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TRACE investigation on the performance of passive safety condenser as ultimate heat sink

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Passive safety systems are integrated into the latest generation of Light Water Reactors (LWRs), including small modular reactors. This paper employs the US-NRC TRACE thermal hydraulic code to examine the performance of a passive safety condenser known as SACO, designed to serve as the ultimate heat sink for dissipating decay heat during accident scenarios. The TRACE model is constructed with reference to the PKL/SACO test facility, which is an integral testing facility replicating a four-loop Western-type KWU pressurized water reactor (PWR). The PKL facility maintains a 1:1 height scaling and a 1:145 power and volume scaling. The safety condenser (SACO) is interconnected with the PKL facility via the secondary side of steam generator 1, effectively serving as a third natural circulation cooling loop during accident scenarios. The modeling of the PKL/SACO facility involves the use of both 1D and 3D TRACE components. Specifically, the SACO water pool is represented as a 3D TRACE VESSEL component, while all other facility components are represented as 1D TRACE components, including PIPE, VALVE, FILL, BREAK, and single junction. Previously, a series of parametric investigations had been conducted aimed at validating the PKL/SACO TRACE model. In the present research, the thermal-hydraulic behavior of the PKL facility is investigated in the presence of the SACO passive safety system during a Station Black Out (SBO) with Extended Loss of AC Power (LEAP) accident scenario. The SBO scenario entails an extended and prolonged transient process, which can be categorized into three distinct phases depending on the activation of the SACO system and the refilling process of the SACO pool. The findings indicate that the SACO system effectively manages to dissipate all decay heat, even though there is temporary evaporation of the SACO water pool.

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