Transatomic Power Corp.
partnered with
Oak Ridge National Laboratory

GA-17OR020109, Optimization and Assessment of the Neutronics and Fuel Cycle Performance of the Transatomic Power Molten Salt Reactor Design

YEAR AWARDED: 2016

TOTAL PROJECT VALUE: $250K (DOE funds awarded, $200K; awardee cost, $50K)

STATUS: Completed

PRINCIPAL LAB INVESTIGATORS: Andrew Worral (woralla@ornl.gov)

DESCRIPTION: Under this Gateway for Accelerated Innovation in Nuclear voucher, Oak Ridge National Laboratory (ORNL) provided Transatomic Power Corp. (TAP) with a neutronic and fuel cycle analysis of the company's liquid-fueled molten-salt reactor (MSR) core design. Working off the original design of the Molten-Salt Reactor Experiment (MSRE), TAP modified two fundamental design features: the fuel salt and the moderator. The substitution of LiF-UF4 for the MSRE's LiF-BeF2-ZrF4-UF4 fuel salt provides an increase in the uranium concentration within the fuel while maintaining a relatively low melting point. For the moderator, the TAP concept used clad zirconium hydride instead of graphite, looking for a significant increase in power density. The idea was that these two choices would allow for a more compact reactor, one that could draw from existing uranium enrichment facilities available to provide up to 5% low-enriched uranium (LEU). The first phase of the voucher project was to perform two-dimensional analysis with ORNL-developed tools to verify TAP-calculated metrics and develop an understanding of the effects of fuel feed and isotopic removal rates. Subsequent phases included the development of a three-dimensional full-core model to calculate safety coefficients, design control systems, and generate fuel cycle metrics for comparisons with other fuel cycles. Design information was based on TAP white papers whenever possible.

BENEFIT: Independent evaluation was considered important for TAP to move forward in its design process, also in its fundraising. The research done under the voucher provided a common basis on which the design and overall fuel cycle performance could be improved. ORNL's results conclusively showed that the Transatomic reactor could operate for decades using the commercially available 5% LEU supply chain.

IMPACT: Although TAP ceased business in 2018, this project demonstrated the applicability of ORNL tools to molten-salt technology research. The work also underlined the importance of validated state-of-the-art tools to perform an early design assessment of the validity and performance of a given advanced reactor design or associated fuel cycle. TAP agreed to open-source its intellectual property, the Gateway for Accelerated Innovation in Nuclear now hosts its legacy data, allowing other MSR companies to exercise the design and lessons learned from the analyses.