Pressure loss prediction by numerical simulations through a square-edged orifice in a round pipe

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A square-edged orifice is a pressure differential device commonly used for flow measurements in EDF’s nuclear power plants. The present study demonstrates the accuracy that can be reached with computational fluid dynamics (CFD) to predict velocity fields, pressure loss and discharge coefficient for a flow through a square-edged orifice in a round pipe at a Reynolds number from 1.73E+05 to 8.69E+05. Experimental data were obtained from Laser Doppler Velocimetry (LDV) and pressure taps measurements at 1D upstream and 0.5D downstream the orifice plate. Simulations were implemented in an open source CFD package developed by EDF (*Code_Saturne*). Sensitivity studies are carried out using different mesh refinements and Reynolds averaged Navier-Stokes (RANS) turbulence models. Results are compared to the ISO 5167 standards. The elliptic blending Reynolds stress model (EB-RSM) with a resolution down to the wall shows better results compared to eddy viscosity models (k-ε, k-ω) which should be avoided for this kind of geometry. This paper provides guidelines to use CFD in the best way to accurately predict the discharge and minor loss coefficients with an optimized time.