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Numerical Approach for Characterization of Flow Field in Pump Intake Using Two Phase Model: Detached Eddy Simulation

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Abstract : Large pumping facility is the necessary requirement of the cooling water systems for power plants, process and manufacturing facilities, flood control and water or waste water treatment plant. With a large capacity of few hundred to 50,000 m3/hr, cares must be taken to ensure the uniform flow to the pump to limit vibration, flow induced cavitation and performance problems due to formation of air entrained vortex and swirl flow. Successful prediction of these phenomena requires numerical method and turbulence model to characterize the dynamics of these flows. In the past years, single phase shear stress transport (SST) Reynolds averaged Navier Stokes Models (like k-ε, k-ω and RSM) were used to predict the behavior of flow. Literature study showed that two phase model will be more accurate over single phase model. In this paper, a 3D geometries simulated using detached eddy simulation (LES) is used to predict the behavior of the fluid and the results are compared with experimental results. Effect of different grid structure and boundary condition is also studied. It is observed that two phase flow model can more accurately predict the mean flow and turbulence statistics compared to the steady SST model. These validate model will be used for further analysis of vortex structure in lab scale model to generate their frequency-plot and intensity at different location in the set-up. This study will help in minimizing the ill effect of vortex on pump performance.

Keywords : grid structure, pump intake, simulation, vibration, vortex
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