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**INFCE**

**International  
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OBJECTIVES AND TASKS FOR SUB-GROUP B: PLUTONIUM MANAGEMENT AND RECYCLE

# International Nuclear Fuel Cycle Evaluation

INFCE/WG.4/8/Rev.1 (B)

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Working Group 4  
Sub-Group B

## PLUTONIUM MANAGEMENT AND RECYCLE

NOTE BY THE CO-CHAIRMEN

(as revised at Sub-Group Meeting 26 January 1978)

### Objectives

1. The prime objectives of Group 4 as a whole (as set out at the Working Group Meeting in London on 6/7 December 1977) are:-

- To evaluate the need for reprocessing of thermal Reactor fuel on an industrial scale and for recycling it in thermal and fast reactors, taking account of economic, environmental, energy resource, technological and institutional aspects and of the work of the other relevant Working Groups as it progresses;

- To identify means of minimising the risk of proliferation in relation to reprocessing of nuclear fuels and to recycling.

2. To accomplish these objectives the Working Group has set up two Sub-Groups. This particular Sub-Group (Sub-Group 4B) has a large work load and our terms of reference oblige us to collect facts, to make assessments, to identify technical options, to consider institutional arrangements and identify any desirable research and development programmes. The Co-Chairmen suggest that we take as our terms of reference those tasks remitted to us by Working Group 4 as a whole at the London Meeting. For ease of reference, these are reproduced as Annex 1.

3. The Final Communiqué of the INFCE Organising Conference enjoined that:

"all participants will have an equal opportunity to contribute to the work".

"...INFCE was to be a technical and analytical study and not a negotiation".

"The evaluation will be carried out in a spirit of objectivity with mutual respect of each country's choices and decisions in this field..."

4. The remainder of this paper identifies the tasks which the Co-Chairmen feel must be carried out to fulfil the remit of the Sub-Group. All participants in the Sub-Group are invited to comment on this work programme and propose additions if they wish. The Co-Chairmen would also welcome offers of contributions to the tasks and/or offers to co-ordinate studies covering the whole scope of a particular task for consideration by the Sub-Group as a whole.

#### Organisational Arrangements

5. The Co-Chairmen propose to establish a secretariat from their Japanese and British colleagues to co-ordinate the work of the Group, keeping in close co-ordination with the IAEA and any other Organisations substantially involved in the work of the Sub-Group. This and other organisational arrangements are described in a separate paper (INFCE/WG.4/7 (B)).

#### MAIN TASKS OF THE SUB-GROUP

##### Task 1: collection of basic data

6. To study both plutonium management and recycle the Sub-Group will need to collect a large amount of basic data. Some of this will

come from information which is already known and published. Some must come from the participating countries. The Co-Chairmen of Sub-Group 4A have proposed the collection of data from participants through the questionnaire circulated as an Annex to the Working Paper agreed at the Working Group 4 Meeting in December 1977 (INFCE/WG 4/3). (This questionnaire is referred to hereafter as the December 1977 questionnaire.) It is proposed that, for the purpose of Sub-Group 4B, this questionnaire should be extended to ask for information relating to plutonium management and recycle. Under each task defined below needs for basic information are indicated where they arise. It is proposed that, after the first meeting of the Sub-Group, the Japanese/British secretariat should collate these needs into questionnaire form in the light of discussion at the meeting, and circulate the questionnaire to participants for the provision of the information. (This second questionnaire will be referred to as the February 1978 questionnaire.)

7. The remaining tasks may be considered under the two headings of plutonium management and plutonium recycle.

#### Plutonium Management

8. The plutonium management tasks below deal with plutonium arising from operation of civil reactors. These tasks should be conducted in the context of a closed fuel cycle, distinguishing where appropriate between recycle in either thermal or fast reactors. The Sub-Group should also take account of studies by other INFCE Groups bearing on plutonium arisings.

#### Task 2: current methods of plutonium storage: base case

9. The February 1978 questionnaire will request information on present stocks of plutonium held by participants:

- (i) in irradiated fuel
- (ii) as separated plutonium

A base case will be prepared covering all aspects of present methods of plutonium storage on the lines indicated in Annex 2. This will serve as a basis for comparison for technical and institutional alternatives. Assessments of the base case should be made:

- (i) to evaluate economic, environmental, technological and safety aspects
- (ii) to judge the degree of proliferation resistance.

Task 3: current methods of plutonium transport: base case

10. A base case should be prepared describing current methods of plutonium transport covering items indicated in Annex 3.

Assessments of the base case should be made:

- (i) to evaluate economic, environmental, technological and safety aspects
- (ii) to judge the degree of proliferation resistance.

Task 4: Plutonium storage: technological alternatives

11. A study on the lines indicated in Annex 4 should be made of technological alternatives for the storage of plutonium which respond to the intentions of the final communiqué of the Organising Conference of INFCE, for example:

- Storage as nitrate, mixed plutonium/uranium oxide, fabricated fuel elements.

Assessments should be made:

- (i) to evaluate economic, environmental, technological and safety aspects
- (ii) to judge the degree of proliferation resistance

Task 5: Plutonium transport: technological alternatives

12. A study on the lines indicated in Annex 5 should be made of technological alternatives for plutonium transport which respond to the intentions of the final communiqué of the Organising Conference of INFCE, for example:

- As fuel elements, pre-irradiated or spiked.

Assessments should be made:

- (i) to evaluate economic, environmental, technological and safety aspects
- (ii) to judge the degree of proliferation resistance.

Whereas work on Tasks 2 and 3 should begin at once, it may be felt appropriate by the Sub-Group to defer work on Tasks 4 and 5 until the base cases as required under Tasks 2 and 3 have been completed.

Task 6: Alternative institutional arrangements

a. International Management of Plutonium

13. IAEA has recently begun a study of ways of implementing a system of international plutonium management, which would be a major step in the context of non-proliferation, and the Sub-Group will need to consider this matter. It is proposed that IAEA should be requested to take the lead in further study of this topic and to

contribute on it to the Sub-Group. In particular, IAEA should now be invited to:

- (i) submit their study on International Management of Plutonium to the Sub-Group
- (ii) continue the study in consultation with interested States
- (iii) take part in consideration of this subject by the Sub-Group.

14. There are also other institutional alternatives to be considered:

- b. Plutonium Management with improved safeguards; and
- c. Any other institutional alternatives.

IAEA and other participants are invited to submit contributions to the Sub-Group on possibilities for improving the safeguards regime as applied to plutonium. They are also invited to propose any other improved institutional arrangements which they consider worthy of examination. Further work on these two topics which may be appropriate for the Sub-Group will be considered in the light of these contributions.

#### Plutonium Recycle

15. The remit given to the Sub-Group by the Working Group on 6/7 December 1977 proposed work on:

- a. plutonium recycle
- b. uranium recycle
- c. plutonium and uranium recycle.

16. The Co-Chairmen propose that work on recycle should concentrate on the recycle of plutonium with uranium in thermal reactors. This is, however, subject to the view of participants, who may wish to suggest that work should be done on other forms of recycle. If they do, it is hoped that suggestions will be accompanied by offers of working contributions.

Task 7: Definition of the Base Case

17. It is proposed that the base case should be a light water reactor. The Sub-Group is required to list national plans for plutonium/uranium recycle in thermal reactors. To begin this task the questionnaire of December 1977 seeks information from participating countries on their plans for recycle. This information will be supplemented by the questionnaire of February 1978. The base case will cover:

- a. National plans for recycle  
As outlined in Annex 6
- b. Definition of reactor  
As outlined in Annex 7
- c. Definition of fuel fabrication facility  
As outlined in Annex 8
- d. Cost data.

A summary of the costs of the base case will be made, drawing on Tasks 7a, b and c; on other data as outlined in Annex 9; and on the work of other INFCE Groups. The summary should note the range of costs derived from the experience of participants.

Task 8: Assessment of Base Case

18. On the basis of Task 7 - which will include storage, fabrication, transport and performance in thermal reactors - and after identification and agreement on the criteria to be used, assessments should be prepared as follows:

- a. economic analysis
- b. environmental aspects
- c. energy resource Utilisation
- d. safety aspects.

An assessment must also be made of the degree of proliferation resistance.

Task 9: Plutonium recycle - reactor alternatives

19. Studies of any reactor alternatives to the base case, which participants wish to contribute to the work of the Sub-Group, should be evaluated on the same lines as indicated in Tasks 7 and 8 for the base case.

Task 10: Plutonium recycle - technological and institutional alternatives

20. It is likely that the work of this Sub-Group on plutonium management will suggest technological and institutional alternatives which require examination in the context of recycle. Task 10 will be an examination and assessment of these alternatives under the headings indicated in Task 8 and in comparison with the base case in Task 7.

Task 11: Plutonium recycle - reprocessing alternatives

21. It is likely that the work of Sub-Group 4A will suggest alternatives in reprocessing which require consideration by Sub-Group 4B in the context of recycle. Task 11 will be an examination and assessment of those alternatives under the headings indicated in Task 8 and in comparison with the base case in Task 7.

## ANNEX 1

Topics and assessments remitted to Sub-Group B for study

### B. Plutonium Management

- (1) Current methods of plutonium management
- (2) Technological alternatives
  - (i) Storage and transport of plutonium mixed with uranium
  - (ii) Transport of plutonium under alternative methods (as fuel elements, pre-irradiated, or spiked);

Assessments (both for B(1) and B(2))

- to evaluate economic, environmental, technological and safety aspects;
- to judge the degree of proliferation resistance

### (3) Alternative insitutional arrangements

- (i) Plutonium management with improved safeguards;
- (ii) International control of separated plutonium;
- (iii) Storage under the auspices of IAEA;

Assessments

- to consider legal and political aspects and those of public acceptance;
- to assess management, economic and environmental aspects;
- to identify possible areas of international control;
- to identify availability criteria;
- to judge the degree of proliferation resistance;

### C. Recycling

The technological, economic, environmental, energy resource utilisation and proliferation resistance aspects of plutonium and

uranium recycle will be studied. Group 4 will be the lead group for the study of plutonium and uranium recycle in thermal reactors; Group 5 in respect of the recycle of plutonium and uranium in fast reaction; and Group 8 in respect of other fuel cycle concepts. Accordingly, close liaison will be necessary between Working Group 4 and Working Group 5 and 8.

#### Assessments

- (a) for plutonium recycle,
  - (b) for uranium recycle, and
  - (c) for plutonium and uranium recycle
- to list the stated needs for and plans of countries around the world regarding plutonium/uranium recycle in thermal reactors;
  - to identify and agree on the criteria to be used, and the basic data needed, for the economic, environmental and energy assessments;
  - to evaluate economic, environmental, energy resource utilisation and safety aspects;
  - to judge the degree of proliferation resistance.

#### 4. Criteria for proliferation resistance

There is a common need across a number of INFCE Working Groups to identify and establish criteria by which to judge the degree of proliferation resistance of various fuel cycles and processes, both in relation to covert/overt national action and sub-national group action. It is proposed to initiate consideration of this requirement after the question of common ground rules has been discussed by the technical coordinating committee.

## ANNEX 2

### Task 2 Guidelines for input - Current methods of plutonium storage

Base case - assumes dry PuO<sub>2</sub> powder in sealed canister

- a. Description of store
- b. Major handling philosophy including accounting procedures
- c. Maintenance philosophy
- d. Criticality control philosophy
- e. Physical protection philosophy and safeguard measures
- f. Major equipment
- g. Ventilation
- h. Utilities and service required
- i. Plant layout
- j. Safety analysis and impact on environment
- k. Estimates of construction and operating costs

ANNEX 3

Task 3 Guidelines for input - Current method of transport of  
plutonium base case

- a. Forms of plutonium transported
- b. Capacity of transport
- c. Technology based on current IAEA regulations
- d. Safety analysis and impact on environment
- e. Container details, i.e. size, weight etc.
- f. Mode of shipment - i.e. surface transportation by truck
- g. Special handling requirements
- h. Distance of shipments carried out
- i. Arrangments for transportation across international boundaries
- j. Container design/details enough to provide an estimate of the  
construction and operating costs  
or  
construction and operating costs
- k. Unclassified details of physical protection

Task 4 Guidelines for input - Plutonium storage:

technological alternatives

Form of plutonium stores other than as  $\text{PuO}_2$

- a. Form in which stored
- b. Description of store
- c. Technology and date achievable
- d. Major handling philosophy including accounting procedures
- e. Operation and maintenance
  - Ordinary operation: remote
  - Maintenance operation: contact
- f. Criticality control philosophy
- g. Physical protection philosophy and safeguards measures
- h. Major equipment
- i. Ventilation
- j. Utilities and service required
- k. Plant layout
- l. Safety analysis and impact to environment
- m. Plant design details enough to provide an estimate of the construction and operating costs

Task 5 Guidelines for input - Plutonium transport:

technological alternatives

- a. Forms of plutonium transported
- b. Alternative methods proposed including date when alternatives expected to be operative
- c. Capacity envisaged or planned
- d. Container details, i.e. size, weight etc.
- e. Any special handling requirements
- f. Distance envisaged by alternative methods
- g. Arrangements for transportation across international boundaries
- h. Estimated construction and operating costs with as much detail as possible

## ANNEX 6

Task 7a Guidelines for input - Present status and future plans  
for plutonium and uranium recycle

- a. Present status including the research and development programmes
- b. Plans to 2000 and 2025 (including reactor types, mode of loading, time schedule for recycle, amount of plutonium required, amount of plutonium fuel handled, need of fabrication facility, etc.)

Task 7b Guidelines for input - Definition of reactor

- a. Definition of the plant
- b. Core fuel load
- c. Annual fuel reload
- d. Design burnup
- e. Physics design characteristics
- f. Fuel assembly size and weight
- g. Discharge fuel energy generation rate after 90 days  
cooling
- h. Utility and service required
- i. Plant layout
- j. Safety analysis and impact to environment
- k. Plant design details enough to provide an estimate on  
the construction and operating costs

## ANNEX 8

### Task 7c Guidelines for input - Fuel fabrication facility

- a. Definition of the plant
- b. Major process philosophy
- c. Maintenance philosophy
- d. Criticality control philosophy
- e. Physical protection philosophy
- f. Average inventory
- g. Major equipment
- h. Ventilation
- i. Utility and service required
- j. Plant layout
- k. Safety analysis and impact on environment
- l. Plant design details enough to provide an estimate of the construction and operating costs

## ANNEX 9

### Task 7d Guidelines for input - Cost data

- a. Pu storage cost
- b. Fuel fabrication cost
- c. Reactor construction cost
- d. Shipping cost
- e.  $U_2O_8$  cost
- f. Enrichment cost
- g. Conversion cost
- h. Reprocessing cost
- i. Financing structure including interest rate