LATTICE-BOLTZMANN SIMULATION OF TRIANGULAR ROD BUNDLE

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ABSTRACT

Lattice-Boltzmann method (LBM) and finite volume method (FVM) simulations were performed for the VVER- 440 type nuclear reactor. Triangular rod bundle array has pitch-to-diameter ratio (P/D) of 1.35 is used in order to validate the Smagorinsky (LES) sub-grid scale turbulence model implemented in lattice-Boltzmann framework. The FVM simulations are handled using ANSYS Fluent 13.0 CFD Solver. For both LBM and FVM, turbulence model study was accomplished and the post-processed turbulence quantities, velocity profiles and Reynolds stresses were compared with the experimental data produced by Trupp and Azad, 1975. The comparisons show that lattice-Boltzmann simulations are in good agreement with the finite volume method based LES simulations and also used experimental data.

Following the completion of validation process of lattice-Boltzmann code, the spacer grid effect on the flow is then investigated. Spacer grids are added to the bundle geometry. Simulations are performed for extracting velocity profiles and pressure drop values along the subchannel of VVER-440. Validation of implemented turbulence model is encouraging in lattice-Boltzmann framework. Thus, simulation of more complex geometries such as spacer grid with mixing vane for a typical VVER type fuel bundle system might be possible in the near future.

Keywords: Thermal-hydraulics, safety, code development, code validation, lattice-Boltzmann, triangular array rod bundle, VVER-440

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