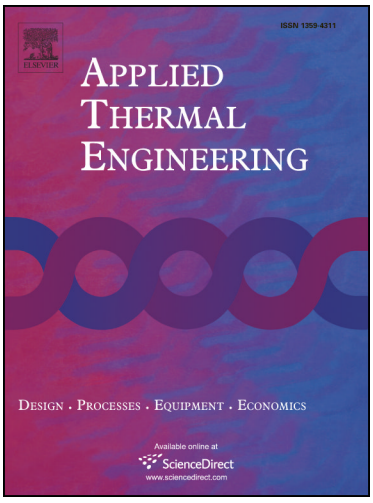

Study on the coolant mixing phenomenon in a 45 degrees T junction based on the thermal-mechanical coupling method

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Study on the coolant mixing phenomenon in a 45 degrees T junction based on the thermal-mechanical coupling method

Mingjun Wang[1], Di Fang[1], Yan Xiang[1], Yi Fei[1], Yun Wang[2], Wuyue Ren[1], Wenxi Tian[1], G. H. Su[1], Suizheng Qiu[1]*

1. Department of Nuclear Science and Technology, Xi'an Jiaotong University, Xi'an China

2. CNNC Key Laboratory on Nuclear Reactor Thermal Hydraulics Technology, Nuclear Power Institute of China, China

Email: szqiu@mail.xjtu.edu.cn

Abstract: The Emergency Core Cooling System (ECCS) is actuated following a Loss of Coolant Accident (LOCA) to inject coolant into the primary loop through a 45 degrees T junction configuration in advanced nuclear power plants. The T junction would suffer high cycle thermal fatigue due to possible temperature fluctuations in a non-isothermal mixing cross section. In this paper, the feasibility of Computational Fluid Dynamics (CFD) method on the complex mixing phenomenon simulation in a 45 degrees T junction during the injecting process was verified against experimental data. The thermal mixing mechanism of different injection patterns, which was characterized by the M_R number, was unveiled. Moreover, the structure stress analysis was performed to investigate the stress distribution features utilizing thermal mechanical coupling method. The flow patterns of impact jet flow, deflection flow and upper wall jet flow were defined. The structure stresses were concentrated at the junction joint zone under all the three flow patterns. The variations of maximum stress with M_R number were achieved. This work provides a guideline of CFD method for the mixing process simulation in a 45 degrees T junction of ECCS and an important basis for the fatigue assessment and safety management in nuclear power plants.

Key words: ECCS, T junction, Coolant Mixing, Thermal-hydraulic, Stress analysis