Parametric and Scaling Studies of Condensation Oscillation in Subcooled Water of the In-containment Refueling Water Storage Tank

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Abstract

Condensation oscillation by jetting the steam into subcooled water through spargers is studied. To provide a suitable guideline for oscillation phenomena in the IRWST of the next generation reactor, scaling methodology is introduced. Through scaling methodology and subsequent tests, it shows that the volume of steam cavity determines the dynamic characteristics of condensation oscillation. The second-order linear differential equation for frequency analysis is derived and its results are compared with those from the test data. Two types of condensation phenomena exist according to steam flow rates. At subsonic jet, condensation interface becomes irregular in shape and upper system volumes affect the dynamic characteristics of condensation oscillation. At sonic jet, a regular steam cavity forms at the exit of discharge holes. Parametric effects and subsequent dynamic responses of the pool tank are investigated through experiments in applicable test ranges. When the temperature of pool water becomes lower, the amplitude becomes larger. Critical parameters are derived from the scaling methodology and are system volume, cavity volume, discharge hole area, and density ration. It is found that system friction factors affect frequency components of condensation oscillation. Oscillations of a steam cavity occur mainly on the face of the axial direction and pressure amplitudes become larger than that of the lateral direction.