18th IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE (D4)
Innovative Concepts and Technologies (1)

Author: Ms. Danika Lenard
Little Prairie Services, United States, danikalenard@gmail.com

A LEU APPROACH TO THE PARTICLE BED NUCLEAR THERMAL ROCKET ENGINE

Abstract

A Particle Bed Reactor (PBR) Nuclear Thermal Rocket Engine (NTRE) was investigated by the Strategic Defense Initiative Organization (SDIO) from late 1987 until early 1993 in a program called Timberwind. During that program, a new TRISO particle fuel form was developed, fuel elements were fabricated and tested, a full-scale critical reactor facility that is still in use today was designed, fabricated and tested, and the basic principles of the PBR were validated. The renewal of NASA's nuclear propulsion program for an early NTRE flight demonstration, along with interest within DARPA, has spawned new interest in this highly capable technology. Unfortunately, the SDIO PBR system employed Highly Enriched Uranium (HEU). Commensurate with the Defense Threat Reduction Initiative (DTRI), there is a desired migration away from HEU to High Assay Low Enriched Uranium (HALEU) whose enrichment is typically <20%. This presents a challenge to the PBR, as it is a rather porous core which leads to low pressure drops. Consequently, the neutron spectrum, which, in the Timberwind program was epi-thermal is not compatible with a LEU core. Efforts at a more thermal neutron spectrum reactor lead to absorption of the bulk of the thermal neutrons in the outer few mm of the fuel element. LPS has created a new approach, with three different TRISO particles concepts: An Infiltrated Kernel, A moderator particle, and a reflector particle. These particles would be dispersed through the fuel element to produce a uniform quantity of thermalized neutrons throughout the fuel element, leading to a flatter, more uniform reactor power spectrum. In this paper, we will discuss the results of our investigations into this novel concept.