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# Investigation on natural circulation for decay heat removal in reactor vessel of sodium-cooled fast reactor

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In Sodium-cooled Fast Reactors (SFRs), it is important to optimize the design and operate decay heat removal systems (DHRS) for safety enhancement against severe accidents which could lead to core melting. To clarify the natural circulation phenomena in a reactor vessel during operation of a decay heat removal system, water experiments have been conducted using a 1:10 scale experimental facility (PHEASANT) simulating the reactor vessel of loop-type SFRs. The dipped-type direct reactor heat exchanger (DHX), the penetrated-type DHX and reactor vessel auxiliary cooling system (RVACS) are mounted in PHEASANT. Moreover, the electric heaters are installed to simulate the core and fuel debris accumulated on the core catcher and upper plenum. Therefore, PHEASANT can simulate the natural circulation phenomena under the various conditions for decay heat sources and DHRS operation. In this paper, the natural circulation phenomena under the conditions of operating the dipped-type DHX and RVACS, respectively, were investigated by the results of PHEASANT experiments and experimental analyses. In the condition of operating the dipped-type DHX, the velocity field was quantitatively obtained by the particle image velocimetry and the characteristic of natural circulation phenomena were clarified by the velocity and temperature data. In the condition of RVACS operation, the temperature was measured using decay heat conditions as a parameter and the effect of decay heat condition on the natural circulation phenomena was investigated. In addition, from the comparison between the experimental results and simulation results, it was confirmed that the numerical simulation is applicable to the natural circulation flow field in the reactor vessel of loop-type SFRs.

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