

TerraPower
partnered with
Argonne National Laboratory

NE-20-23944, Thermophysical Property Measurements of NaCl-PuCl₃

YEAR AWARDED: 2020

TOTAL PROJECT VALUE: \$525k (DOE: \$400k; TerraPower: \$125k)

STATUS: Completed

PRINCIPAL LAB INVESTIGATORS: Melissa Rose (ANL), Perry Motsegood (TerraPower)

DESCRIPTION: In developing a Molten Chloride Fast Reactor (MCFR), TerraPower, a private nuclear energy technology company headquartered in Bellevue, Wash., launched the Molten Chloride Reactor Experiment (MCRE), a zero-power fast reactor. Although the original concept was to use molten sodium chloride and plutonium trichloride eutectic (NaCl-PuCl₃) salt as fuel, after GAIN and Argonne agreed they could complete the same work under the voucher the proposal transitioned to uranium chloride (NaCl-UCl₃) to support the same transition for MCRE fuel.

BENEFIT: The MCRE project will not only engage industry, it should provide information to the Nuclear Regulatory Commission to build institutional knowledge regarding fast spectrum, liquid fueled systems, with corresponding improvement in the efficiency of future application reviews.

IMPACT: Data and experience from MCRE operation will support further development of computer models to be used for licensing of commercial reactors and ideally aid in the reduction of licensing costs.

SIGNIFICANT CONCLUSIONS: The need for high quality, traceable data that quantifies composition dependencies and measurement uncertainty to inform operating conditions is paramount for proper design in any reactor, especially a liquid fueled molten salt reactor. Completed in collaboration with Argonne National Laboratory, this work provides substantial technology readiness benefits for grid-scale MCFR commercialization.

NEXT STEPS: TerraPower and Southern Company finalized a subrecipient agreement in February 2022 to design, construct and operate the Molten Chloride Reactor Experiment (MCRE) at Idaho National Laboratory (INL). The MCRE project was selected for funding under the U.S. Department of Energy's (DOE) Advanced Reactor Demonstration Program (ARDP). Other partners in the project include CORE POWER, Orano Federal Services, the Electric Power Research Institute and 3M Company. The team's ongoing alliance with DOE's Office of Nuclear Energy through the ARDP is essential for delivering this key technology and is supported by a five-year, \$170 million cost-share funding agreement.