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Numerical simulation of a liquid sodium turbulent flow over a backward facing step with a four parameter logarithmic turbulence model

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In recent years a great interest has grown around liquid metals. These fluids are characterized by much higher thermal conductivity, if compared with standard fluids like air and water and can be used in applications where large heat fluxes are present while being subjected to small temperature gradients. In the present paper we simulate a turbulent flow of liquid sodium, with a Prandtl number equal to 0.0088, over a vertical backward-facing step. A uniform heat flux is applied on the vertical wall next to the change of cross section. Reynolds stresses and turbulent heat flux are modeled with a four logarithmic parameter turbulence model. We investigate the cases of purely forced convection, where the temperature field is just a passive scalar, and of mixed convection, where temperature has an impact on the fluid behavior through a buoyancy term that is introduced in the momentum equation with the Boussinesq approximation. The results are reported for various values of the Richardson number, i.e. Ri=0 for the purely forced convection and Ri>0 for the mixed convection case, and compared with data coming from Direct Numerical Simulation that is present in literature.

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