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Blade Vortex Interaction of Bi-directional flow in a Uni-directional Impulse Turbine CARLOS VELEZ, University of Central Florida — Uni-directional impulse turbines are used for the extraction of wave energy by converting oscillating air flow generated by waves into uni-directional rotational energy. The symmetric airfoil design requires a large camber, in order to function in bi-directional flow, which creates a large boundary layer separation region towards the trailing edge of the blade. A three-dimensional, viscous, transient turbulent CFD model with rotating reference frame is created to model the blade vortex interaction (BVI) which occurs during transient bi-directional air flow. Various LES models are compared to determine an adequate turbulence model to accurately resolve the vortices created on the blade trailing edge. A study of the adverse effects of this BVI is conducted and a novel blade jet technique is introduced to prevent the separation of air flow from the trailing edge of the blade. Results show strong stresses arise from BVI during bi-directional transitional flow and the effectiveness of the blade jet technique in diminishing flow separation is successfully demonstrated. Results indicate that the increase in blade lift is linearly proportional to the blade jet mass flow rate once the jet velocity reaches approximately 120% of the turbine inlet velocity and that the increase in efficiency created by the blade jets are greater than the loss in efficiency in reducing the mass flow rate extracted from the inlet to the blade jet.

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