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## STATUS OF WORK ON TRANSMUTATION IN SWITZERLAND

(Summary)

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Studies on the transmutation of long lived radionuclides are concentrated at the Paul Scherrer Institute (PSI) in the department "Nuclear Energy". Merging out of existing activities on Nuclear Fuel and Reactor Physics two general subjects have been identified for experimental work.

- PREPARATION of TARGET MATERIALS for fast reactor application utilizing wet chemistry processes for the direct conversion of nitrate solutions into a fuel form (dense spheres) or in an intermediate product to be pelletized (porous spheres).

The aim is to prepare uranium-plutonium-neptunium nitride and uranium-plutonium nitride microspheres and to compare sphere pac fuel and hybrid sphere-pellet with the dry route pellets in a fast flux reactor. This cooperative work is being shared with the Departement d'Etudes des Combustibles at Cadarache of the French Commissariat a l'energie atomique (CEA) and PSI.

In parallel, an evaluation of possible matrix materials in the form of oxides or nitrides to be prepared by wet chemistry processing has started. The oxide of magnesium and the nitride of zirconium are in the center of interest. Preliminary tests in the zirconium-cerium oxide and the zirconium-uranium nitride systems have been initiated in collaboration with Japan Atomic Energy Research Institute (JAERI).

- NUCLEAR DATA AND CALCULATIONAL METHODS PROBLEMS related to the accelerator-based transmutation of actinides.

High energy nucleon-meson transport computer codes used in the design of accelerator based transmutation systems have to be capable of correctly predicting, among other things, the yield and the mass distribution of spallation and fission products generated in the target. Simple code comparisons for the irradiation of thin samples of actinides have revealed considerable differences in the prediction of these quantities. To resolve the discrepancies and to confirm the high potential of the high-energy fission reactions for the transmutation of actinides, an experimental programme, ATHENA (Actinide Transmutation using High Energy Accelerators), has been initiated. In a first phase of the programme, thin samples of uranium, neptunium and americium encapsulated in aluminium will be irradiated with 590 MeV protons from the PSI ring accelerator using the PIREX irradiation facility. The distribution of the reaction products will be measured using different methods such as the ICP-MS and the total reflection X-ray fluorescence technique and compared with results of model calculations.

For accelerator-based systems in which protons are used directly to transmute actinides, integral information on the adequacy of neutronic design methods is scarce. In a second phase of the ATHENA programme, it is therefore proposed to study neutronic behaviour of such systems with the help of zero-power experiments at a separate beam of the accelerator.

The physics related studies are carried out in the framework of a collaboration with the Département d'Etudes des Réacteurs of the CEA at Cadarache.

The activities make use of existing knowledge and capabilities and utilize an almost unique combination of facilities available at PSI. The two topics, accelerator transmutation and target fabrication, are regarded by the PSI as long-term basic research and help to preserve and further develop competence in the area of advanced fuels and reactor physics.

## SCIENTIFIC RESEARCH PROGRAM ON ACTINIDE TRANSMUTATION BY USE OF FAST REACTORS

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### Abstract

For the recent years in the Ministry of Atomic Energy of Russian Federation the national program on RAW management has been under development. The program of actinides transmutation (as the most hazardous part of RAW) was treated as its component. According to this program various investigations within this field have been supported for the last two years. The program includes five sections dealing with actinide transmutation with the use of fast reactors.

1. The problem of radioactive waste (RAW) management has recently become of immense importance in nuclear power of all the countries involved in its solution. Evidently in the nearest future it will be an issue of the main priority in the IAEA activity along with the safeguards and NPP's safety. The nuclear power progress could hardly be anticipated without its adequate solution. It doesn't mean that the authorities and experts absolutely neglect the problem. The time has just come when the attention to this problem is considered insufficient, when the problems of finding the sound solution of RAW management are more obvious. Nowadays we are quite aware of the international aspect of the problem and the scale of the financial support necessary. The nuclear power development as it is makes it necessary to work out:

- certain concepts of RAW management ;
  - national and international standards, regulations and rules;
  - research and development programs;
  - practical recommendations based on scientific and research works data and on the assimilated expertise.
- When working out the concept of RAW management we should proceed from the assumption of at least long-term preservation of the Earth natural radiotoxicity level. If we leave alone low-level