(Track 8)

Feasibility of Waste Transmutation Using Accelerator-Driven IRIS Subcritical System

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ABSTRACT

Waste transmutation is considered for reducing radio-toxicity of nuclear waste generated in power reactors. Accelerator driven subcritical systems (ADS) offer certain advantages over the use of nuclear reactors. Transmutation of fission products (e.g. Tc99) generally requires thermal neutron spectrum, while for actinides fast spectrum provides better performance. Proposed solutions to this problem include a multi-strata approach as well as a multi-zone (thermal/fast-spectrum) single systems. In this paper we examine the feasibility of employing a dual-spectrum two-zone accelerator-driven IRIS subcritical for waste transmutation.

IRIS (International Reactor Innovative and Secure) is an innovative concept of a light water reactor, designed under a DOE NERI program, by an international consortium that includes industry, universities and research labs. Main features of the reactor are improved safety and economics, and extended core life (about 8 years). The IRIS system design is flexible, allowing use of enriched uranium or MOX fuel in different configurations. Neutronic studies examined two approaches to achieving the extended core life. One is to employ very tight lattice with a hard spectrum, while the alternative is to employ well moderated lattice with thermal spectrum.

Hence, as a natural extension of these studies we analyzed feasibility of using a subcritical two-zone IRIS configuration. The inner tight-lattice zone is accelerator driven and provides fast spectrum, while the outer open lattice provides thermal spectrum. Nuclear material flow is out-in, i.e., it is first loaded into the outer zone. The paper quantifies main performance parameters and transmutation rates for IRIS based ATW. This dual-spectrum single system is based on the proven light water technology (yet with a fast spectrum zone), and may therefore provide an effective approach to waste transmutation. On the other hand, gas and heavy liquid metal coolants may potentially provide better performance, but they would probably also require longer developmental path.