

# Concluding Discussion

Chaired by Dr. Yuri Orechwa

The session opened with a review by each of the previous session chairmen, after which ideas were presented on possible ways to approach systems studies.

## Summary of Session 1- F.J. Goldner (United States)

Dr. Goldner noted that the French and Japanese contributions at the Argonne Conference dealt with policy approaches; others had looked at specific scientific or technical topics. Key features in France were the increased independence given to ANDRA, the waste management organisation, and the attempts to gain greater public acceptance by involving the public more intimately in the decision-making process. In Japan there was the aim to see how far resources could be recycled by more intensive partitioning, with decisions on further pursuit of these ideas to be taken in 2000. The support of current R&D was seen as complementary to efforts to develop geological disposal of radioactive waste. Dr. Goldner noted that current US policy is to dispose of spent fuel without reprocessing. The question has been opened as to whether Partitioning and Transmutation (P&T) could generate benefits to the management of radioactive waste: a decision to evaluate the technical and economic feasibility of pyroprocessing of LWR spent fuel was scheduled for 1995. Mr. Michaels' presentation had raised questions as to whether there was an analysis of the nuclear fuel cycle from a public health risk point of view comparable to that for other fuel cycles, and whether, if one were available, it would help to gain public acceptance for nuclear policies, and waste disposal in particular. Dr. Baetsle had presented a comprehensive picture of many points to be considered in decisions on P&T policy.

Dr. Goldner suggested that the papers presented had indicated a wide range of studies that could be useful:

- What was the legal background for P&T in different countries?
- What were the implications for the whole fuel cycle for direct disposal as opposed to P&T? It would be necessary to take standard basic assumptions and explore the differing results and the different locational patterns for benefits and losses.
- What were the incentives for P&T in different countries?

## Summary of Session 2- L. Koch (CEC)

Dr. Koch suggested that the conclusion from reviewing the papers presented should be that Partitioning was the real problem that had to be addressed. It was still an open question as to which nuclides should be the focus of interest. One over-riding point was the expected losses in Partitioning. He noted that the IFR process in which 99.9 per cent recovery was targetted would give a 100-fold reduction of radiotoxicity, whereas the wet processes for the recovery of about 95 per cent of minor actinides would reduce radiotoxicity 10-fold. Seven wet processes had been presented, including some that mixed minor actinides with lanthanides. As well as the IFR process of recycling, two routes to take LWR spent fuel into the process had been outlined. The trends he had observed in recent reporting included attempts to minimise secondary wastes, and to avoid the use of salts in wet partitioning

processes. There seemed to be a **developing consensus** to use wet processes to separate the output into **three groups** (plutonium plus minor actinides; technetium and platinum group metals; iodine and fission gases) whereas for dry processing the groups **would be** alkaline rare earths; TRU; and technetium plus platinum group metals. The research priorities that seemed to be suggested were:

- the separation of americium and curium **from rare earths**, in both wet and dry processing;
- the effect of rare earths on fuel stability;
- minor **actinide** and plutonium losses, which ought to be kept to less than 0.5%;
- a “hot demonstration” of **electro-refining** with separation of minor **actinides** and **lanthanides**; and
- the feasibility of Accelerator-based Transmutation of Waste.

### Summary of Session 3- H. Yoshida (Japan)

Dr. Yoshida noted, *inter alia*, the useful result **from the work** of Inoue *et al.* that showed the **thermal** conductivity of alloy fuels containing minor **actinides** and rare earths to be approximately the same as for conventional fuels. **There** had been a wealth of useful information **presented** in all the **papers; compared** with the **first** meeting at Mito City **there** had been **remarkable progress**. However, although much necessary data had been accumulated, that was **useful** for **more** quantitative discussion of the merits and costs of **P&T**, there was still a need for much more data in order to prepare conclusive analyses.

### Summary of Session 4 - M. Salvatores (France)

Dr. **Salvatores** was pleased that a very wide range of advanced ideas had been **presented**. He suggested that the work by Ludwig *et al.*, addressing the **variability** of the input stream, should be repeated in other contexts. The papers by Ludwig and **Mukaiyama** demonstrated the **relevance** of looking at the whole **fuel** cycle when considering the **requirements** for transmutation. He noted the intensive work on particle beam accelerator in Japan that was showing first results after **three** or four year work.

**He noted** that **there** was considerable difficulty in finding satisfactory means of transmuted fission products.

**He found it** difficult to **compare more** futuristic systems with **more** conventional reactors, although it seemed that their efficiencies of “incineration” did not seem very different. **A consistent** physics analysis and a clear definition of criteria for **intercomparison** is needed. This raised the question as to why it was necessary to pursue **reactors**. Some of the contributions had not addressed the incineration of plutonium. There was a need for **integration**; for example, did devices perform as well for plutonium as they did for neptunium?

## General Discussion of Future Directions

Dr. Baetsle suggested that two questions should be addressed:

1. Was a systems study important, and;
2. What should be the role of the NEA?

He noted that there were already four studies under way that had something of the character of systems studies, organised by the European Commission, the USDOE, JAERI and in Russia. His paper in the first session had the character of an embryonic systems study. There was a need for a broad study for the benefit of governments and waste disposal authorities. This should elaborate a data base (that of Ludwig could be a good starting point), set chemical processing flowsheets (preferably avoiding complexity), describe the fuel fabrication technology, the transmutation systems and the recycling processes. Ideally it would include an economic analysis but it was too early to do this. He went on to present more detailed ideas using viewgraphs that are included in Annex 1.

Dr. Yoshida believed the NEA should continue to play a leading role and commented on related activities in the NEA's Nuclear Science Committee (NSC). It was important to seek complementarity of actions. He presented a Japanese proposal (see Annex 2) that could be forwarded to the Nuclear Development Committee (NDC). The aim was to explore ways of defining future directions of R&D. The study should consider incentives for P&T, identify any required technological break-throughs, and define targets for decontamination factors and transmutation rates.

Mr. Stevens suggested that the NEA could help in two ways -- the NSC, together with the IAEA, could complete the necessary data bases on neutronic, other physical and chemical data, and on inventories, while the NDC could develop a framework for intercomparison of different systems.

Several speakers cautioned against embarking on over-ambitious, or even any systems studies, for which insufficient data were as yet available. Nevertheless there was a widespread view that it was desirable to perform studies that would help to orient future research work, taking reasonable assumptions for various critical parameters and seeking to identify the main uncertainties in present understanding of the overall balance of benefits and penalties.

Some contributors hoped that progress could be made towards defining an international systems study on an agreed scenario. Others suggested that at least an attempt should be made to compare current studies. This would involve consideration of criteria for measuring benefits of P&T. That could lead to a desirable concentration of effort on radioactive species of greatest interest.

The point was made that funding for a research programme would be more readily obtained if its rationale were clearer. This would also help attract the younger scientists whose efforts would be needed to maintain the momentum of nuclear development into the next century.

There had been much progress made already within the life of the Programme but there was clearly scope for additional specific studies and calls were made for more bilateral and multilateral projects. It was noted that there were many fields to be worked in and only a small resource available.

Mr. Stevens suggested that one common thread was the need for guidance on research needs and after further discussion he drew the following conclusions:

1. A comparison of systems studies, or proto-systems studies, already in progress would be a major topic at the next general meeting of the **Programme**. This would be regarded as a first phase in the approach to a more **co-ordinated** systems study that would seek to identify benefits and penalties of adding **P&T** to the nuclear fuel cycle and provide guidance on the most fruitful areas for **further** research.
2. Given the many **diverse** approaches and criteria in use it would be necessary to have **careful preparation** of a **framework within** which the studies could be compared. The framework should be conceived in order to allow as wide a range as possible of studies and criteria **to** be included, extending beyond studies of effects at a waste repository. A proposal **to this effect should be put to the NEA's Nuclear Development Committee, taking account of text.ain elements of the Japanese proposal.**
3. Dr. **Baetsle** was encouraged to update his report. °
4. Mr. Stevens **would circulate** both the **Baetsle** report and **copies** of the **Proceedings** of the meeting.
5. The Nuclear Science Committee of the NEA would. be invited to take over the organisation of specialist meetings on scientific topics.