

Feasibility Study on Heterogeneous ThO₂-DUPIC Fuel Recycling in a CANDU Reactor

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Abstract

A heterogeneous ThO₂-DUPIC fuel cycle option of a Canada deuterium uranium (CANDU) reactor was assessed. The fuel bundle consisted of both the DUPIC and thorium fuels. In the heterogeneous recycling model, the DUPIC fuel is replaced after each fuel cycle, while the thorium fuel is continuously recycled. This study investigated the feasibility of the proposed fuel cycle from the viewpoints of the reactor physics and fuel cycle economics. The physics calculations have shown that it is feasible to heterogeneously recycle the thorium fuel through the dry process in the CANDU reactor. For the economic analysis of the ThO₂-DUPIC fuel cycle, the fuel cycle cost was estimated for different dry process parameters such as the rare earth removal rate and initial uranium fraction. The fuel cycle cost estimation of the equilibrium fuel cycle showed that the cost decreased as the rare earth removal rate increased, while it slightly increased as the initial uranium volume fraction increased.