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Reynolds number effects on the performance and near-wake of a cross-flow turbine[1] PETER BACHANT, MARTIN WOSNIK, Center for Ocean Renewable Energy, University of New Hampshire — To design wind or marine hydrokinetic (MHK) turbine farms with high efficiency, interactions between turbine wakes must be accurately predicted. However, to date numerical models predicting detailed wake properties of cross-flow (or vertical-axis) turbines have been validated with experimental data taken at Reynolds numbers significantly lower than those of full scale devices, casting doubt on the models' accuracy. To address this uncertainty, we investigated the effects of Reynolds number on the performance and near-wake characteristics of a 3-bladed cross-flow turbine, both experimentally and numerically. Mechanical power output and overall streamwise drag were measured in a towing tank at turbine diameter Reynolds numbers $Re_D = 0.5 \times 10^5$–2.0×10^6. A detailed map of the near-wake one turbine diameter downstream was acquired via acoustic Doppler velocimetry for each Reynolds number case, from which differences in the mean velocity, turbulence intensity, and Reynolds stresses are highlighted. Finally, Reynolds-averaged Navier-Stokes (RANS) numerical simulations were performed, the results from which are compared with the experimental data.

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