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Influence of Near-blade Hydrodynamics on Cross-flow Turbine Performance ABIGALE SNORTLAND, BRIAN POLAGYE, OWEN WILLIAMS, University of Washington — Cross-Flow turbines are a promising technology for harvesting kinetic energy from wind and water currents. The hydrodynamics are complex and rapid changes in angle of attack lead to phenomena such as dynamic stall and periodic vortex shedding. A robust understanding of local flow features at the turbine blades and their impact on phase-averaged performance is essential for turbine design and can inform control strategy development. Phase-averaged 2D planar PIV data is examined for both optimal (maximum power generation) and sub-optimal rotation rates over the entire sweep of a two-bladed, cross-flow turbine. The phase and rotation-rate dependent, near-blade/wake hydrodynamics are examined in concert with phase-averaged performance data. The duration/severity of flow reversal on, and detachment from, the blades appear critical to average performance. Strong stall and vortex interactions occur over most of the turbine rotation for the sub-optimal case, possibly producing parasitic forces that outweigh any increases in lift from the leading-edge vortex. At the optimal rotation rate, vortex shedding on the upstream blade is significantly delayed, and the downstream blade is weakly stalled. This likely explains the difference in power output between the two cases.

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