test bed for hydrokinetic turbines was used to evaluate different cross-flow axis turbines, and investigate effects of waves and turbulence. Turbine thrust (drag) and mechanical power were measured in a tow tank with cross section 3.7 x 2.4m at speeds of 0.6-1.5 m/s for a Gorlov Helical Turbine (GHT) and a Lucid spherical helical turbine (LST). GHT performance was also measured in progressive waves of various periods, grid turbulence, and in a cylinder wake. Overall, the GHT performs with higher power and thrust coefficients than the LST. A 2nd law, or kinetic exergy efficiency, defined as the fraction of kinetic energy removed from the flow that is converted to usable shaft work, was measured. The distribution of energy into shaft work and turbulent kinetic energy in the wake can affect environmental transport processes and performance of turbines arrays. Progressive waves generally enhance performance of the GHT, but can lead to stall at higher tip speed ratios compared to the steady case. Grid turbulence delays dynamic stall and enables operation at lower tip speed ratios, while not decreasing maximum power coefficient. Performance in a cylinder wake is highly dependent on the cylinder's cross-stream location, ranging from benign to detrimental. The experimental observations provide insight into the physical principles of operation of cross-flow axis turbines.

Martin Wosnik
University of New Hampshire

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