Elysium Industries
partnered with
Argonne National Laboratory

NE-18-16168, Assessing Fuel Cycle Options for Elysium Molten Chloride Salt Fast Reactor from Spent Nuclear Fuel, Plutonium, and Depleted Uranium

YEAR AWARDED: 2018

TOTAL PROJECT VALUE: $625k (DOE Funds Awarded: $500k; Awardee Cost Share: $125k)

STATUS: Completed

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DESCRIPTION: Following a 2017 investigation backed by GAIN, this project was to develop the computational fluid dynamics models needed to simulate and optimize the flows of molten-chloride-salt fuel in a reactor vessel and heat exchangers for Elysium Industries' molten-chloride-salt fast reactor (MCSFR) design. Elysium concepts related to closing the fuel cycle and eliminating light water reactor waste include no purification for 50-plus years or on-line purification without removal of actinides to improve plant economics worldwide at a low cost and low proliferation risk. Under this voucher, Elysium collaborated with Argonne National Laboratory (with extensive experience with fast reactor fuel cycles and depletion calculations) to confirm that these fuel cycle options can be accomplished. ANL has recently improved their tools for molten salt reactor application to provide detailed and accurate modeling of these complex systems.

BENEFIT: Through this project, Elysium intends to demonstrate the viability, safety, and economic improvement of using spent nuclear fuel and plutonium in molten chloride salt fast reactor fuel salt. A main objective is to eliminate waste and close the fuel cycle, thereby minimizing proliferation, in addition to providing dispatchable power complementary to renewables.

IMPACT: These results will be helpful in demonstrating a revenue source in spent nuclear fuel, plutonium, and depleted uranium consumption that will be helpful in securing investors who are seeking creative solutions to costly issues. The findings will be important in selecting the preferred salt and fissile source for future nuclear applications and subsequent locations.

NEXT STEPS: The application of traditional methodologies (one-dimensional modeling of heat and fluid flow) to the design of MSRs will limit developers' ability to address these thermal-hydraulic issues. In the absence of a vast and expensive experimental program, CFD is necessary to optimize the design and provide data for simulation-driven correlations. Elysium will coordinate, guide all research activities, and design processes, in addition to performing simulations using OpenFoam to then benchmark against available data and high-fidelity Nek5000 results.