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Tradeoff Study of Advanced Transmutation Fuels in Sodium-cooled Fast Reactors

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Advanced transmutation fuels are being developed for Sodium-cooled Fast Reactors (SFRs) with reduced chemical interaction between the fuel and cladding and higher burnup achievable. Different diluent materials such as Zirconium, MTZ (5Mo-4.3Ti-0.7Zr), with addition of Palladium are considered, together with Cr-coating inside the cladding. The use of advanced transmutation fuels was assessed in this study based on the ABR-1000 concept.

This study confirms the significant impact of using advanced transmutation fuels on the reactor physics parameters due to the reduction in heavy nuclei density and to the addition of more absorbing elements. The addition of Palladium leads to increase in the fissile content while decreasing the conversion ratio. The reduced neutron flux in the low-energy range affects the neutronic feedback coefficients by reducing the Doppler effect and increasing the sodium void worth. Using MTZ diluent is also found to affect the reactor physics parameters by requiring higher fissile content, and decreasing the conversion ratio. In this case, however, no significant changes in the feedback coefficients are found despite the large shift in spectrum observed, and caused by the elastic scattering cross-section of Ti-48. A 20 μm coating of Chromium had a minor effect on the reactor physics performance of the SFR.

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