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Applying Turbulence Models to Hydroturbine Flows: A Sensitivity Analysis Using the GAMM Francis Turbine[1] BRYAN LEWIS, JOHN CIMBALA, ALEX WOUDEN, Pennsylvania State University — Turbulence models are generally developed to study common academic geometries, such as flat plates and channels. Creating quality computational grids for such geometries is trivial, and allows stringent requirements to be met for boundary layer grid refinement. However, engineering applications, such as flow through hydroturbines, require the analysis of complex, highly curved geometries. To produce body-fitted grids for such geometries, the mesh quality requirements must be relaxed. Relaxing these requirements, along with the complexity of rotating flows, forces turbulence models to be employed beyond their developed scope. This study explores the solution sensitivity to boundary layer grid quality for various turbulence models and boundary conditions currently implemented in OpenFOAM. The following models are resented: k-omega, k-omega SST, k-epsilon, realizable k-epsilon, and RNG k-epsilon. Standard wall functions, adaptive wall functions, and sub-grid integration are compared using various grid refinements. The chosen geometry is the GAMM Francis Turbine because experimental data and comparison computational results are available for this turbine.

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