

RFA-17-14583, Fuel Salt Characterization for the Transatomic Power Molten Salt Reactor

A central feature of the Transatomic Power (TAP) molten salt reactor (MSR) is its ability to consume 5% enriched uranium fuel from the existing supply chain, something it accomplishes in part by using a LiF-UF₄ molten salt. The use of this binary mixture allows for a high mole percent of uranium to be contained in the reactor's fuel salt (27.5%) while maintaining a relatively low melting point (490°C). This feature stands in contrast to the Molten Salt Reactor Experiment (MSRE), which used a LiF-BeF₂-based salt that only practically allowed small mole percentages of uranium and thus required higher enrichments to achieve and maintain criticality.

The use of LiF-BeF₂ in the MSRE led to the salt's extensive characterization over the course of the original MSR research and development program. However, similar in-depth characterization data (including fundamental properties such as density, viscosity and heat capacity) does not exist at the level of detail necessary for high fidelity modeling, sustained regulatory engagement, and long-term design development solely for the binary system of LiF and UF₄. Thus, a key aspect of the TAP technology development program is to characterize the thermo-physical properties of the LiF-UF₄ system and provide quality data that will inform both the design and regulatory processes.

By performing a detailed analysis of the TAP MSR fuel salt's thermo-physical properties, this project with Argonne National Laboratory will markedly enhance the development of the TAP MSR design, and thus allow the company to continue its progress toward demonstrating enhanced capabilities. In the long term, TAP aims to commercialize a 520 MWe facility. In the near term, TAP is developing a design for a 10 MWt demonstration-scale facility. TAP's demonstration-scale plant, as well as its first commercial product, will utilize 5% enriched fresh uranium fuel to utilize as much of the existing U.S. fuel cycle infrastructure, licensing framework, and operating experience as possible.