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Criticality and Burnup Analysis of a Generic VVER-1200 for Core Lifetime Prediction Using Hybrid Burnable Poisons using OpenMC and ORIGEN Codes

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Abstract
Controlling reactivity is still a major problem that is typically solved with burnable poisons (BPs). Gadolinium is one example of a single BP that can cause power peaking and uneven depletion. The use of hybrid burnable poisons (HBPs), which balance residual reactivity with neutron absorption, presents a possible substitute. Hybrid BP combinations in VVER-1200 cores have received little attention in previous research, which mostly focuses on conventional poisons (such as Gd alone). OpenMC and ORIGEN have been partially integrated for isotopic and decay analysis in VVER-1200 reactors and inadequate long-term forecasting of cycle life and k-eff degradation in hybrid BP scenarios. Fuel cycle economics and reactor safety are the driving forces behind the deployment of HBPs. Extended operational cycles, better power distribution, and less reactivity swings are all possible with HBPs. For effective fuel cycle planning, waste control, and economical operation, an accurate core lifespan prediction is essential. The performance of conventional burnable absorbers, such as gadolinium or boron compounds, may be improved by hybrid burnable poison (HBP) techniques that combine materials (e.g., GdO_3 + ErO_3). A thorough computational examination of a generic VVER-1200 core using hybrid burnable poisons is presented in this paper. Predicting isotopic evolution, core lifespan, and reactivity behavior (k-effective) under various burnable poison loading procedures is the goal of the study. To allow a thorough assessment of fuel cycle performance, a coupled OpenMC–ORIGEN process is created and used to simulate burnup and post-irradiation inventories.

Technical Track

Reactor Physics

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