Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

An Experimental Evaluation of Blockage Corrections for Current Turbines[1] HANNAH ROSS, BRIAN POLAGYE, Univ of Washington — Flow confinement has been shown to significantly alter the performance of turbines that extract power from water currents. These performance effects are related to the degree of constraint, defined by the ratio of turbine projected area to channel cross-sectional area. This quantity is referred to as the blockage ratio. Because it is often desirable to adjust experimental observations in water channels to unconfined conditions, analytical corrections for both wind and current turbines have been derived. These are generally based on linear momentum actuator disk theory but have been applied to turbines without experimental validation. This work tests multiple blockage corrections on performance and thrust data from a cross-flow turbine and porous plates (experimental analogues to actuator disks) collected in laboratory flumes at blockage ratios ranging between 10 and 35%. To isolate the effects of blockage, the Reynolds number, Froude number, and submergence depth were held constant while the channel width was varied. Corrected performance data are compared to performance in a towing tank at a blockage ratio of less than 5%. In addition to examining the accuracy of each correction, underlying assumptions are assessed to determine why some corrections perform better than others.

[1]This material is based upon work supported by the National Science Foundation Graduate Research Fellowship Program under Grant No. DGE-1256082 and the Naval Facilities Engineering Command (NAVFAC).

Hannah Ross
Univ of Washington

Date submitted: 31 Jul 2017 Electronic form version 1.4