SESSION I

Overview of National and International Programmes

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SUMMARY

This session gave an overview of the major activities in the field of partitioning and transmutation (P&T) in some of the Member countries, i.e. Japan, France and the USA as well as by international groups (TWG) and organisations (EC, IAEA, NEA).

Significant progress has been made in many countries since the previous Information Exchange Meeting in Mol, November 1998. The OMEGA programme in Japan underwent a review by the AEC's Advisory Committee on Nuclear Fuel Cycle Back-End Policy that released a report entitled *Research and Development of Technologies for Partitioning and Transmutation of Long-lived Nuclide: Status and Evaluation Report* (March 2000). This report gave an overview of ongoing and planned R&D by the different governmental and private organisations in Japan and identified future activities. The report concluded that the R&D at the three research institutes (JAERI, JNC and CRIEPI) had resulted in the establishment of processes for P&T technology with the expected performance. The aims of the Phase I R&D have thus been achieved according the expectations included in the OMEGA-programme. R&D in Phase II has experienced some delays, the primary reason being that Japan is redefining its entire FBR programme, and facilities to handle MAs and other materials have yet to be constructed. The report also mentioned that in carrying out further R&D, it would be important to promote co-operation with domestic and foreign organisations in order that experimental facilities – including those for engineering experiments – can be used efficiently.

The three Japanese research organisations indicated in the report that a common issues is the implementation of experiments to demonstrate processes using actual HLLW. In addition, the preparation of a database on fuel irradiation behaviour for performance analysis and the development of fuel fabrication technology were considered an issue as well.

While several R&D activities are planned in the future, e.g. economic aspects, P&T technology as part of the fuel cycle, system design and others, it was considered appropriate to conduct R&D in these areas on a time schedule compatible with nuclear fuel cycle R&D. At present, feasibility studies on commercialised FBRs and related fuel cycles system is being carried out under the collaborative efforts of JNC, electric utilities, CRIEPI and JAERI. In this study, R&D scenarios toward commercialisation of fast reactor system will be reviewed by about the year 2005. Thus, around the year 2005 is deemed to be an appropriate time to reconsider all R&D scenarios of P&T including the

use of FBRs for transmutation together with power generation, and the double-strata fuel cycle. Thereafter, progress, results and R&D policy will be checked and reviewed every five years or so. Evaluations of P&T technology system concepts, and reviews of introduction scenarios, should also be conducted.

In France, research is conducted with the goal of establishing by 2006 the scientific feasibility of transmutation in various types of nuclear reactors (PWR, innovative reactors) and the technical feasibility of intensive separation downstream from reprocessing at La Hague, as well as of the specific conditioning of separated long-lived radionuclides. The research is conducted in co-operation with partners in the nuclear industry, EdF, COGEMA and FRAMATOME, as well as with CNRS and universities. It benefits form significant co-operation at the European and international level. It is constantly evaluated by the National Evaluation Commission, which draws up and publishes an evaluation report annually. The procedure involves identifying a set of complementary scientific and technical solutions, which serve to define open and flexible strategies for the back-end of the cycle and lay the groundwork for a decision in 2006.

Concerning partitioning research, a reference programme has been defined for an advanced separation process for the main long-lived radionuclides in waste. The families of extractors were defined, the principal reference molecule synthesised, and their performances verified experimentally on real radioactive solutions in the ATALANTE facility in order to reach the stage of scientific feasibility in 2001. The next stage will be that of technical feasibility, moving from the molecule to the overall chemical process, which will be defined and validated in 2005. Experimental studies on fuel for the transmutation in fast neutron reactors have been launched, in particular in the PHENIX reactor, whose irradiation programme has focused on this research since 1998 and which therefore has been the object of inspection, renovation and maintenance, in view of a power increase in 2001.

In addition, teams at CEA and CNRS, in co-operation with industrial partners, have provided the technical data for a request for an experimental demonstration model of a hybrid reactor for transmutation, in a European and international framework.

Since the last meeting on P&T in 1998 in Mol, the US accelerator transmutation of waste (ATW) programme has changed significantly. Two years ago, the only effort was the preparation of a research plan for developing ATW technology. Today, a significant research effort is underway, and the US is seeking opportunities to collaborate with other national programmes. Transmutation R&D in the US initially has been focused on ADS and has involved a series of trade-off studies. In all cases, it has been assumed that uranium remaining in civilian spent fuel elements would be recovered, probably by a modified PUREX process called UREX. Initial studies of the UREX process have shown that the uranium product will meet US Class C requirements and could be disposed of as low level waste or be stored for possible future use in a nuclear fuel cycle. Various combinations of proton accelerator designs, spallation neutron sources, and transmutation target have been evaluated for technology readiness, and assumed irradiated targets have been studied for the effectiveness of chemical processing to recycle untransmuted long-lived isotopes. These evaluations have resulted in a base-line design which includes a linear proton accelerator, a lead-bismuth spallation target, and sodium-cooled metallic or ceramic dispersion transmutation target/blanket non-fertile fuel elements. Another interesting transmutation system design currently being evaluated consists of a “dual strata” approach which would involve a thermal critical reactor within which plutonium and minor actinides would fission and $^{99}Tc/^{129}I$ would be subjected to a thermal neutron flux.

The ATW programme during the Fiscal Year 2001 involved approximately a doubling of the Fiscal Year 2000 funding. This will allow an expansion of experimental programmes, and DOE’s Office of Nuclear Energy, Science and Technology (NE) is actively seeking opportunities for collaborative research with foreign ADS programmes. Meanwhile, the programme is being

reorganised to combine the objectives of the DOE Defence Programme's Accelerator Production of Tritium (APT) programme with those of NE's ATW efforts. The combined programme is known as Advanced Accelerator Application (AAA), and it will be administered by NE. Congress has requested a report by March 1, 2001 on how the new activity will be carried out.

In Europe, a Technical Working Group (TWG) was established with the task of identifying the critical technical issues in which R&D is needed to develop an European demonstration programme of ADS over a 10-year time scale. The TWG, currently extended to ETWG, started in 2000 an intensive work aimed at defining a European Roadmap towards an experimental ADS, called XADS. The roadmap document is expected to be issued in the first half of 2001. The first goal of the roadmap is to propose a technological route to reduce the risks associated with nuclear waste, based on the transmutation of this waste using an ADS. The second and main goal of the roadmap is to prepare a detailed technical programme, with cost estimates, which could lead to the demonstration of an experimental ADS in 10 years. The programme as described in the roadmap will lead to a rationalisation of human resources and experimental facilities, a training ground for young researchers, the development of innovative fuels and reprocessing technology, spin-offs in the fields of accelerators, spallation sources, liquid metal technology, radioisotope production and actinide physics and chemistry. Hence, a final goal of the roadmap is to identify possible synergies and rationalisation that this programme could have within the nuclear community, indicate potential spin-offs, show how competence can be maintained in a currently stagnating field.

The European Commission has included in its previous Framework Programmes and in the current ongoing Fifth one, FP5 (1998-2002), several activities related to P&T. These activities address the chemical separation of long-lived radionuclides and the acquisitions of technological and basic data, necessary for the development of an ADS. Collaboration is also being implemented in this field between scientists of the European Union (EU) and the Commonwealth of Independent States (CIS).

The interest for P&T in the EU is reflected in the increase of funding over the EURATOM Framework Programme, i.e. 4.8, 5.8 and about 26 million € for the Third, Fourth and Fifth Framework Programmes respectively.

The P&T projects in FP5 have been grouped in three clusters. The experimental investigation of efficient hydro-metallurgical and pyrochemical processes for the chemical separation of long-lived radionuclides from HLW is carried out in the cluster on partitioning. The work on transmutation is mainly related to the acquisition of data, both technological and basic, necessary for the development of an ADS. The cluster on transmutation-technological support deals with the investigation of radiation damage induced by spallation reactions in materials, of the corrosion of structural materials by lead alloy and of fuels and targets for actinide incineration. In the cluster transmutation-basic studies, basic nuclear data for transmutation and ADS engineering design are collected and sub-critical neutronics are investigated. Additional projects will be funded in 2001, such as preliminary engineering design studies for an ADS demonstrator, complementary projects for technological support and networking.

The Commissioner responsible for research in the EC launched the idea of an "European Research Area" in January 2000. The intention is to contribute to the creation of better overall working conditions for research in Europe. In view of the future research programme, the EURATOM Scientific and Technical Committee has prepared a report on the strategic issues to be considered in the development of the appropriate nuclear energy research strategies in a 20-50 year perspective. In the area of nuclear fission, continued support should be given to maintain and develop the competence needed to ensure the safety of existing and future reactors. In addition, support should be given to explore the potential for improving present fission technology form a sustainable development point of view, i.e. better use of uranium and other nuclear fuels, whilst reducing the amount of long-lived radioactive waste produced.

The session ended with two presentations by the international nuclear agencies, IAEA and NEA, showing their programmes of work in the area of P&T. A more detailed overview of their activities is given in the respective papers. The need for further international co-operation was once again repeated and strengthening of existing co-operations between countries as well as in the framework of international organisations has been requested in order to secure the effective use of scarce resources. This need for international co-operation will also be needed as prioritisation of R&D will be needed in the nearby future while decisions for new infrastructure will be requested.

The discussion during this session already highlighted the need for convergence of R&D in the future. A selection of fuel cycle schemes and an associated precise work-programme or strategy was requested where new international studies should focus on fuel cycle impacts and R&D needs.

One may remark that quite significant resources are spent in R&D in the various areas of P&T. While some countries perform in essence theoretical studies on possible P&T scenarios, others are embarked in experimental programmes and commit resources for construction of specific facilities. In the meantime, these countries also recognise that P&T is a long-term endeavour and that no immediate decisions are needed before about 2005. In France and Japan, a review of the P&T programme in the light of a long-term back-end policy is foreseen by the middle of this decade, while real implementation of a P&T scheme would still need an additional 20 years.