Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Why do Cross-Flow Turbines Stall? ROBERT CAVAGNARO, BENJAMIN STROM, BRIAN POLAGYE, University of Washington — Hydrokinetic turbines are prone to instability and stall near their peak operating points under torque control. Understanding the physics of turbine stall may help to mitigate this undesirable occurrence and improve the robustness of torque controllers. A laboratory-scale two-bladed cross-flow turbine operating at a chord-based Reynolds number $\approx 3 \times 10^4$ is shown to stall at a critical tip-speed ratio. Experiments are conducting bringing the turbine to this critical speed in a recirculating current flume by increasing resistive torque and allowing the rotor to rapidly decelerate while monitoring inflow velocity, torque, and drag. The turbine stalls probabilistically with a distribution generated from hundreds of such events. A machine learning algorithm identifies stall events and indicates the effectiveness of available measurements or combinations of measurements as predictors. Bubble flow visualization and PIV are utilized to observe fluid conditions during stall events including the formation, separation, and advection of leading-edge vortices involved in the stall process.

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Date submitted: 18 Jul 2015 Electronic form version 1.4