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Validation of the SPACE Code through Simulated Accident Scenarios in SMART-ITL: A Focus on Pressurizer Safety Valve Break and Safety Injection Line Break Concurrent with TLOSHR

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Demonstrations of the capabilities of nuclear system analysis codes are required to obtain a license for their use in various applications of nuclear power plants. The Safety and Performance Analysis CodE (SPACE) has been developed and approved to be used for licensing applications of Pressurized Water Reactors (PWRs). However, since new innovative designs such as SMART100, a 100 MWe system-integrated modular advanced reactor, incorporate inherent and passive safety design features that are not used in conventional loop-type reactors, especial models should be developed and validated to reflect the characteristics of the SMART-100 and obtain reliable predictions. A thermal-hydraulic integral effect test facility, SMART-ITL, was constructed to examine the system performance of SMART-100 and to Investigate the thermal hydraulic phenomena occurring in the reactor systems and components during the normal, abnormal, and emergency conditions. The experimental data also serves to validate the related thermal-hydraulic models of the safety analysis codes. This study presents a validation of the SPACE code, using the SMART-ITL facility, to evaluate its applicability for analyzing thermal hydraulics in integral reactors. Simulations were performed for two experimental test scenarios: pressurizer safety valve break and safety injection line break concurrent with total loss of secondary heat removal (TLOSHR). The validation results indicate that the SPACE code accurately predicted key thermal hydraulic behaviors, such as primary and secondary system pressures and temperatures. However, a slight underestimation of the reactor pressure vessel's water level was observed, attributed mainly to the overestimation of the accumulated break flow due to inaccuracies in the two-phase critical flow models.

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