
ATF Solutions to Light Water-Cooled SMRs

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Program: Fuel Cycle 2.1

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ABSTRACT:

Fuel is the heart of all the nuclear reactor systems where the defense-in-depth principles and safety systems are designed around it. While traditionally treated as a low-cost item as part of the nuclear power plant total cost, nuclear fuel dictates the reactor power density and the nuclear island construction requirements (e.g. containment size to prevent radioactivity release from fuel). The increasing of the power density of SMRs could be critical to its economic viability to overcome the lack of economy of scale. Indeed, a logical area of economic opportunity for ATFs is increase in core power density (e.g. power uprates) given their high temperature capability.

The objective of the proposed work is to: (1) Investigate near term opportunities of accident tolerant fuels for light water cooled small modular reactors (LWR-SMR) design spaces with Holtec's SMR-160 as the reference plant for the US university partners and Rolls-Royce's UK-SMR as the reference plant for UK university partners (2) Simulate the fuel and safety performance of Lightbridge concept for the NuScale SMR (3) Provide scoping analysis of promising longer term advanced fuel forms to improve the safety and economics of LWR-SMRs. (4) If the first 3 objectives have been addressed ahead of schedule, we will extend the work to GEH's BWRX-300.

We will meet the outlined objectives by addressing each critical research question in a dedicated task, and leveraging the expertise of our multi-disciplinary team. The team is made up of nuclear fuels, design and safety engineers. Particularly, the PI has led various activities on the techno-economic and value assessment of advanced fuels for large and small water-cooled reactors including the Accident Tolerant Fuels (ATF) and Lightbridge metal fuel concept for >10 years. We will work closely with industry which represents the entire light water cooled small modular reactor sector in the US and UK. Since Idaho National Lab is currently supporting SMR-160 and Lightbridge fuel concepts, INL is also a collaborator to increase synergy with other DOE activities and also facilitate hosting student internship.