A Study on the Heat Source in a Molten Pool During the Severe Accident of PWRs

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Abstract

Heat transfer and fluid flow in a molten pool are influenced by internal volumetric heat generated from the radioactive decay of fission product species retained in the pool. The pool superheat is determined based on the overall energy balance that equates the heat production rate to the heat loss rate. Decay heat of fission products in the pool was estimated by product of the mass concentration and energy conversion factor of each fission product. For the calculation of heat generation rate in the pool, twenty-nine elements were chosen and classified by their chemical properties. The mass concentration of a fission product is obtained from released fraction and the tabular output of the ORIGEN 2 code. The initial core and pool inventories at each time can also be estimated using ORIGEN 2. The released fraction of each fission product is calculated based on the bubble dynamics and mass transport. Numerical analysis was performed for the TMI-2 accident. The pool is assumed to be a partially filled hemispherical geometry, 1.45 m in radius and 32,700 kg in mass. The change of pool geometry during the numerical calculation was neglected. The peak temperature sizably decreased by about 60 K as the fission products are released from the pool.