A Feasibility Study for Designing U-Pu-Zr Fueled, Lead cooled, Long-Life ENHS Cores having Zero Burnup Reactivity Swing

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Abstract

The objective of this paper is to design U-Pu-Zr fueled, Long-Life ENHS (Encapsulated Nuclear Heat Source) cores that can maintain zero burnup reactivity swing (~0.5%) up to 15 years without refueling and shuffling. In this study, 125MWth (80W/cm) and 250MWth (120W/cm) cores were selected. The neutronics calculations were performed with the REBUS-3/DIF3D code and nine energy group cross section set. The nine energy group cross section set based on ENDF/B-VI was prepared for each case of this study. The initial plutonium enrichment of all considered cores is determined to have keff=1.0042 for initial, hot state. And the optimal pitch-to-diameter (P/D) ratio was determined such that the reactivity swing is minimized for 15 years. For searched cores the temperature reactivity coefficients, the lead void reactivity coefficient, reactivity worth of the reflector, mass of heavy isotopes were calculated and analyzed to estimate the feasibility.