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Analysis of Fluid Flow Uniformity in Molten Salt Reactor – Repowering using CFD

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The Sustainable Nuclear Energy (SNE) research team is designing a Molten Salt Reactor (MSR) for repowering coal power plants. MSR is an Generation IV reactor, uses liquid fuel composed of fluoride or chloride salt mixtures, enabling high-temperature operation at low pressure [1]. Optimal flow distribution is essential to ensure uniform power and efficient heat transfer across all fuel channels [2]. Several previous studies [2], [3], and [4] have calculated the flow rate ratio of each channel relative to the average flow rate. In this context, the focus of the present study is placed on assessing the performance of the reactor's hydraulic structure in achieving uniform fluid flow distribution. Therefore, this study aims to design an optimized MSR–Repowering system with improved uniformity in fluid flow distribution.

The flow uniformity characteristic is determined by the mass flow rate entering each individual fuel pin (mi), the average mass flow rate per fuel pin (ma), and the total number of fuel pins (n).

This study successfully reduced flow maldistribution, with Sreactor decreasing from 63.3% to 54.96% and Sring from 5.0% to 4.89%. Further research will install shrouds to significantly reduce maldistribution.

Technical Track

Student Competition

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