NUCLEAR ENERGY UNIVERSITY PROGRAMS

Heterogeneous Recycling in Fast Reactors

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Abstract

Current sodium fast reactor (SFR) designs have avoided the use of depleted uranium blankets over concerns of creating weapons grade plutonium. While reducing proliferation risks, this restrains the reactor design space considerably. This project will analyze various blanket and transmutation target configurations that could broaden the design space while still addressing the non-proliferation issues. The blanket designs will be assessed based on the transmutation efficiency of key minor actinide (MA) isotopes and also on mitigation of associated proliferation risks.

This study will also evaluate SFR core performance under different scenarios in which depleted uranium blankets are modified to include minor actinides with or without moderators (e.g. BeO, MgO, B_4C, and hydrides). This will be done in an effort to increase the sustainability of the reactor and increase its power density while still offering a proliferation resistant design with the capability of burning MA waste produced from light water reactors (LWRs). Researchers will also analyze the use of recycled (as opposed to depleted) uranium in the blankets. The various designs will compare MA transmutation efficiency, plutonium breeding characteristics, proliferation risk, shutdown margins and reactivity coefficients with a current reference sodium fast reactor design employing homogeneous recycling. The team will also evaluate the out-of-core accumulation and/or burn-down rates of MAs and plutonium isotopes on a cycle-by-cycle basis, producing input that is readily usable by the fuel cycle systems analysis code, VISION, for assessment of the sustainability of the deployment scenarios.