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Numerical Modeling and Experimental Analysis of Scale Horizontal Axis Marine Hydrokinetic (MHK) Turbines[1] TEYMOUR JAVAHERCHI, NICK STELZENMULLER, University of Washington, JOSEPH SEYDEL, The Boeing Company, ALBERTO ALISEDA, University of Washington —
We investigate, through a combination of scale model experiments and numerical simulations, the evolution of the flow field around the rotor and in the wake of Marine Hydrokinetic (MHK) turbines. Understanding the dynamics of this flow field is the key to optimizing the energy conversion of single devices and the arrangement of turbines in commercially viable arrays. This work presents a comparison between numerical and experimental results from two different case studies of scaled horizontal axis MHK turbines (45:1 scale). In the first case study, we investigate the effect of Reynolds number (Re=40,000 to 100,000) and Tip Speed Ratio (TSR=5 to 12) variation on the performance and wake structure of a single turbine. In the second case, we study the effect of the turbine downstream spacing (5d to 14d) on the performance and wake development in a coaxial configuration of two turbines. These results provide insights into the dynamics of Horizontal Axis Hydrokinetic Turbines, and by extension to Horizontal Axis Wind Turbines in close proximity to each other, and highlight the capabilities and limitations of the numerical models. Once validated at laboratory scale, the numerical model can be used to address other aspects of MHK turbines at full scale.

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