RFA-17-14589, Conversion of Light Water Reactor Spent Nuclear Fuel to Fluoride Salt Fuel

Muons, Inc., intends to quantify the economic advantages of burning spent nuclear fuel (SNF) from light water reactors (LWRs) in a GEM*STAR accelerator-driven subcritical reactor. This technique converts SNF to fluoride salt that is mixed to form a eutectic molten salt fuel with lithium fluoride (LiF). Costs of this new approach will be compared with traditional ones that either convert SNF to MOX fuel assemblies or prepare fuel assemblies from enriched uranium ore. The MS LiF fuel has 6Li that will produce tritium. Tritium costs need to be quantified for a possible commercial opportunity in itself or a serious problem for any commercial reactor for electrical power or process heat applications.

The successful outcome of this project with Oak Ridge National Laboratory will turn LWR SNF into a valued commodity instead of a problem to be buried and will contribute to an integrated SNF and nuclear waste system. The technique should extract seven times as much energy from the SNF as was generated in the LWR, but without enrichment or chemical reprocessing. The cost of the SNF conversion to MS fuel will be amortized over five 40 year passes through a GEM*STAR reactor, since the conversion needs to be done only for the first pass. Each subsequent pass will use the same fuel but require higher accelerator power to overcome neutron absorption by fission products. After 200 years, the accelerator would require more than 15% of the output of the reactor to overcome neutron absorption by fission products and the fuel can then be chemically reprocessed or buried. Normalized to the generated energy, the remaining SNF/waste, including long-lived actinides, will be reduced after 200 years of operation by more than a factor of seven.