# Properties of Vortex Flows in Liquid Metal Coolants of Nuclear Reactors

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A simulation of flow swirling in pressure chambers of nuclear reactor collectors is one of the actual problems for hydrodynamics of collector systems, in particular for liquid metal coolants. The large-scale vortices arising here cause an irregularity of flow rate in the radial direction of the reactor core. Besides the appearance of the vortex in the form of tore, caused by the sharp turn of downward flow in the region of coolant outlet from the annular zone, the central vortex axis may arise in the round bottom collector. The existence of this vortex leads to a decrease of mass flow rate in the most power-stressed channels of the core, owing to pressure fall in the central region of the collector. Analysis of current status in the field of simulation of complex vortex and swirling flows showed that the application of turbulence models of different classes to the prediction of swirling flows cannot give adequate results, and the continuing investigations demonstrate that the physical nature of swirling flows still remains to be studied. The brief description of a modelling procedure proposed for the simulation of complicated vortex flows in collector systems with liquid metals is presented. The background of the proposed approach consists of the combined consideration of the following modelling aspects: the description of mechanisms of arising from large-scale circulation (or swirling) in the flows, the consideration of boundary layer influence on the vorticity generation in the fluid, and the solution of the closure problem for determination of the governing parameters of system, in particular the vorticity intensity critical value. The formation of steady-state vortex structures is connected with the process of helicity generation in a vortex flow. Equations for the rate of helicity change in the dynamic liquid system have been obtained to determine the critical conditions of flow field alteration. The use of the proposed physical model gives a possible explanation for a number of phenomena, in particular, an appearance of large-scale flow circulation in nuclear reactor collectors.