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## Regenerating Missing Experimental Parameters with Data-Assimilation Methods for MSRE Transient Benchmark Development and Evaluation

**PI:** Zeyun Wu – Virginia Commonwealth University

**Collaborators:** Massimiliano Fratoni, UC Berkeley; Benjamin Betzler, ORNL; Tingzhou Fei, ANL; Kurt Harris, Flibe Energy.

**Program:** MS-NE-1

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### ABSTRACT:

The Molten Salt Reactor Experiment (MSRE) performed at Oak Ridge National Laboratory (ORNL) in the 1960s is currently the only collection of experimental data for this class of advanced reactor concepts. The experimental data obtained should be carefully evaluated, peer-reviewed, formally documented, and included in the International Reactor Physics Experiment Evaluation Project (IRPhEP) handbook to avoid being lost, as reproducing these experiments would incur an enormous and unnecessary cost. An initial set of the *static* MSRE benchmark was successfully developed through a collaboration between the University of California, Berkeley (UCB) and ORNL and included into the 2019 edition of IRPhEP handbook, whereas evaluations of MSRE *transient* experiments still remain lacking.

The main goal of this proposal is to develop and evaluate a transient benchmark of the MSRE and include it into the IRPhEP handbook as a complementary to the existing static MSRE benchmark. The whole primary loop of MSRE will be modeled to have a thorough evaluation of the transient experiments performed at MSRE. The undocumented basic data for the transient experiments will be regenerated from available data by using advanced data-assimilation methods to facilitate the whole-loop modeling of the representative MSRE transients. The following importances and advantages are observed through accomplishment of the proposed study:

- The proposed work will fill the gap that currently there is no transient MSR benchmark evaluations in IRPhEP, although transient analysis is vital important for reactor safety analysis;
- The developed MSRE transient benchmark will be a valuable reference for the validation of modeling activities of MSR development and deployment;
- The advanced data-assimilation methods employed in the proposed study will provide innovative insights and demonstrate superior advantages in reactor physics benchmark development by regenerating undocumented data from available experimental data.

Specifically, the following objectives will be achieved in the proposed study:

- Specification of representative transient experiments and identification of missing data;
- Regeneration of missing parameters through advanced data-assimilation methods;
- Verification and validation of the experimental transient benchmark and uncertainty quantifications;
- Documentation of the investigated experimental transients and submission for an inclusion into the IRPhEP handbook.