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One Dimensional Approach to External Cooling of Reactor Vessel Lower Head

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Abstract

The Corium Attack Syndrome Immunization Structures (COASIS) are being developed as prospective in-vessel retention devices for an advanced light water reactor (ALWR) in concert with existing ex-vessel management measures. Both the engineered gap inner structure (COASISI) and outer structure (COASISO) are demonstrated to maintain effective heat transfer geometry during molten core debris attack when applied to the TMI-2 and the Korean Standard Nuclear Power Plant (KSNPP) reactors. To quantity the external cooling effect, we wrote a computer program using the one-dimensional transient heat conduction equation. Using the above program we investigated the effects of the mass and initial temperature of the fallen material, and the effect of the heat transfer coefficient value in convection with water or air. To verify the validity of the program, we applied the written program to predict the LAVA preliminary test. Of all the cases considered, the shortest melting time was calculated to be about 70 sec compared with 2~3 sec in the tests. As the impingement demonstrated a decisive impact on the failure of the vessel in the tests, our prediction of the temperature profile based on pure thermal behavior of the vessel tends to overestimate the time to failure. According to the results, the mass effect diminished if the mass exceeds an arbitrary critical quantity and the temperature profile of the vessel depended on the initial temperature of the fallen material.