**Review on the project**

**“Study of deeply subcritical accelerator driven systems and features of their application for energy production and transmutation of spent nuclear fuel”. Part III. Quasi infinite target (Project E&T&RM)**

The present project proposed the energy production and transmutation of the spent nuclear fuel by using the subcritical(keff ~ 0.9-0.98) accelerator driven systems i.e. ADSs.

In conventional ADSs, the incineration of long-lived minor actinides (237Np, 240Pu, 241Am, 243Am, 244Cm) and transmutation of long-lived fission products (93Zr, 99Tc, 109Pd, 129I, 135Cs) can be done using high energy neutrons. The high energy neutrons can be generated by bombarding high energy (GeV) proton from accelerator on spallation targets such as natPb and/or209Bi. The high energy neutron can cause fission long-lived minor actinides and transmutation of long-lived fission products in the reactor core. Besides this, the high energy neutron will cause fission of232Th and natU, which were kept in the blanket.Such a system makes it possible to obtain sufficiently high neutron fluxes (Ф~1015-17 neutrons/(cm2•s)), for transmuting radiotoxic isotopes, generating tritium for thermonuclear facilities or plutonium for fast reactors and finally generating nuclear energy for power production.

The new approach of recent years is the creation of new nuclear processing technologies, in which nuclear transformation of long-lived radionuclides into stable or short-lived nuclides can be done under the action ofproton, alpha particle, electron besides neutron. Among these, neutron transmutation of long-lived radioactive materials using synergistic systems will be the most promising direction of nuclear transmutation.

In this research project, the conventional ADSs system has been proposed, in which important parameters to be solved are: (1) Selection of energy and current of the proton beam and creation of an accelerator with the required parameters; (2) Selection of target material and creation of a target design for obtaining the fission neutrons;(3) Development of a scheme of heat extraction in the target block; (4)Development of a scheme and design of a subcritical blanket and to solve issues of nuclear safety; (5) Development of a scheme for heat extraction in a subcritical blanket; and (6) Determination of the reaction rates for the transmutation of long-lived nuclides and the rate of their formation.

The researchers are aware of the above important parameters. However, they have forgotten to mention about the design of subcritical reactor core and preparation of fuel for the ADSs. In the subcritical reactor, high energy neutron has to be used. This is because during spallation and fission high energy neutron will be produced. Besides this high energy gamma rays in the form of bremsstrahlung will also be produced. Thus it is necessary to take care about the high energy neutron and gamma ray shielding for the safety of environmentand human society.

The researchers havetested the first part of the proposed project at JINR (Dubna, Russia) in 20011-2013 years on the target of natural uranium (setting "Quinta") irradiated with deuterons (energy 0.5 - 4 GeV / nucleon).They have installed and used different know equipment’s for this test experimental run. Based on this test experimental run, they have tested the methods for measuring various neutron-physical characteristics (beam parameters, impulse characteristics, fission and capture numbers, neutron output, etc.).

In the present project “Study of Deeply subcritical accelerator driven systems and features of their application for energy production and transmutation of spent nuclear fuel (E&T-SNF)”will be developed for experimental and theoretical studies of various neutron-physical characteristics after irradiation of a large uranium target (TS BURN) with high-energy deuteron beams.

Based on the write up and test experiment of the researchers, I observed that the output of the present project will be as follows:

A large uranium target will be used in the experiment. Thus in the proton or deuteron induced fission of natural uranium,a rigid neutron spectrum will be formed due to the absence of light nuclei. Certainly, this will make it possible to measure the spectral characteristics and cross sections of various reactions in this energy range. Besides this, the experimental data that can be obtained within the framework of this project are of great interest from the viewpoint of the connection between the accelerator and the subcritical reactor, the development of neutron measurement techniques, the verification of computer codes and the libraries of the estimated nuclear data in the high-energy range.

**The researchers are experience scientists. They have gained a lot of experience from their preliminary experimental test. Thus, they can complete the present project with excellent results and output mentioned above. Thus, I strongly support the present proposal.**

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