
Liquid metal-cooled fast reactor instrumentation technology development

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Program: RC-3: Liquid
metal-cooled fast reactor
technology development
and demonstration to
support deployment

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ABSTRACT:

The sodium cooled fast reactor (SFR) has received significant interest in the last couple years due to major companies such as Terra Power, GE and others focus on development and commercialization. Now with the strong focus from the Department of Energy (DOE) to design and build the Versatile Test Reactor (VTR) to provide a facility for fast flux fuel and component testing capabilities (and the fact that it has been determined that this will be a sodium reactor) there is even more need for work and training on sodium reactor systems and technology. To aid in the success of this venture it is of interest to revitalize US competence in sodium reactor components, analysis and instrumentation. This will aid in the realization of the VTR, increase the accuracy and quality of measurements for future VTR test articles that support multiple reactor designs, and advance the technology for use in future SFRs. The Mechanisms Engineering Test Loop at Argonne National Laboratory (METL) coupled with significant loop facilities at the University of Wisconsin can play a major role in development and validation of data as well as advances in technologies to simplify and ensure safe operation and improve economics of Liquid Metal Fast Reactors (LMFRs). This proposal plans to complete the following three objectives. Through these objectives the team will also train new works in sodium technology that will be available to the national laboratories and to run the VTR.

Objective 1 – Obtain detailed heat transfer measurements in sodium to develop more precise heat transfer relations with highly resolved temperature sensors. This data would be used as a test case for CFD models focused on low Prandtl number fluids and serve as an initial test of the distributed fiber optics systems that will be used in objective 2. This objective will also help to address recent questions posed by GE with regard to the best correlation for the design of the Intermediate heat exchanger (IHX) for the VTR.

Objective 2 – Perform testing and analysis of compact heat exchangers for use with sodium. Under this objective we will test a sodium to sCO₂ compact printed circuit heat exchanger. The data from these tests will be made available for complex CFD models to be used to test the fidelity of the models for design calculations.

Objective 3 – Under this objective we will develop, test and calibrate an in pool submersible flow meters with modern materials and technologies. This flow meter will be key to tests planed in METL and also be of use for flow measurements within pool type reactor system designs.