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Large Eddy Simulation of Supercritical CO2 Through Bend Pipes[1] XIAOLIANG HE, Oregon State University / National Energy Technology Laboratory, SOURABH APTE, Oregon State University, OMER DOGAN, National Energy Technology Laboratory — Supercritical Carbon Dioxide (sCO2) is investigated as working fluid for power generation in thermal solar, fossil energy and nuclear power plants at high pressures. Severe erosion has been observed in the sCO2 test loops, particularly in nozzles, turbine blades and pipe bends. It is hypothesized that complex flow features such as flow separation and property variations may lead to large oscillations in the wall shear stresses and result in material erosion. In this work, large eddy simulations are conducted at different Reynolds numbers (5000, 27,000 and 50,000) to investigate the effect of heat transfer in a 90 degree bend pipe with unit radius of curvature in order to identify the potential causes of the erosion. The simulation is first performed without heat transfer to validate the flow solver against available experimental and computational studies. Mean flow statistics, turbulent kinetic energy, shear stresses and wall force spectra are computed and compared with available experimental data. Formation of counter-rotating vortices, named Dean vortices, are observed. Secondary flow pattern and swirling-switching flow motions are identified and visualized. Effects of heat transfer on these flow phenomena are then investigated by applying a constant heat flux at the wall.

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Xiaoliang He
Oregon State University

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