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Comparative Assessment of Safety Margin Using Two CHF Correlations considering Core Flow Asymmetry

Ilsuk Lee, Donghyeog Yoon, Taehoon Kim
Korea Institute of Nuclear Safety
Yuseong, Daejeon, Republic of Korea
islee@kins.re.kr

Extended Abstract

Concerns over the asymmetric phenomena in the core region have increased considering safety issues that were highly possible to reduce the nuclear power plants' thermal margin significantly. Since the seized reactor coolant pump (RCP) accident of APR1400 can be regarded as a representative core asymmetric event with respect to the core inlet flow, the departure from the nucleate boiling ratio (DNBR), which is a regulatory acceptance criterion in nuclear safety, should be evaluated with consideration of the uncertainty range of the core inlet flow reflecting the actual geometry [1]. This study investigated the DNBR quantitatively in the entire fuel assemblies of the core by using two correlations which are the Groeneveld lookup table, and KCE-1 correlation specialized for PLUS-7 fuel. Based on the results from a system thermal-hydraulic analysis of a seized RCP accident of APR1400 [2], this study presents the uncertainty range calculated by the computational fluid dynamics on the core inlet flow's asymmetry. Damaged fuel rods analyzed by two different CHF correlations were quantitatively identified through a sub-channel analysis, which presented statistical relevance to obtain the DNBR at a 95% reliability and 95% accuracy level.

References

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[2] I.S. Lee, "Regulatory Audit Assessment of Non-LOCA (MSLB and LR) on the Fuel Damage for APR1400", KINS, 2019.