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3D CFD Simulation of passive decay heat removal system under boiling conditions: role of bubble sliding motion on inclined heated tubes

by

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Abstract

In order to design advanced nuclear reactors with enhanced safety systems such as passive decay heat removal system (PDHRS), a new design of isolation condenser (IC) has been proposed. The effect of inclination of condenser tube on sliding bubble dynamics and associated heat transfer has been studied for seven angles of tube inclination α (with respect to vertical direction), in the range $0^{o} \leq \alpha \leq 90^{o}$. For this purpose, two phase transient 3D CFD simulations using mixture model (based on Euler-Euler approach) have been performed. The model considers different mechanisms such as single phase natural convection, latent heat transfer due to evaporation, transient conduction due to disruption of thermal boundary layer and enhanced liquid convection due to bubble sliding motion (quenching). The transient vapor fraction (ϵ_G) contours and flow distribution enables to understand the mechanism of bubble formation and bubble sliding motion. The major heat transfer mechanism was found to be the liquid agitation caused by sliding bubbles on the tube surface. The heat transfer contribution due to evaporation was found to be very small because of highly sub cooled $(\Delta T_{sub} =$