RFA-17-14592, Molten Chloride Salt Fast Reactor

Elysium is developing a concept for a molten chloride salt fast reactor for the purpose of utility-scale electrical power generation. In this reactor concept, the molten chloride salt is both the fuel source and coolant for the reactor. The actinides used to manufacture the molten salt are chemically recovered from sources such as light water reactor used nuclear fuel, Canadian Deuterium Uranium (CANDU) Reactor used nuclear fuel, high enriched uranium (HEU) used nuclear fuel, dispositioned weapons grade and reactor grade plutonium stock, and HEU and natural uranium stock. Briefly stated, the actinide (metallic or oxide) containing source material is prepared and contacted with a molten chloride salt (e.g., NaCl-KCl at 725°C) containing an oxidant (e.g., $ZrCl_4$) that will chemically convert the actinides (metallic or oxide) in the source materials into actinide chlorides in the molten salt. Rare gasses naturally evolve and noble metals precipitate out, but soluble chlorinated fission products are not separated from the molten fuel salt. By this means, a fuel salt containing both actinides and fission products suitable for reactor operations is prepared from suitable source materials.

With this voucher award Elysium has requested the Idaho National Laboratory (INL) to study the exchange chemistry between irradiated mixed-oxide (MOX) fuel and a ternary molten salt (e.g., NaCl-KCl-$ZrCl_4$) and to consult with Argonne National Laboratory. The MOX fuel will be taken from an inventory of Fast Flux Test Facility (FFTF) Reactor fuel present in the Hot Fuel Examination Facility (HFEF) argon-atmosphere hot cell located at the INL Materials and Fuels Complex (MFC). INL will demonstrate this process for Elysium.