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Compact Design for CVCS heat exchangers for SMR

The CVCS of a typical large nuclear power plant includes two shell-and-tube heat exchangers. Replacing these with a printed circuit heat exchanger (PCHE), a high-performance heat exchanger, can lead to significant space savings. Hence, this study proposes the optimized size of the PCHE for CVCS heat exchangers. The PCHE consists of a straight channel with a semi-circular cross-sectional area and performs all functions of them. Numerical solutions are obtained using the Engineering Equation Solver (EES). Since the working fluids to be heated and cooled are all single-phase water, the scope of the numerical analysis expended to the turbulent flow region.

As a result of this study, it was evaluated that if PCHE is applied as a SMR CVCS heat exchanger, the space required to install the heat exchanger is less than 20% compared to the shell and tube type heat exchanger applicable to SMR while satisfying thermal hydraulic performance such as heat capacity. This PCHE is composed of a straight channel with a semi-circular cross-sectional area and performs all the functions of two existing shell and tube-type heat exchangers.

Considering that volume is one of the most important indicators in SMR, this can be considered an important progress. This small-sized heat exchanger is expected to be of great help in reducing construction costs and construction periods by modularizing the entire CVCS system and allowing it to be manufactured at the factory. In addition, since the heat exchanger is manufactured through diffusion welding, stability is expected to increase.

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