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Core Geometry and Reflector Optimization of 10 MWt Micro-PeLUIt Pebble Bed HTGR

Previous research has explored the effects of reducing the size of nuclear reactor cores to identify smaller, optimal dimensions for applications in remote Indonesian locations. This investigation aimed to reduce the core dimensions while maintaining the height-to-diameter ratio (H/D) at 1.1, following the HTR-10 model. The previous findings indicated that, with a minimum burnup target of 60 MWD/kg-HM, the optimized reactor volume is 4.4 m^3, featuring a diameter of 172 cm and a height of 189.2 cm. Lowering the burnup target revealed five alternative geometric configurations for a downsized Peluit 10 MWt reactor. This study delves into the impact of reflector size modifications on these five reactor geometry options, employing the Pebble Bed Reactor Neutron Diffusion (PEBBED) Code, a computational tool designed for analyzing High-Temperature Gas-cooled Reactor (HTGR) physics, specifically Pebble Bed Reactors. The analysis encompasses neutronic parameters such as total fuel flow, burnup, power peaking factors, and power density distribution, which are critical for understanding the reactor's performance and safety. Furthermore, the study examines thermal-hydraulics and safety parameters, including steady-state and transient fuel temperatures, focusing on scenarios involving Depressurized Loss of Forced Cooling (DLOFC) accidents. This comprehensive analysis aims to enhance the design and safety features of compact nuclear reactors suitable for isolated areas, contributing to developing more accessible and safe nuclear energy solutions.
Keywords: HTGR, PEBBED, PeLUIt-10, TRISO, Pebble bed

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