Sensitive Study of Core Meltdown Energetics in Liquid Metal Fast Reactor

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Abstract

Core disruptive accidents have been investigated at Korea Atomic Energy Research Institute(KAERI) as part of work to demonstrate the inherent and ultimate safety of the conceptual design of the Korea Advanced Liquid Metal Reactor(KALIMER), a 150 Mwe pool-type sodium cooled prototype fast reactor that uses U-Pu-Zr metallic fuel. In this study, a simple method was developed using a modified Bethe-Tait method to simulate the kinetics and hydraulic behavior of a homogeneous spherical core over the period of the super-prompt critical power excursion induced by the ramp reactivity insertion. Calculations of energy release during excursions in the sodium-voided core of the KALIMER were subsequently performed using the method for various reactivity insertion rates arising from fuel compaction. Benchmark calculations were made to compare with the results of more detailed analysis for core meltdown energetics of the oxide fuelled fast reactor. A set of parametric studies was also performed to investigate the sensitivity of the results on the various thermodynamics and reactor parameters.