The SPHINX Project
(Experimental Verification of Design Inputs for a Transmuter with Liquid Fuel based on Molten Fluorides)

(Topic 8 – Molten Salt Reactors)

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Abstract

The current proposals for high-active long-lived (more then 10^4 years) waste from spent nuclear fuel disposal call forth an increasing mistrust of society towards nuclear power at all. These problems are highly topical in the Czech Republic, the country which is operating nuclear power and accumulating spent fuel from PWRs and located on an inland and heavily populous Central European region.

The proposed project which is known under the acronym SPHINX (**SP**ent **H**ot fuel **I**ncineration by **N**eutron flu**X**) is dealing with a solution of some principle problems of a very promising way of radioactive waste treatment, high level wastes from spent nuclear fuel in particular, by means of transmutation of radionuclides by use of a nuclear reactor with liquid fuel based on molten fluorides (Molten Salt Transmutation Reactor-MSTR) which might be a subcritical system driven by a suitable neutron source. Its superiority lies also in the fact that it makes possible to utilize actinides contained, by others, in spent nuclear fuel and so to reach a positive energy effect. After the first three year stage of R&D programme which has been focused mostly on computer analyses of neutronics and corresponding physical characteristics, the next again three year stage is devoted to experimental verification of inputs for designing of a demonstration transmuter with molten fluoride fuel.

The R&D part of the SPHINX project in the area of fuel cycle of the MSTR is focused in the first place in the development of suitable technology of the preparation of an introductory liquid fluoride fuel for MSTR and consecutively in the development of suitable fluoride pyrometallurgical technology for the separation of the transmuted elements from the non-transmuted ones.

The idea of the introductory fuel preparation is based on the reprocessing of PWR spent fuel by the Fluoride Volatility Method which may result in a product the form and composition of which might be applicable as a starting material for the production of liquid fluoride fuel for MSTR. Consequently, the objective is a separation of a maximum fraction of uranium component from Pu, minor actinides and fission products. Final processing of the fuel for MSTR is proposed by use of electroseparation methods in the fluoride melt medium and also the partitioning technologies used after passing the fuel through the MSTR should be on the basis of electrowinning.

The adjusting of a solution development and obtained results with worldwide trends will certainly be a project benefit. The project will support a solution of a spent nuclear fuel issue as well as a limitation of its bad influence upon the environment. Simultaneously, it will contribute to a perspective energy source introduction with a nearly waste-less technology.