Ocean energy research has grown in popularity in the past decade and has produced various designs for wave energy extraction. This research focuses on the performance analysis of a uni-directional impulse turbine for wave energy conversion. Uni-directional impulse turbines can produce uni-directional rotation in bi-directional flow, which makes it ideal for wave energy extraction as the motion of ocean waves are inherently bi-directional. This impulse turbine is currently in use in four of the world’s Oscillating Wave Columns. Current research to date has documented the performance of the turbine but little research has been completed to understand the flow physics in the turbine channel. An analytical model and computational fluid dynamic simulations are used with reference to experimental results found in the literature to develop accurate models of the turbine performance. To carry out the numerical computations various turbulence models are employed and compared. The comparisons indicate that a low Reynolds number Yang-shih K-Epsilon turbulence model is the most computationally efficient while providing accurate results. Additionally, analysis of the losses in the turbine are isolated and documented. Results indicate that large separation regions occur on the turbine blades which drastically affect the torque created by the turbine, the location of flow separation is documented and compared among various flow regimes. Furthermore, various solutions are offered to mitigate the turbine losses in an attempt to increase turbine efficiency. The model and simulations show good agreement with the experimental results and the two proposed solutions enhance the performance of the turbine showing an approximate 10% increase in efficiency based on simulation results.

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The public is welcome to attend.