REACTORS, FUELS AND TARGETS
Chairman: T. Mukaiyama

In this session, 17 paper were presented: five paper on transmutation in fission reactors, six papers on accelearator transmutation, three papers on fuels, two papers on strategic studies of transmutation and one paper on related nuclear data.

1. Transmutation in fission reactors (five calculational papers)

The potential of fast reactors for transmutation of minor actinides (MA) was discussed and, in order to avoid the significant deterioration of neutronic safety parameters, a mazimum MA fraction of 5% in the fuel was recommended (Siemens of Germany and PNC of Japan). For a quantitative reduction of Tc-99 and I-129 in fast reactors, an irradiation time of 100-200 years will be needed (Siemens).

The long-term Am radiotoxicity can only be reduced when Am is irradiated at an extermely high thermal neutron flux. The most promising Tc-99 transmuter is the inner core of a fast reactor, regardless of moderation or non-moderation and the yearly transmutation mass is about 100 kg (4% of inventory) in a 3000 MW reactor (ECN Petten, Netherlands). KAERI (Korea) calculated the transmutation rate of MA, Tc-99 and I-129 in the central region of the multi-purpose research reactor "KMRR" for 206 days irradiation. The net transmutation is about 30% for MA, 13% for Tx-99 and 10% for I-129.

2. Accelerator based transmutation systems (one experimental and five calculational papers)

Several groups (ENEA of Italy, LANL of USA and a CERN group) recommended the liquid lead as the target and/or as the coolant material of accelerator driven transmutation or of energy production systems. Based on the experiments using a proton beam of energy between 0.6 to 2.75 GeV for the water-moderated sub-critical natural uranium target, the CERN group concluded that the optimal proton energy is above 1 GeV for the energy gain of about 30 and indicated that a 1 GeV cycloton can deliver a 10 mA proton beam using present day technology and that the limit will be around 20 mA. An overview of the Swedish research activities on accelerator driven transmutation systems was given (RIT and Uppsala University). The incentive of this work is to reduce the cost associated with geological repositories. The activities are concentrated at the universities with limited financial support from the industry and utility groups. An approach to dispose of Tc-99 and I-129 into outer solar space by using an accelerator was proposed by Dr. Takahashi of BNL (USA). PNC presented the paper on the electron accelerator transmutation of Sr-90 and Cs-137 by using the (g,n) reaction.

3. *Fuels and targets (one calculational and two experimental papers)*

Belgonucléaire studied the scenario of Pu and Am recycling in PWRs and concluded that one recycling step of Am in addition to Pu is the limit of recycling. The dose rate increase is significant when Am is added to the MOX fuel. CEA reported on the well-organised, wide range fuel and target studies under the SPIN program. These include fuel fabrication and irradiation for Np and Am homogenous recycling. Some of the irradiation experiments have been done and some will start in PHENIX, OSIRIS and SUPERPHENIX. Tc-99 irradiation experiment will also start in 1995. It is expected that some of the experimental data will be disclosed at the next NEA information Exchange meeting. JAERI has been developing the nitride fuel fabrication method and the pyro-chemical process of nitride fuel for the proposed JAERI Actinide Burner Reactor.

4. *Nuclear Data (one data evaluation paper)*

JAERI is compiling the evaluated nuclear data files in order to provide a reliable database for the OMEGA programme. On file contains neutron-induced reaction data of about 90 actinides for designing Actinide Burner Reactors in which MA is a major fuel component. The other file contains the high energy neutron and proton data for designing accelerator driven transmutation systems.

5. *Strategic studies on transmutation (two papers)*

ECN Petten is conducting the research programme "RAS" which is aimed at informing the public and advising the authorities on transmutation and conditioning of nuclear waste. The paper of ECN concluded that transmutation scenarios in which the waste are contaminated with U-234 are not preferable because they will, in the long run, lead to mobile Rn-222. Reduction of collective dose risk seem, at first sight, to be less relevant, because such risks are far below the natural dose risks, but there are incentives to reduce doses even below such marginally small values keeping in mind past resistance against ocean-dumping of low-level nuclear waste.

PSI of Switzerland developed a method for investigating the effectiveness of actinide transmutation systems. Systems having a wide range of characteristics were compared. One interesting result of the study is that, from the point of view of radiological risk reduction of waste in the long term, the U-Pu cycle and the Th-U cycle are similar.

6. *General remarks on the session*

On of the objectives of this session was to provide basic technical information for P&T system studies which were presented at session 3. Only two of the fuel related papers (CEA and JAERI) provided relevant information. Several national and international programmes on irradiation experiments of fuels containing MA have been launched. In order to facilitate further fruitful discussion on transmutation system studies, the experience and knowledge obtained from these irradiation experiments are indispensable.