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DES of turbulent vortex breakdown in an abrupt axisymmetric expansion at Re = 10^5.[1] JOONGCHEOL PAIK, FOTIS SOTIROPOULOS, St Anthony Falls Laboratory, University of Minnesota — Turbulent swirling incompressible flow through an abrupt axisymmetric expansion at Re = 100,000 is investigated numerically using detached-eddy simulation. The effects of swirl intensity on the coherent dynamics of the flow are systematically studied by carrying out numerical simulations over a range of swirl numbers from 0.17 to 1.23. Comparisons of computed solutions and the experimental measurements of Dellenback et al. [AIAA Journal. Vol 26, pp. 669-681] show that the numerical simulations resolve both axial and swirling mean velocity profiles and corresponding turbulence statistics with very good accuracy. Coherent structure visualizations with the q-criterion and Lagrangian particle tracking are used to elucidate the rich dynamics of the flow as a function of the swirl number with emphasis on the various modes of vortex breakdown and other large scale instabilities in the shear layers and along the pipe wall.

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