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INFCE

**International
Nuclear
Fuel
Cycle
Evaluation**

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ECONOMIC EVALUATION OF REPROCESSING-INDICATIVE GERMAN POSITION

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INTERNATIONAL FUEL CYCLE EVALUATION

Working Group 4: Reprocessing, Plutonium Handling, Recycle

Sub-Group 4A: Reprocessing

Economic Evaluation of Reprocessing

Indicative German Position

Delegation of the Federal Republic of Germany

1. According to the existing atomic energy regulations in the Federal Republic of Germany, new construction permits and operating licences for nuclear power plants will be granted in the future only if sufficient evidence will be provided that the back-end problems of the nuclear fuel cycle can and will be solved in an environmentally secure and safe manner.
2. Taking into account the special conditions prevailing in the Federal Republic of Germany thermal recycling of plutonium is considered the most appropriate way to cope with the back-end problems of nuclear power plants.
3. Thermal plutonium recycle, would have the following advantages in that:
 - (a) it decreases the national needs for
 - natural uranium requirements
 - enrichment services;
 - (b) it helps to decrease the foreign exchange demand and, as a result, to improve the balance of payments for countries having no indigenous fuel resources;
 - (c) it serves as a decisive step for establishing the mixed oxides (MOX) fuel manufacturing technology and know-how needed later in the commercial deployment of the FBR;
 - (d) it decreases considerably the amount of plutonium to be stored outside the reactor, thus reducing the plutonium proliferation and diversion potential;
 - (e) it has the potential of decreasing the fuel cycle cost of existing thermal reactors as compared to the once-through or throw-away fuel cycle mode of operation, depending, a.o., on the uranium ore price.

4. The diagrammatic representation of economic factors affecting the nuclear fuel cycle strategy presented in the attached diagram deals only with the question addressed in 3(e).

4.1 Due to the fact that a large thermal plutonium recycle research, development and demonstration (R, D&D) programme has been carried out in Germany, F.R. since 1972, in which as many as around 10,000 MOX fuel rods have been successfully irradiated in light water reactors up to target exposures in some cases exceeding those presently achieved for uranium rods, the technical design data and to a large extent the economic input data relevant to thermal plutonium recycle required for the phase diagram analysis can be assessed satisfactorily from practical experience. For those parts of the input data that are not yet felt to be sufficiently well based on experience, particularly for some of those pertaining to the waste disposal aspects of the fuel cycle, plausible ranges rather than single values have been used. As a result, twin values for the phase boundaries U_{OT} , Q_{BT} (and also for U_{RT} and U_{OR}) have been obtained indicating a possible band of uncertainty.

4.2 The attached diagram using best estimates for input data representative of our economic conditions suggests the following conclusions can be drawn:

- the Germany F.R. economic environment clearly leads to a "case 1" with no R regime, i.e. with no regime representing "reprocessing with uranium recycle only";
- the lower (U_{OT1}) and upper (U_{OT2}) value of the boundary demarcating the zone of thermal recycle preferred (T) from that of once-through preferred are:

$$U_{OT1} = 27.9 \text{ \$/lb } U_3O_8$$

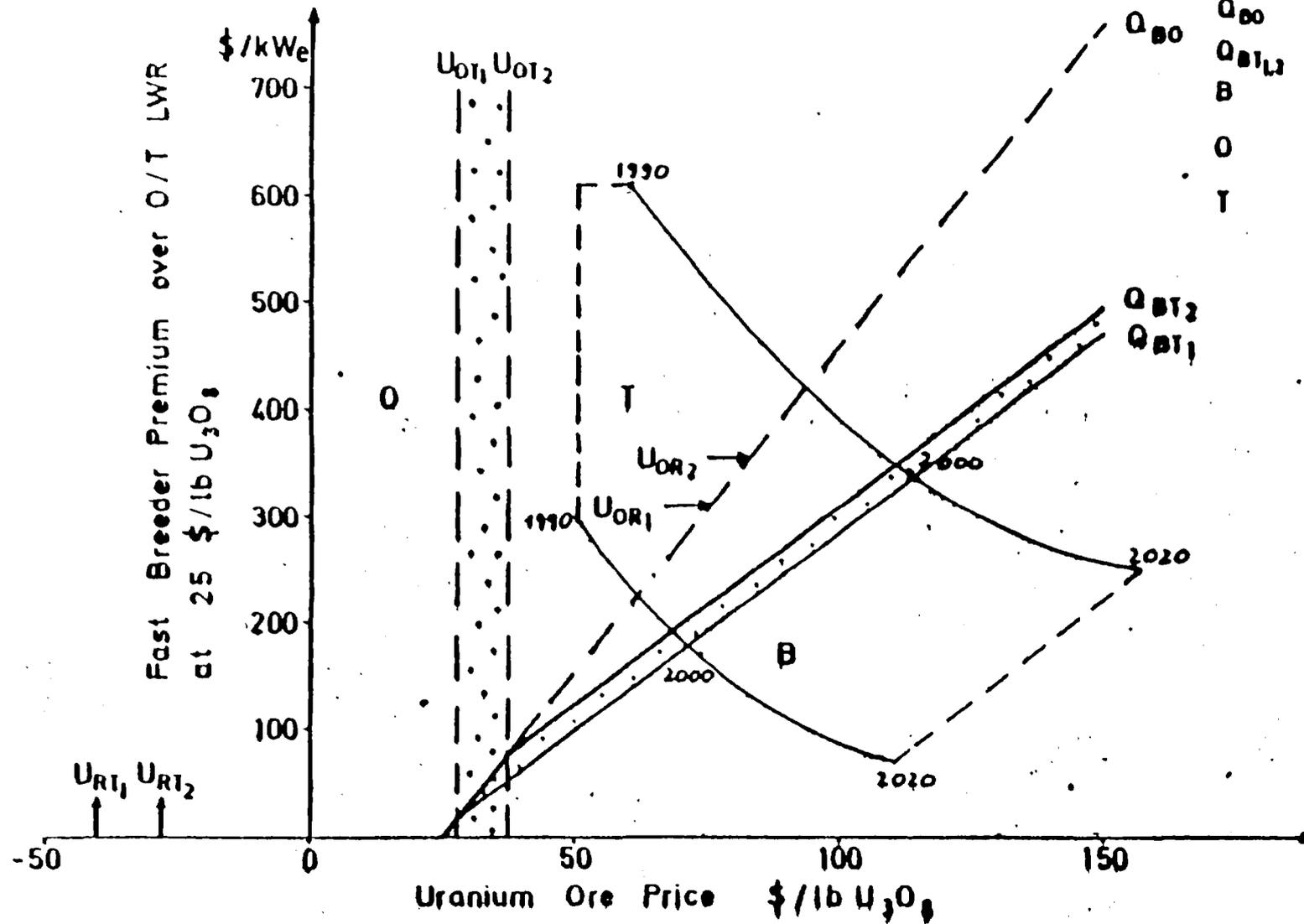
$$U_{OT2} = 37.3 \text{ \$/lb } U_3O_8$$

This clearly suggests that thermal (i.e. U and Pu) recycle will be economic even under present day uranium prices.

(Use of potential fuel cycle improvement factors resulting in uranium utilisation improvements in the once-through fuel cycle would shift the phase boundary U_{OT} to somewhat higher uranium ore prices. If, however, the same improvement factors - although in a quantitatively somewhat different combination - are applied also to the thermal recycle LWR, only a minor shift of the phase boundary U_{OT} occurs, so that the conclusions drawn above remain essentially unchanged.)

- Our views on the FBR premium over the once-through LWR (at \$/lb U_3O_8) and the possible increase in natural uranium price are illustrated by the "kidney" shaped area superimposed on the graph. The use of an area rather than a line reflects the uncertainty to be attached to the fast reactor premium on the one hand and to the evolution of uranium price on the other hand. The FBR overlay as plotted in the diagram suggests that the FBR might become commercially economic around the year 2000. It should be noted that the evolution of uranium price will depend strongly on the reactor strategy adopted in the world as a whole.

Diagrammatic Representation of Economic Factors
Affecting Nuclear Fuel Cycle Strategy



Legend

- Q_{BO} Once through LWR
- Q_{BT1,2} Pu Recycle LWR
- B Zone of Fast Breeder preferred
- O Zone of once through preferred
- T Zone of U+Pu Recycle preferred