RFA-17-14615, IMSR® Fuel Salt Property Confirmation: Thermal Conductivity and Viscosity

Integral Molten Salt Reactor (IMSR®) components are integrated within a sealed and replaceable core-unit. Thus, optimization of IMSR® performance requires the optimization of each component individually. To achieve the optimal design, Terrestrial Energy USA (TEUSA) requires a more extended and accurate physical properties data set of the IMSR® fuel salt, including data for thermal conductivity and viscosity.

The last definitive compilation of the physical properties of potential fuel-salt candidates date from 1956. Although the density and viscosity of several liquid fluoride salts have been measured since that time, the salts measured do not include the specific composition selected for the IMSR® fuel salt. In addition, while estimation techniques for salt properties have been developed, they are largely empirically based using lighter fluoride salts and are recognized to be often ill-suited for UF_4 bearing fuel salts. Thus, several physical properties of the IMSR® fuel salt are still largely unknown, including those important for design choices such as thermal conductivity and viscosity. A thorough verification of thermal conductivity and viscosity of the IMSR® fuel salt will permit TEUSA to meet and surmount this challenge.

Because superior heat transfer by molten salts is a fundamental feature of the IMSR® power plant design, the TEUSA-Argonne National Laboratory research partnership will provide the data necessary for the optimization of reactor components in the IMSR® core-unit, and by extension the IMSR® design as a whole. In addition, the new Argonne National Laboratory data set will permit TEUSA to specify equipment-design and facility system parameters, determine IMSR® operational requirements, and complete design-basis and beyond-design-basis accident analyses.

These new data will significantly enhance DOE’s current molten-salt database and help to remove present uncertainties in molten-salt heat-transfer properties, which remain large. This new body of knowledge can also be used to further DOE research relating to any other advanced reactor technologies employing molten salts in either liquid-fueled reactors or salt-cooled solid-fuel systems.