

## **RFA-17-14621, Evaluation of Power Fluidic Pumping Technology for Molten Salt Reactor Applications**

Molten salt reactor (MSR) concepts, associated subsystems, and technology development activities require the pumping of molten salt, either as the reactor coolant, or during salt processing. While molten salts have great heat transport properties, they also have some characteristics that severely challenge traditional centrifugal pumps. These include the salt's high temperature operation ( $\geq 700^{\circ}\text{C}$ ) and accommodating differential thermal expansion, the limited materials that are compatible with the salt, a potentially high radiation environment that challenges electronics (motor windings) and maintenance, and shaft sealing requirements to maintain salt purity. Operating life of conventional electro-mechanical pumps in such applications is greatly restricted by degradation arising from the abrasiveness of the solids and issues such as metal-metal contact/galling. Commercially, there are no off-the-shelf high temperature molten salt pumps available. Identifying viable and available pumping technology for molten salt applications is a key enabling factor to allow MSR reactor designs to take the next step forward toward deployment.

Power Fluidics <sup>TM</sup> (PF) is a NuVision Engineering proprietary technology which uses fluids (gas or liquid) to control the flow of other fluids in industrial applications. It is especially suited to pumping and mixing of liquids in hazardous or safety related applications (e.g., in nuclear process plants) and is in extensive use for such applications in the nuclear industries in U.S., United Kingdom, Japan, and China. Pumping systems using PF technology are characterized by inherent safety, robustness, low maintenance, high reliability and long operating life. Some of the new generation of small nuclear power reactor designs currently under development have a need for such systems to handle challenging liquid pumping duties. Specifically, NuVision has been approached by U.S.-based commercial developers of MSR systems to provide technical data on PF system applicability and performance and aid them in integrating PF systems into their MSR designs.

Currently, NuVision has no directly relevant archive or experience data to provide answers to the specific questions required to confirm the technical feasibility and advance the development of the MSR application. In addition, NuVision does not have in-house knowledge of MSR technology and the qualified personnel to carry out such an evaluation. However, partner Oak Ridge National Laboratory (ORNL) has an established background in both PF technology and MSRs. ORNL has performed testing on fluidic diodes and completed the first phase of a study on traditional centrifugal pumps for salt applications. ORNL has extensive knowledge of the specific characteristics of salts and related MSR technology needs and is therefore amply equipped and well qualified to support NuVision in this venture.

The project results will demonstrate to MSR manufacturers that the PF pumps would be a robust solution for multiple pumping applications.