Optimization of Fueling Strategies and Material Surveillance through Real-time Pebble Tracking in Pebble Bed Reactors

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Program: Topic Area 1 – Reactor Development and Plant Optimization

ABSTRACT:

The pebble bed reactor (PBR) based on tristructural-isotropic (TRISO)-fueled pebbles is one of the most promising Gen-IV reactor designs because of its excellent intrinsic safety and thermal efficiency. Like many advanced reactors, PBRs are being designed for the electricity market of the future and a premium is being placed on flexible operation including load following. At the same time, optimizing fuel usage is a high priority, which means maximizing burnup of fueled pebbles before they are discharged to disposal. The proposed work will help address these challenges and enable more economical operations by developing the tools to determine optimal fuel reloading strategies through pebble identification and tracking.

The method will be based on a combined experimental and computational approach and will provide accurate knowledge of the in-core burnup with a spatial resolution of a single pebble, in real time.

This project will develop and demonstrate a novel fuel tracking method to optimize grid-scale and transient application of PBRs through a data-driven computational approach that can be implemented on-site and will be scalable to PBR reactor designs based on different types of coolant. Optimized load factors derived from accurate fuel management are expected to increase utility profits and, therefore, enhance the competitiveness of the U.S. reactor fleet and strengthen the national strategic fuel cycle.