U.S. DEPARTMENT OF ENERGY | Office of NUCLEAR ENERGY

Evaluation of Accelerated Fuel Test in a Thermal Reactor for its Representativeness and Advancement

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Collaborators: None

Pathway: Regulatory Assistance Grant and Technology Development Opportunities

Abstract

Most advanced reactor designs rely on the use of fuel types that differ, substantially in many cases, from the conventional zircaloy-clad uranium dioxide (UO_2) used in light-water reactors (LWRs). As such, one of the main challenges relative to the commercialization of advanced non-LWRs is obtaining the required data, analyses, and overall approach for Nuclear Regulatory Commission (NRC) licensing of a new fuel type. Therefore, before embarking on an extensive and potentially expensive development campaign, it is highly beneficial to develop the fuel verification approach and have an initial interaction with the NRC to lay out the requirements for licensing, as well as a practical strategy for accomplishing the licensing.

General Atomics Electromagnetic Systems (GA-EMS) is developing a Fast Modular Reactor (FMR) as one of Advanced Reactor Concepts-20 (ARC-20) under advanced reactor demonstration program (ARDP) using UO_2 fuel and silicon carbide (SiC) composite cladding materials. The SiC composite is a new type of cladding being considered as one of the accident tolerant fuels (ATFs) due to its high-temperature and high-irradiation resistance. As such, this material is used for the FMR that operates with high coolant temperature and longer fuel cycle. However, there are two distinct obstacles when verifying the fuel design of such a long-life FMR: 1) long irradiation time to achieve the target burnup, and 2) lack of prototypic neutron source of the fast reactor in the US. This is a common problem that industries are facing when developing new materials and fuels, especially for the fast reactor system.

The FMR program includes an irradiation test plan of rodlets in the Advanced Test Reactor (ATR) to confirm the fuel integrity during the high-temperature, high-burnup irradiation. The proposed work (this proposal) will supplement those accelerated irradiation tests in a thermal reactor by analyzing the bases of the scalability of the fuel behavior and thermal versus fast irradiation. The proposed work also includes interaction with NRC. The desired outcome of the NRC interaction would be the objective review of validity of the scaled and thermal irradiation tests, and/or identification of supplementary efforts required to validate the scaled and thermal irradiation tests that can serve as the time-effective and cost-effective fuel qualification process with potential application to all the advanced reactor rod-type fuels.

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