Muons

partnered with

Oak Ridge National Laboratory / Idaho National Laboratory / Savannah River National Laboratory

RFA-17-14589, Conversion of LWR Spent Nuclear Fuel to Fluoride Salt Fuel

YEAR AWARDED: 2017

TOTAL PROJECT VALUE: $500k (DOE Funds Awarded: $400k; Awardee Cost Share: $100K)

STATUS: Completed

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DESCRIPTION: With support from GAIN, Muons collaborated with ORNL, INL and SRNL to design a fuel processing plant that can convert spent nuclear fuel into molten-salt fuel for its Mu*STAR accelerator-driven subcritical reactor. The project supported the use of neutronics and multi-physics codes to supplement the initial results from using MCNP and ORIGEN codes, enabling a much more thorough analysis of the system. The company's expectation is that such a facility will be relatively small and inexpensive enough to consider building one at every existing reactor site in the United States and abroad, wherever spent nuclear fuel is stored. The additional neutron flux provided by the accelerator permits a much deeper burn, such that several times more energy can be produced from the fuel than was generated by the LWR. The limit is reached when the accelerator cannot economically overcome the neutron absorption by fission products. This innovative and disruptive concept eliminates the need for uranium mining, fuel enrichment, fuel rod manufacturing, off-site storage and transport of spent nuclear fuel. It encourages local communities to consider consent-based storage of spent nuclear fuel combined with continued operation of their power utility using Mu*STAR when their LWR is retired.

BENEFIT: Leaving spent nuclear fuel on the site where it was produced solves many problems that have long confounded the U.S. Government, which is legally required to eventually take title to the spent fuel.

IMPACT: Molten salt fuel eliminates fabrication, installation, replacement and waste management needed for fuel rods or pellets, replacing them with simpler procedures. The complexity of the reactor is reduced by adding a superconducting radio frequency (SRF) accelerator, already proven as the best tool for producing high-energy, high-quality particle beams. One accelerator can feed several Mu*STAR reactors. The accelerator is itself modular, truck transportable, and can be repaired quickly and safely.

NEXT STEPS: Building Mu*STAR reactors at existing LWR sites allows a new view of closing the fuel cycle. The spent nuclear fuel created on site stays on site and is used to provide electricity for centuries. No more SNF is generated and, normalized to the energy produced, the volume and toxicity of the fuel is reduced dramatically.