Development of Predicting Model for Sodium Coolant Boiling

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Abstract

Sodium coolant boiling is a safety concern in Liquid Metal Reactors using sodium as coolant. It affects the safety through the void reactivity feedback and heating up the fuel rod. The present model is being developed to meet the demand for predicting the void fraction as well as the fuel and cladding temperatures in the KALIMER, to analyze the damage of the fuel rods core after onset of sodium boiling. Modeling of the sodium boiling was basically issued because the model adopted in Light Water Reactor systems were not proper to be directly applied to the sodium coolant reactors, mainly due to the phenomenon difference observed between two types of coolant systems. The developing model is a multiple-bubble slug ejection model. It allows a finite number of bubbles in a channel at any time. Voiding is assumed to result from formation of bubbles that fill the whole cross section of the coolant channel except for liquid film left on the cladding surface. The vapor pressure, currently, is assumed to be uniform within a bubble. The present study is focused on not only demonstration of the sodium voiding behavior predicted by the developed model, but also confirmation on the qualitative acceptance. In a result, the model catches the key phenomena for sodium boiling, continuous effort, however, should be made for the complete analysis.