Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Wake structure of axial-flow hydrokinetic turbines in tri-frame arrangement[1] SAURABH CHAWDHARY, Saint Anthony Falls Laboratory, Department of Mechanical Engineering, University of Minnesota, XIAOLEI YANG, CRAIG HILL, ALI KHOSRONEJAD, MICHELE GUALA, FOTIS SOTIROPOULOS, Saint Anthony Falls Laboratory, Department of Civil, Environmental, and Geo- Engineering, University of Minnesota — Marine and hydro-kinetic (MHK) energy hold promise for future of sustainable energy generation. Tri-frame of turbines, three turbines mounted on vertices of a triangle, are an effective way to build a power producing array of hydrokinetic turbines in marine environment. Large eddy simulation (LES) is used to simulate the flow past a tri-frame and characterize its wake. Full geometry of all three turbines in the tri-frame is resolved using the Curvilinear Immersed Boundary (CURVIB) method of Kang et al. (2011). High fidelity solution of flow field is obtained owing to the inclusion of detailed geometry of the turbines. Excellent agreement is obtained with the experiments conducted in a flume at Saint Anthony Falls Laboratory (SAFL). The wake evolution of the three turbines is compared to that of an isolated single turbine. The differences in wake dynamics are highlighted to elucidate the importance of turbine wake interaction in an array. The simulations indicate lower levels of TKE and lower levels of momentum deficit in the wake of the upstream turbine of tri-frame compared to the other turbines. Analysis of the far wake recovery is useful for the optimal MHK array design.

[1]This work was supported by NSF grant IIP-1318201. The simulations were carried out at the Minnesota Supercomputing Institute.

Saurabh Chawdhary
Saint Anthony Falls Laboratory, Dept of Mechanical Engineering,
University of Minnesota

Date submitted: 01 Aug 2015 Electronic form version 1.4