Proceedings of CHT-17
ICHMT International Symposium on Advances in Computational Heat Transfer

May 28-June 1, 2017, Napoli, Italy

CHT-17-311

DEVELOPMENT OF JET IMPINGEMENT MODEL TO IMPROVE MARS FOR MIXING BEHAVIOR IN A DOWNCOMER

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ABSTRACT Korea Atomic Energy Research Institute has carried out experiments by utilizing ATLAS (Advanced Thermal-hydraulic Test Loop for Accident Simulation), an integral test facility. Among the experiments, a 50% DVI line break accident was selected for International Standard Problem No. 50 exercise. In this exercise, multidimensional phenomena such as Emergency Core Cooling water mixing in the upper downcomer observed were highlighted in terms of the capability of system codes. It was found that the codes' prediction capability of three-dimensional downcomer mixing phenomena was not satisfactory in most calculations. The cold water was well mixed with the hot inventory according to the test result. However, this vigorous mixing was not predicted appropriately by the system codes including a best-estimated system code, MARS (Multi-dimensional Analysis Reactor Safety). In MARS, the momentum flux terms are set to zero for the junction between the one-dimensional volume and the three-dimensional cell of MultiD component because the axial and radial velocities are small in the large three-dimensional region. However, if the nozzles are attached to the downcomer, which has a thin gap size, the axial and radial velocities are not small when the incoming orthogonal flow through the nozzles impinges against the downcomer wall. It was necessary to consider the momentum flux terms induced by the impinging flow, so that an appropriate jet impingement model to apply for the system code, MARS, was developed. To develop the jet impingement model, Computational Fluid Dynamics calculations were carried out, and the jet impingement model was formulated based on the calculations with various conditions. The momentum flux term by the jet impingement phenomena was correlated with the diameter of the nozzle, the gap size of the downocmer, and the velocity of the incoming flow. This model was applied to MARS by considering the momentum flux term for the junctions connected to the three-dimensional cell. The modified MARS with the jet impingement model was validated with the test result from ATLAS, and the analysis results showed good agreements with test data.