Development of COOLAP Code: Parametric Model for Ex-Vessel Debris Coolability

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Abstract

The Fukushima accident results in global strengthening of nuclear regulation especially on severe accidents for nuclear power plants. In Korea, the newly amended nuclear safety acts enforced from June 2016 set new safety targets including the Cs-137 release rule and the submission of severe accident management guideline (SAMG) in the regulatory process for all reactors. Therefore, nuclear power plants need to submit the effective SAMG to meet the new targets. It means that the severe accident phenomena in the containment will be assessed and their consequences be evaluated against the target. In the case, corium released from a Reactor Pressurized Vessel (RPV) manages to be cooled to ensure the stabilization and termination of severe accident without significant threats to containment. If a reactor cavity is flooded prior to the corium release as one of SAMG actions, the process of the ex-vessel molten core cooling in the cavity includes complicated phenomena such as melt jet breakup, debris bed formation and cooling, the molten core-concrete interaction (MCCI). Therefore, the corium coolability affecting the containment consequences such as containment failure due to over-pressurization are dependent on the interactions among those phenomena. In POSTECH, Korea, during last several years, a new simplified parametric model, COOLAP (recently COOLAP-II), covering the melt jet breakup, debris bed formation and cooling was developed for the synthetic assessment of the ex-vessel melt coolability. The model was validated on the melt breakup and initial cooling by comparison with a full-model for fuel-coolant interactions. In this paper, the development efforts of the COOLAP code will be introduced.

Keywords: Parametric Model, Ex-Vessel Coolability, FCI, Debris Bed Formation and Cooling, SAMG, Containment Risk, Severe Accident, Nuclear Safety.