Development and Validation of a Computational Fluid Dynamics Model for the Simulation of Two-Phase Flow Phenomena in a Boiling Water Reactor Fuel Assembly

This paper presents the current status in the development and validation of an advanced Computational Fluid Dynamics (CFD) model, CFD-BWR, which allows the detailed analysis of the two-phase flow and heat transfer phenomena in Boiling Water Reactor (BWR) fuel assemblies under various operating conditions. The CFD-BWR model uses an Eulerian Two-Phase (E2P) approach, and is also referred to as the E2P modeling framework. It is being developed as a customized module built on the foundation of the commercial CFD-code STAR-CD which provides general two-phase flow modeling capabilities. The integral validation efforts have focused on the analysis of the NUPEC Full-Size Boiling Water Reactor Test (BFBT) within the framework of the OECD/NRC benchmark exercise.The paper reviews the two-phase models implemented in the CFD-BWR code, and emphasizes recently implemented models of inter-phase and coolant-cladding momentum and energy exchanges. Results of recent BFBT experiment simulations using these models are presented and the effects of the new models on the calculated void distribution are discussed. The paper concludes with a discussion of future model development and validation plans.

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