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Optimizing Neutronics and Thermal Performance in High-Temperature Gas-Cooled Reactors

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Abstract

This research focuses on the design and analysis of a High-Temperature Gas-Cooled Reactor (HTGR), specifically utilizing the High Temperature Test Reactor (HTTR) model, with the objective of achieving an outlet temperature of 850 ℃ and a thermal power output of at least 70 MWth without altering the core volume. The study meticulously addresses critical safety aspects, emphasizing the reactor's inherent safety features and compliance with rigorous evaluation criteria. Neutronic behavior is investigated using Open-MC simulations to assess the effective multiplication factor (K_eff) and the impact of various control rod configurations on reactor stability. Additionally, thermal hydraulics are examined, focusing on helium's properties as a coolant, including mass density and heat transfer characteristics, with detailed analyses of temperature distributions within the reactor core to optimize thermal management and prevent overheating. This work enhances our understanding of high-temperature reactor designs and their operational efficiencies, laying the groundwork for future advancements in nuclear reactor technology.

Technical Track

Reactor Physics

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