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Computational Fluid Dynamics Modeling of Two-Phase Flow Topologies in a Boiling Water Reactor Fuel Assembly

This paper presents recent advances in the development and validation of the two-phase flow topology models implemented in CFD-BWR, an advanced Computational Fluid Dynamics (CFD) computer code that 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 local inter-phase surface topology plays a central role in determining the mass, momentum, and energy exchanges between the liquid and vapor phases and between the two-phase coolant and the fuel pin cladding. The paper describes the topology map used to determine the local inter-phase surface topology and the role of the local topology in determining the inter-phase mass, momentum, and energy transfer. It discusses the relationship between the local inter-phase surface topology and the traditional channel flow regimes and presents results of experiment analyses in which computed local topologies are aggregated into flow regimes and compared with experimental observations.

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