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PREPARATION OF FISSION-PRODUCT CROSS-SECTIONS LUMPED FOR A MULTI-GROUP LIBRARY

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ABSTRACT

The development of a method for calculating lumped fission-product (FP) cross-sections is described. The group constants of each nuclide are generated by the NJOY code on the basis of ENDF/B-V data. In this first version, cross-sections of 28 nuclides are grouped together for the characteristics of the Binary Breeder Reactor (BBR). In order to ascertain the influences of time, of the number of fission products and of the fuel composition on the lumped cross-section, calculations are performed in one energy group for a 1000 MW(e) fast reactor.

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1. INTRODUCTION

During the past three years the EXPANDA code [1] has been used at the Nuclear Energy Division (ENU) of this Institute to calculate the effective cross-sections used in the Binary Breeder Reactor (BBR) project [2]. EXPANDA's old cross-section library, JFS-1 [3, 4], which had been drawn up on the basis of the JENDL-1 library [5], ceased to be up to date, and it became necessary to draw up a new library on the basis of ENDF/B-IV. The generation of this new library with 37 isotopes has been described in an ENU Technical Note [6]; however, the old data are still being used for fission products (FPs).

This paper describes the procedures used to obtain cross-sections of FPs for a typical multi-group library and also the preparation of these cross-sections for a simplified case in which 28 nuclides are considered.

In reactor burn-up calculations it becomes impossible to take the individual effect of each fission product into account since they are present in the system in large numbers, of the order of hundreds. What is normally done is to group them in one or more sets of pseudo-fission products (PFPs) which represent the average behaviour of all the FPs of the reactor. There are various models or procedures for grouping such FPs, and thus also for calculating the lumped cross-sections of PFPs. One of these is the Garrison-Roos model [7], which lumps the FPs into three sets, with the nuclides ^{135}Xe and ^{149}Sm being considered separately. The three cross-section sets ("rapidly saturating", "slowly saturating" and "non-saturating") do not have scattering matrices, unlike ^{135}Xe and ^{149}Sm. Another model consists of two sets of cross-sections, one of which is calculated for fission products of even mass number, and the other for FPs of odd mass number [8]. This model is based on the fact that absorption cross-sections of nuclides of odd mass number are a number of times higher than those of nuclides of even mass number. A third model has a single data set representing all FPs formed during burn-up [9].

Generally, the calculation codes of reactors have in their nuclear data library a set of time-independent grouped cross-sections calculated by means of a representative spectrum of a class of reactor with a given fuel composition.

An important procedure is the selection of the FPs which are grouped; it is particularly important that they should be properly representative of the type and class of reactor for which the calculations are to be made. In addition to there being some hundreds of FPs, many are formed at a negligible rate in the fission process or have insignificant absorption cross-sections as compared with other nuclides.

In this preliminary work, 28 FPs have been lumped into a single FP in 70 energy groups. The cross-sections are calculated for given parameters, such as irradiation time, temperature, reactor spectrum and fission rates. In order to test the calculation method and to verify the results of lumping the 28 FPs, a further 43 FPs, making a total of 71, were selected. In this case, calculations were performed in one energy group for a 1000 MW(e) reactor [9].

2. GROUPING SCHEME

In the model with a single data set it is considered that all the FPs are combined in a pseudo-fission product, for which the microscopic cross-sections are calculated. These lumped cross-sections are obtained on the basis of microscopic cross-sections of each of the nuclides selected, which are weighted by constants calculated on the basis of the concentrations of each FP in a given irradiation time. The unit used is the barn.

A cross-section of type $\underline{x}$ is grouped as

$$\bar{\sigma}_{x,g} = \sum_{i=1}^{I} \omega_i \, \sigma^i_{x,g} \quad , \qquad \text{where}$$

ω_i is the weighting parameter of the i-th nuclide and $\sigma^i_{x,g}$ is the microscopic cross-section of the group $\underline{g}$ of the i-th nuclide.

The inelastic scattering matrix of a group $\underline{g}$ for another group $\underline{g}'$ is given by

$$\bar{\sigma}_{in}(g \to g') = \sum_{i=1}^{I} \omega_i \; \sigma^i_{in} \; (g \to g') \quad , \quad \text{while}$$

and the mean cosine of the elastic scattering angle ($\bar{\mu}$) is lumped as

$$\bar{\mu}_g = \sum_{i=1}^{I} \frac{\omega_i \, \mu_g^i \, \sigma_{el,g}^i}{\bar{\sigma}_{el,g}} \quad , \quad \text{while}$$

$$\bar{\sigma}_{el,g} = \sum_{i=1}^{I} \omega_i \, \sigma_{el,g}^i \quad \text{and}$$

$\sigma_{el,g}^i$ is the elastic scattering cross-section of the nuclide $\underline{i}$.

The weighting parameters (ω_i) are determined on the basis of the concentrations of each FP, whereby it is assumed that two fission products are formed in each fission event. Thus,

$$\omega_i = \frac{N_i}{F} \quad , \quad \text{where} \quad F = \frac{1}{2} \sum_{i=1}^{I} N_i$$

and N_i is the concentration of the nuclide $\underline{i}$ for a time $\underline{t}$.

3. CONCENTRATION CALCULATION [10]

The variation in the quantity of an isotope $\underline{i}$ can be expressed by the following formula:

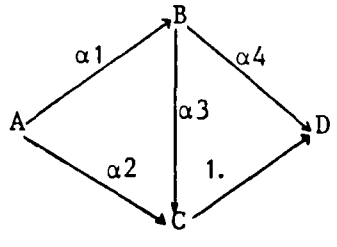
$$\frac{dN_i}{dt} = G_i'(t) + \sum_j \lambda_j N_j(t) + \sum_k \sigma_k \phi(t) N_k(t) - (\lambda_i + \sigma_i \phi(t)) N_i(t) \qquad (3.1)$$

The first term on the right-hand side of the above equation shows the rate of formation of the nuclide i directly from fission. This term depends on the rate of production of each FP, which in turn depends on the incident neutron energy. Moreover, it is a function of the type of nuclide which undergoes fission and of the fission rate. The second term shows the formation of the nuclide i by the decay of other nuclides. The third term represents the formation of the nuclide i by the reaction of neutrons with other nuclides. The final term shows the loss rate of i through decay and through reaction with neutrons of the nuclide i itself.

In this study the solution of Eq. (3.1) is obtained analytically without considering the transfer of a nuclide from one beta decay chain to another as a result of the absorption of neutrons. Only the formation of a nuclide i as a result of fission and beta decay is considerd.

The general solution is an analytical solution for a linear chain of arbitary length. For the case of a complex decay chain, the chain is broken down into all possible linear chains and the final solution is obtained by superimposition of the solutions of all these linear chains.

For example, for the following chain



the possible linear chains are

$$A \xrightarrow{\alpha_1} B \xrightarrow{\alpha_3} C \xrightarrow{1.} D$$

$$A \xrightarrow{\alpha_1} B \xrightarrow{\alpha_4} D$$

$$A \xrightarrow{\alpha_2} C \xrightarrow{1.} D$$

3.1 Linear chain solution

Considering the following linear chain:

$$\begin{array}{ccccccccccccc} A_1 & \xrightarrow{\alpha_1} & A_2 & \xrightarrow{\alpha_2} & A_3 & \xrightarrow{\alpha_3} & A_i & \xrightarrow{\alpha_i} & A_{i+1} & \cdots & \longrightarrow & A_n & \xrightarrow{\alpha_n} \\ \lambda_1 & & \lambda_2 & & \lambda_3 & & \lambda_i & & \lambda_{i+1} & & & \lambda_n & \end{array} ,$$

where A_1 represents a radioactive nuclide with decay constants λ_i and α_i is the decay rate of the nuclide A_i for A_{i+1}, the solution to Eq. (3.1) for a nuclide $\underline{i}$ is expressed by

$$N_i\ (t) = \sum_{I=1}^{i} N_I^o\ B_I^1\ (t,\ \lambda_I,\ \lambda_{I+1}\ ,\ \ldots,\ \lambda_i)\ +$$

$$G_I\ B_I^2\ (t,\ \lambda_I,\ \lambda_{I+1}\ ,\ \ldots\ \lambda_i)\ , \tag{3.2}$$

where N_I^o is the initial concentration of A_I,

$$B_I^1 = \sum_{j=I}^{i} d_j\ e^{-\lambda_j t} \quad \text{and} \tag{3.3}$$

$$d_j = \frac{\prod_{k=I}^{i-1} \lambda_k}{\prod_{\substack{k=I \\ k\neq j}}^{i} (\lambda_k - \lambda_j)} \ . \tag{3.4}$$

In the fission source term the function B_I^2 is obtained from the function B_I^1 by integration over time. Thus,

$$B_I^2 = \sum_{j=I}^{i} d_j\ \frac{1-e^{-\lambda_j t}}{\lambda_j} \tag{3.5}$$

where d_j is expressed by Eq. (3.4).

The percentages or rates of decay of the branches of complex chains need to be taken into consideration when calculating the concentration of each nuclide in each linear chain. Calling this parameter α_ℓ, the solved equation is given by

$$N_i(t) = \sum_{I=1}^{i} \left(\prod_{\ell=I}^{i-1} \alpha_\ell\right) \{N_I^o \, B_I^1 \, (t, \lambda_I, \lambda_{I+1} \ldots \lambda_i) \; +$$

$$\gamma_I (FR) \, B_I^2 \, (t, \lambda_I, \lambda_{I+1} \ldots \lambda_i)\} \quad , \qquad (3.6)$$

where γ_I is the production rate of the nuclide I and FR is the fission rate, which is assumed to be constant.

4. CALCULATION FLOW DIAGRAM

In order to perform the calculations described in section 3, the CALCON program was developed. This calculates the concentrations of nuclides of a chain for a given irradiation time or for time intervals at various stages of burn-up. The initial concentration of a nuclide at a certain stage of burn-up is the value of the concentration at the end of the previous stage.

The program calculates the fission product concentration in the case of fuel with a mixed composition of up to four different nuclides. This means that the fission rates and FP production rates are those corresponding to each of the nuclides undergoing fission. Another limit laid down in the program relates to the total number of nuclides in each linear chain. This is fixed at ten, although the total number of chains is not limited.

With the CALCON program it will not be possible to process chains consisting of nuclides with the same decay constant because the expression for B_I (Eqs (3.3) and (3.5)) becomes infinite. If this occurs, the expression will have to be redefined in order for the problem to be circumvented.

In addition to the concentrations of each of the nuclides of the chain, the program also gives their respective activities.

The concentrations obtained with CALCON require normalization in order to obtain the weighting parameters. This is done by a simple program called NORMAL.

The final lumped FP cross-sections are calculated with the PFCOND program, which was developed in this study. The principal input data are the microscopic cross-sections of each of the FP nuclides and the weighting parameters. The cross-sections of each FP are calculated with the GROUPR module of the NJOY code [11]. These need to be prepared and formatted appropriately with the RGENDF program [6]. The main purpose of the latter program is to prepare data in a format suitable for the EXPANDA program on the basis of data in the format of the ENDF/B library. It also performs calculations involving cross-sections.

The PPFCOND program processes the following cross-sections: total, elastic, inelastic, (n,2n), mean cosine of elastic scattering angle, and elastic, inelastic and (n,2n) scattering matrices.

The maximum number of nuclides which can be grouped together in each processing operation is 100. If the number of FPs is greater than the maximum, the program stores the processed data in an archive which must be read and taken into consideration in the calculations for the following processing operation.

Two types of output are possible for the results: one in a format similar to that of ENDF/B and the other as shown in Table 1 of Appendix III.

A calculation flow diagram is shown in Fig. 1 of Appendix I.

5. RESULTS

Appendix III gives the results from complete processing of the following 28 FPs in 70 energy groups:

^{90}Sr	^{103}Rh	^{131}Xe	^{145}Nd
^{93}Zr	^{104}Ru	^{133}Cs	^{147}Pm
^{95}Mo	^{105}Pd	^{135}Cs	^{147}Sm
^{97}Mo	^{106}Ru	^{137}Cs	^{149}Sm
^{99}Tc	^{107}Pd	^{143}Nd	^{151}Sm
^{101}Ru	^{109}Ag	^{144}Ce	^{153}Eu
^{102}Ru	^{129}I	^{144}Nd	^{155}Eu

which are responsible for some 80% of the total capture of FPs in a fast reactor.

The microscopic cross-sections were processed with the NJOY code for a temperature of 300 K in 70 energy groups. The structure of these groups is shown in Table 1 of Appendix I. Figure 2 shows the spectrum of the BBR fast reactor used for processing multi-group cross-sections. The basic data for this processing operation came from the ENDF/B library, 1979 and 1980 version. The system considered was of infinite dilution. Decay constants, production rates, decay rates and schemes of the chains were obtained from Ref. [12].

The group constants of the 28 FPs given here were grouped for a burn-up time of 600 days, when the variation in the FP concentration is small. Data sets were generated for two PFPs, one corresponding to FPs from fission of ^{233}U (inner core) and the other from fission of U-Pu fuel (outer core). In the latter case, the fission rates used were 62.8%, 23%, 12.9% and 1.3% for ^{239}Pu, ^{241}Pu, ^{238}U and ^{235}U respectively. Although ^{240}Pu and ^{242}Pu are present in the composition of the outer core, they were not considered in the calculations because of the lack of data available on the production rates of their FPs. For both the cases mentioned above, the calculations were performed for 1, 30, 360 and 600 days of burn-up. The normalized concentrations and grouped constants for 600 days are shown in the tables in Appendices II and III respectively.

In order to compare the results and to test the calculation procedure, lumped cross-sections were calculated in one energy group for a 1000 MW(e) reactor. The specturm for this is shown in Table 2 of Appendix I and the results are presented in Tables 3 and 4 of Appendix III. The microscopic cross-sections used for lumping were the same as those used in Ref. [9].

Initially, the 28 FPs mentioned earlier were processed, with ^{239}Pu being considered a fuel. In order to evaluate this result in relation to the reference result, a new calculation was performed whereby a further 43 FPs were added to the 28. The selection criterion related to the capture cross-section of each nuclide. Results for ^{239}Pu, ^{241}Pu, ^{238}U and ^{235}U are presented individually and also for fuels made up of these nuclides. The results of Ref. [9] relate to a pseudo-fission product consisting of 193 nuclides.

Also, considering the same 28 nuclides from section 5, lumped cross-sections (σ_t, σ_{el}, σ_{in}) were calculated in one energy group. The purpose was to find the difference between the results using evaluated nuclear data from ENDF/B-V and from JENDL-1. In both cases the same weighting constants were used, and the microscopic cross-sections of each nuclide were generated with the same code (NJOY). The results are shown in Table 5 of Appendix III.

6. CONCLUSIONS

The principal factors influencing the relative importance of FP nuclides are their individual cross-sections and the rate at which they are formed in the fission process, which in turn directly affects grouped cross-sections.

When only the 28 FPs considered most important are processed, a considerable difference is found as compared with the results for the 193 grouped FPs, mainly in the capture cross-section. This is because they have higher capture cross-sections than the other FPs, so that the results are over-estimated. When a further 71 FPs are added, a better agreement with the results of Ref. [9] is obtained.

Other factors such as the burn-up time, the reactor spectrum and the fuel composition influence the lumped data. These data for PFPs vary with time in line with the variation in concentrations of the nuclides they are composed of. This is mainly the result of the beta decay process. The most notable variations occur in the first 30 days, and diminish to a level of approximately 0.95% between 360 and 720 days of burn-up for capture cross-sections. An idea of the behaviour of capture cross-sections with time is given by Fig. 1 of Appendix III.

The fuel composition is another factor on which the lumped cross-sections depend. This is because the distribution of the production rate of each FP is a function - in addition to the energy of the fission neutron - of the type of nuclide undergoing fission.

Links between beta decay chains were not considered in our work. Earlier publications [9, 13] show that the variation in the final result due to this approximation is negligible compared with other errors, despite the fact that the transformation of a nuclide by neutron absorption is greater in a higher energy band.

The greatest region of uncertainty with the grouped nuclear constants is considered to be uncertainty in the microscopic cross-sections of FPs

from different evaluated data libraries. In order to analyse this factor, JNDC has performed calculations using various libraries such as JENDL, COOK, ENDF/B-IV, RCN etc. [9]. The discrepancies found in cross-sections processed in one group for a fast reactor are as much as 15%. In this study it was scarcely possible to calculate lumped cross-sections on the basis of two libraries, JENDL-1 and ENDF/B-V. The maximum difference found was 3.7% in the inelastic scattering cross-section.

From the results obtained with calculations in one group we found that 28 FPs were insufficient for the purpose intended. Thus, for generating the data for the EXPANDA library, a calculation of lumped FPs with approximately 90 nuclides is being performed.

ACKNOWLEDGEMENTS

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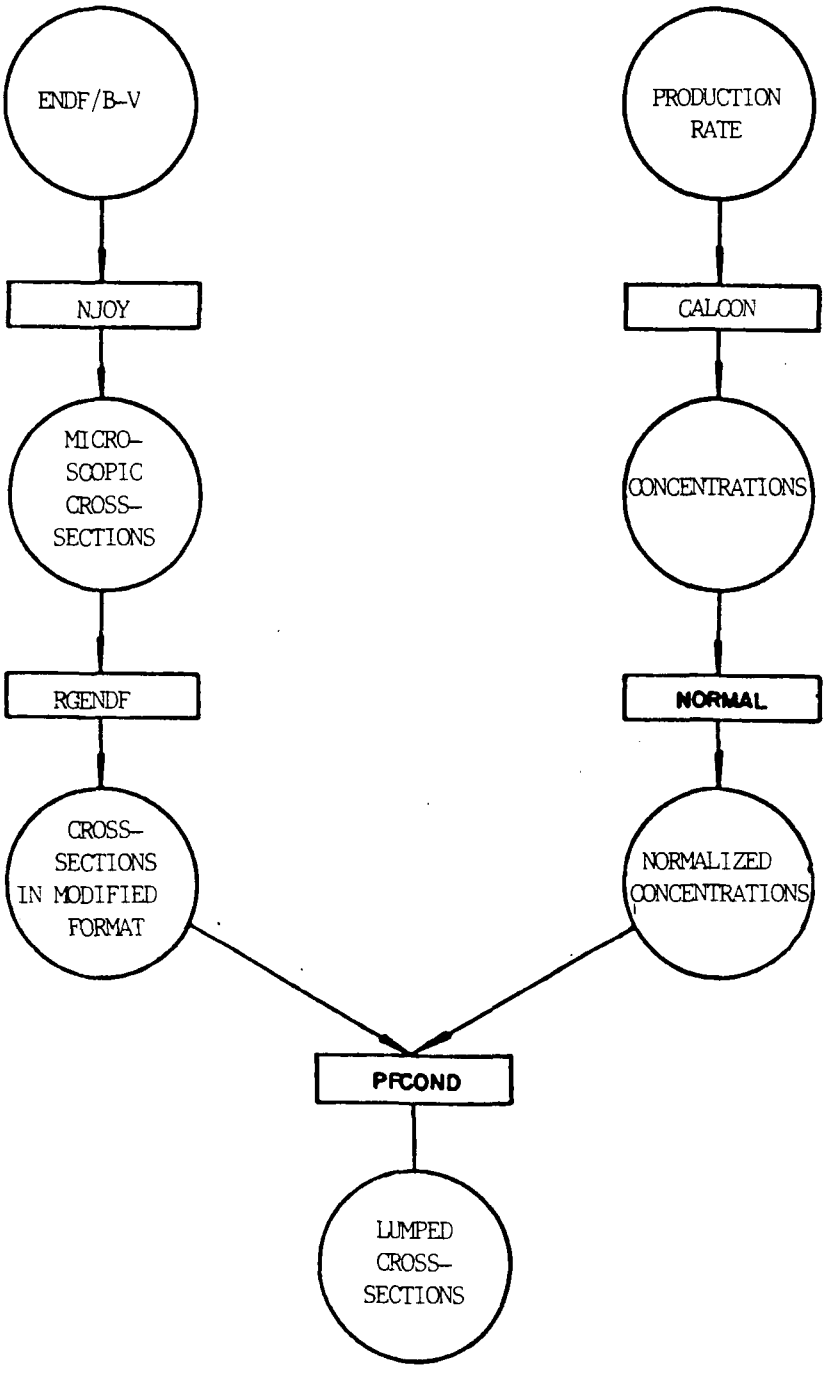
APPENDIX I

Fig. 1. Calculation Flow diagram



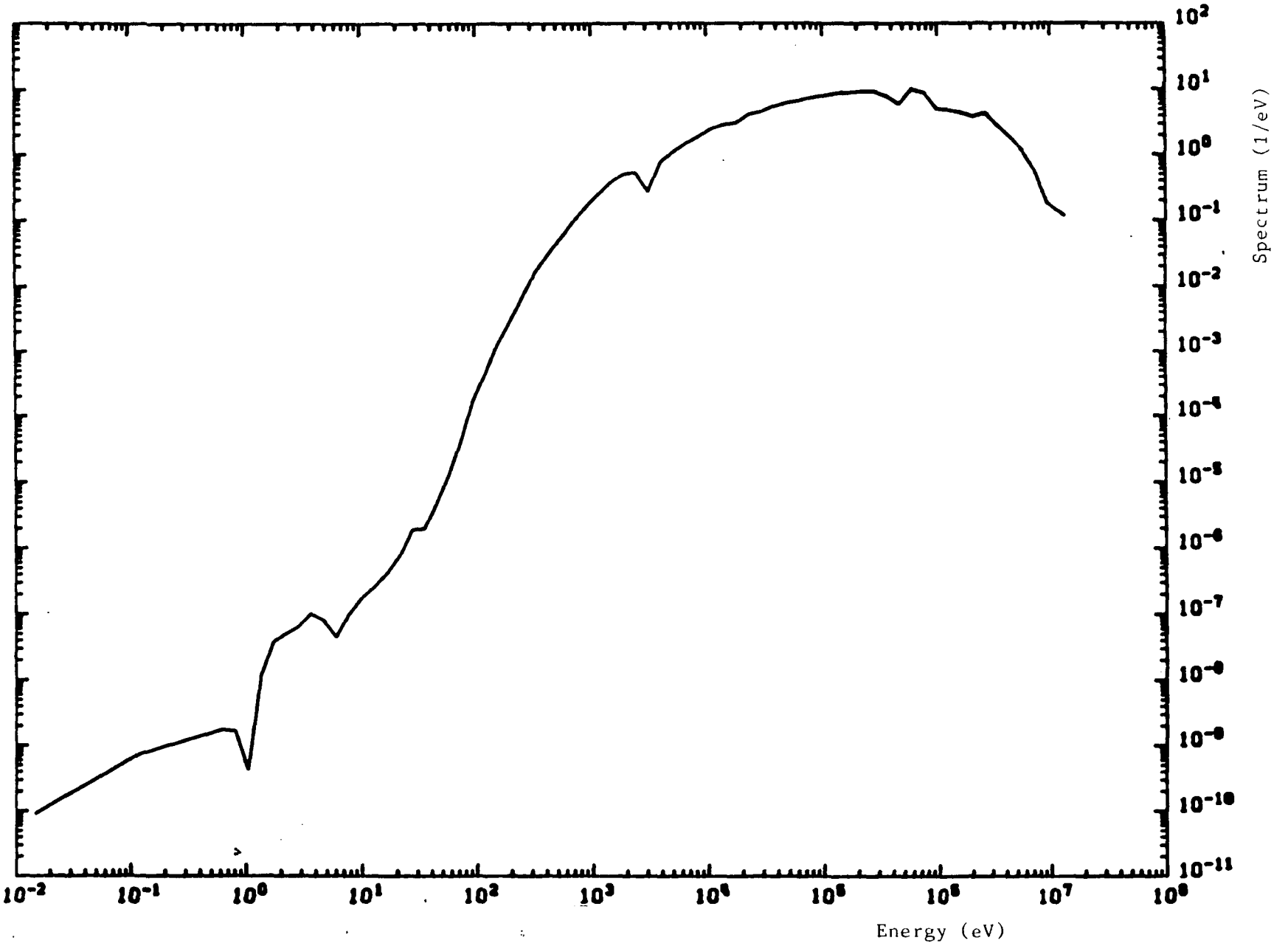


Fig. 2 Spectrum of BBR Reactor

Table 1 Structure of 70 energy groups

ENERGY GROUP	LOWER LIMIT (eV)	UPPER LIMIT (eV)	ENERGY GROUP	LOWER LIMIT (eV)	UPPER LIMIT (eV)
1	2,15E-01	2,78E-01	36	1,66E+03	2,15E+03
2	2,78E-01	3,60E-01	37	2,15E+03	2,78E+03
3	3,60E-01	4,65E-01	38	2,78E+03	3,60E+03
4	4,65E-01	5,98E-01	39	3,60E+03	4,65E+03
5	5,98E-01	7,73E-01	40	4,65E+03	5,98E+03
6	7,73E-01	1,00E+00	41	5,98E+03	7,73E+03
7	1,00E+00	1,29E+00	42	7,73E+03	1,00E+04
8	1,29E+00	1,66E+00	43	1,00E+04	1,29E+04
9	1,66E+00	2,15E+00	44	1,29E+04	1,66E+04
10	2,15E+00	2,78E+00	45	1,66E+04	2,15E+04
11	2,78E+00	3,60E+00	46	2,15E+04	2,78E+04
12	3,60E+00	4,65E+00	47	2,78E+04	3,60E+04
13	4,65E+00	5,98E+00	48	3,60E+04	4,65E+04
14	5,98E+00	7,73E+00	49	4,65E+04	5,98E+04
15	7,73E+00	1,00E+01	50	5,98E+04	7,73E+04
16	1,00E+01	1,29E+01	51	7,73E+04	1,00E+05
17	1,29E+01	1,66E+01	52	1,00E+05	1,20E+05
18	1,66E+01	2,15E+01	53	1,20E+05	1,50E+05
19	2,15E+01	2,78E+01	54	1,50E+05	2,00E+05
20	2,78E+01	3,60E+01	55	2,00E+05	2,50E+05
21	3,60E+01	4,65E+01	56	2,50E+05	3,10E+05
22	4,65E+01	5,98E+01	57	3,10E+05	4,00E+05
23	5,98E+01	7,73E+01	58	4,00E+05	5,00E+05
24	7,73E+01	1,00E+02	59	5,00E+05	6,30E+05
25	1,00E+02	1,29E+02	60	6,30E+05	8,00E+05
26	1,29E+02	1,66E+02	61	8,00E+05	1,10E+06
27	1,66E+02	2,15E+02	62	1,10E+06	1,40E+06
28	2,15E+02	2,78E+02	63	1,40E+06	1,90E+06
29	2,78E+02	3,60E+02	64	1,90E+06	2,50E+06
30	3,60E+02	4,65E+02	65	2,50E+06	3,10E+06
31	4,65E+02	5,98E+02	66	3,10E+06	4,00E+06
32	5,98E+02	7,73E+02	67	4,00E+06	5,10E+06
33	7,73E+02	1,00E+03	68	5,10E+06	6,50E+06
34	1,00E+03	1,29E+03	69	6,50E+06	8,30E+06
35	1,29E+03	1,66E+03	70	8,30E+06	1,05E+07

Table 2 Spectrum of 1000 MW(e) fast reactor

ENERGY GROUP	ϕ_g
1	0,0
2	0,0
3	0,0
4	0,0
5	0,0
6	5,6878E-06
7	4,5502E-05
8	2,3320E-04
9	1,1887E-03
10	4,1293E-03
11	1,0795E-02
12	2,2819E-02
13	2,0977E-02
14	3,6823E-02
15	7,2622E-02
16	1,2448E-01
17	1,5202E-01
18	1,5240E-01
19	1,5100E-01
20	9,8439E-02
21	7,1985E-02
22	4,6475E-02
23	2,3138E-02
24	8,7706E-03
25	1,6608E-03

APPENDIX II Table 1

Concentrations of the 28 FPs - Inner core of BBR

Isotope	1 day	30 days	360 days	600 days
38SR 90	4.639992E-01	2.459452E-01	1.995339E-01	1.802773E-01
40ZR 93	1.378137E-01	1.413636E-01	1.168707E-01	1.056640E-01
42MO 95	1.540340E-05	5.719753E-03	1.109621E-01	1.243855E-01
42MO 97	1.216174E-01	1.898201E-01	1.592474E-01	1.440516E-01
43TC 99	2.280117E-02	1.508345E-01	1.410281E-01	1.280312E-01
44RU101	2.137352E-01	1.161838E-01	9.433277E-02	8.523191E-02
44RU102	1.650192E-01	8.815757E-02	7.153919E-02	6.463596E-02
45RH103	8.866714E-04	1.333994E-02	4.103436E-02	3.984736E-02
44RU104	6.863628E-02	3.695135E-02	2.999281E-02	2.709899E-02
46PD105	4.104306E-03	1.595133E-02	1.396794E-02	1.265372E-02
44RU106	1.757582E-02	9.045357E-03	5.495250E-03	4.102160E-03
46PD107	7.760542E-02	4.206219E-03	3.414849E-03	3.085376E-03
47AG109	1.286074E-03	1.557244E-03	1.295431E-03	1.171471E-03
53 I129	6.619933E-02	5.217905E-02	4.589543E-02	4.173079E-02
54XE131	8.344589E-03	1.095046E-01	1.366112E-01	1.097624E-01
55CS133	5.613229E-03	1.529895E-01	1.712394E-01	1.562970E-01
55CS135	1.451361E-01	2.172916E-01	1.810518E-01	1.637358E-01
55CS137	7.184912E-04	6.023762E-04	2.525035E-03	1.753881E-01
60ND143	1.437885E-03	9.230484E-02	1.608467E-01	1.489748E-01
58CE144	3.079816E-01	1.571197E-01	8.797517E-02	6.271921E-02
60ND144	4.365870E-04	5.851143E-03	4.423019E-02	5.672822E-02
60ND145	1.519239E-01	1.201669E-01	9.857359E-02	8.909660E-02
61PM147	3.486364E-03	3.347233E-02	4.218132E-02	3.576696E-02
62SM147	8.353088E-07	2.754599E-04	5.478594E-03	8.092965E-03
62SM149	5.951608E-03	2.421880E-02	2.186995E-02	1.983243E-02
62SM151	5.157087E-03	1.078858E-02	9.207350E-03	8.313712E-03
63EU153	1.113258E-03	3.404531E-03	3.023884E-03	2.740680E-03
63EU155	1.403345E-03	7.546561E-04	5.755978E-04	5.839266E-04

Table 2 Concentrations of the 28 FPs - Outer core of BBR

Isotope	1 day	30 days	360 days	600 days
38SR 90	7.788212E-02	4.619986E-02	3.377287E-01	3.960609E-02
40ZR 93	7.241447E-02	8.321688E-02	6.199252E-02	7.274928E-02
42MO 95	6.267875E-06	2.686135E-03	4.700059E-02	6.838761E-02
42MO 97	6.506224E-02	1.150486E-01	8.698697E-02	1.021346E-01
43TC 99	1.615581E-02	1.195973E-01	1.007571E-01	1.187281E-01
44RU101	2.388334E-01	1.452803E-01	1.062854E-01	1.246464E-01
44RU102	2.498871E-01	1.493893E-01	1.092325E-01	1.281002E-01
45RH103	1.988330E-03	3.347502E-02	9.278211E-02	1.169453E-01
44RU104	2.440059E-01	1.470066E-01	1.075163E-01	1.260884E-01
46PD105	2.646064E-02	1.150804E-01	9.079996E-02	1.067674E-01
44RU106	1.792098E-01	1.032107E-01	5.649810E-02	4.793960E-02
46PD107	1.315597E-01	7.979370E-02	5.837099E-02	6.845428E-02
47AG109	2.485139E-02	3.367368E-02	2.524048E-02	2.962664E-02
53 I129	3.164509E-02	2.794156E-02	2.207261E-02	2.604304E-02
54XE131	4.994061E-03	6.738013E-02	7.385981E-02	8.999968E-02
55CS133	3.593015E-03	1.099666E-01	1.108898E-01	1.313726E-01
55CS135	9.226121E-02	1.638749E-01	1.231554E-01	1.445702E-01
55CS137	2.517108E-01	1.492083E-01	1.079499E-01	1.256482E-01
60ND143	6.191405E-04	4.449255E-02	6.985973E-02	8.401642E-02
58CE144	1.793797E-01	1.024044E-01	5.166503E-02	4.780863E-02
60ND144	2.254799E-04	3.796175E-03	2.596232E-02	4.322687E-02
60ND145	8.027931E-02	7.105699E-02	5.252074E-02	6.161685E-02
61PM147	2.466020E-03	2.649578E-02	3.008568E-02	3.311226E-02
62SM147	5.908196E-07	2.180459E-04	3.907590E-03	7.492297E-03
62SM149	6.028680E-03	2.746265E-02	2.234547E-02	2.630177E-02
62SM151	7.557756E-03	1.770803E-02	1.361748E-02	1.595973E-02
63EU153	2.749188E-03	9.415712E-03	7.535561E-03	8.864920E-03
63EU155	8.172938E-03	4.919652E-03	3.381092E-03	3.792531E-03

Table 3 Concentrations of the FPs - ^{239}Pu - 1000 MW(e) reactor

Isotope	1 day	30 days	90 days	180 days	360 days	720 days
38SR 90	2.656448E-02	2.162789E-02	2.147752E-02	2.126462E-02	2.180741E-02	2.125361E-02
40ZR 93	2.489105E-02	3.924765E-02	3.951497E-02	3.925686E-02	4.032750E-02	3.935367E-02
42MO 95	2.251539E-06	1.294625E-03	7.668587E-03	1.773521E-02	3.122217E-02	3.971689E-02
42MO 97	2.246215E-02	5.343042E-02	5.436844E-02	5.415357E-02	5.570199E-02	5.439174E-02
43TC 99	5.370255E-03	5.456444E-02	6.019211E-02	6.108346E-02	6.340557E-02	6.219372E-02
44RU101	7.343471E-02	6.131110E-02	6.091940E-02	6.032430E-02	6.186840E-02	6.032529E-02
44RU102	7.571640E-02	6.212782E-02	6.170670E-02	6.109790E-02	6.265882E-02	6.109447E-02
45RH103	6.869292E-04	1.587345E-02	3.529931E-02	4.897942E-02	6.068449E-02	6.470528E-02
44RU104	7.440757E-02	6.152718E-02	6.112097E-02	6.052050E-02	6.206796E-02	6.051902E-02
46PD105	8.554651E-03	5.106557E-02	5.363662E-02	5.382928E-02	5.550079E-02	5.433156E-02
44RU106	5.464807E-02	4.319575E-02	4.060095E-02	3.709218E-02	3.261472E-02	2.402443E-02
46PD107	4.202809E-02	3.498731E-02	3.476142E-02	3.442130E-02	3.530216E-02	3.442150E-02
47AG109	8.919750E-03	1.658888E-02	1.677748E-02	1.668637E-02	1.715090E-02	1.674133E-02
53 I129	1.165628E-02	1.412369E-02	1.460281E-02	1.479469E-02	1.539875E-02	1.512970E-02
54XE131	1.638241E-03	3.257310E-02	3.858923E-02	5.384848E-02	5.018854E-02	4.975202E-02
55CS133	1.218970E-03	5.120174E-02	6.476108E-02	6.767196E-02	7.122092E-02	7.033012E-02
55CS135	3.096196E-02	7.422526E-02	7.519761E-02	7.482062E-02	7.691935E-02	7.509022E-02
55CS137	8.380458E-02	6.818249E-02	6.758134E-02	6.672262E-02	6.804046E-02	6.559847E-02
60ND143	2.025740E-04	1.997715E-02	3.456721E-02	3.949749E-02	4.326486E-02	4.352963E-02
58CE144	4.741782E-02	3.715475E-02	3.435206E-02	3.065938E-02	2.585574E-02	1.784367E-02
60ND144	6.081976E-05	1.378349E-03	3.910561E-03	7.223312E-03	1.299380E-02	2.003567E-02
60ND145	2.504921E-02	3.043145E-02	3.046395E-02	3.022255E-02	3.102493E-02	3.026513E-02
61PM147	7.803666E-04	1.150783E-02	1.680279E-02	1.784607E-02	1.802354E-02	1.591772E-02
62SM147	1.869668E-07	9.470318E-05	4.745766E-04	1.090014E-03	2.340935E-03	4.398807E-03
62SM149	1.825429E-03	1.141116E-02	1.226357E-02	1.237267E-02	1.280675E-02	1.254453E-02
62SM151	2.340991E-03	7.524949E-03	7.769965E-03	7.760362E-03	7.981591E-03	7.771378E-03
63EU153	7.289141E-04	3.424697E-03	3.635358E-03	3.657350E-03	3.780456E-03	3.700540E-03
63EU155	2.082678E-03	1.729938E-03	1.718693E-03	1.701851E-03	1.745390E-03	1.701844E-03
42MO 98	7.469895E-02	6.065653E-02	6.023118E-02	5.963324E-02	6.115490E-02	5.962730E-02
59PR141	4.365393E-04	1.407656E-02	3.000674E-02	3.992017E-02	4.781084E-02	5.011034E-02
42MO100	8.643019E-02	7.015306E-02	6.966043E-02	6.896872E-02	7.072858E-02	6.896175E-02
62SM150	1.235041E-05	1.202056E-05	1.184266E-05	1.175798E-05	1.206336E-05	1.175906E-05
54XE132	7.252564E-03	4.723719E-02	5.254612E-02	5.342398E-02	5.550465E-02	5.446770E-02
44RU103	8.751874E-02	5.568614E-02	3.572793E-02	2.132166E-02	1.139470E-02	5.564935E-03
62SM152	7.387566E-03	6.080339E-03	6.039538E-03	5.980058E-03	6.132887E-03	5.979791E-03
60ND148	2.072144E-02	1.686411E-02	1.674665E-02	1.658070E-02	1.700384E-02	1.657913E-02
57LA139	6.546509E-02	5.834359E-02	5.805272E-02	5.750570E-02	5.898809E-02	5.752184E-02
46PD108	2.786910E-02	2.271906E-02	2.256174E-02	2.233827E-02	2.290854E-02	2.233642E-02
53 I127	1.163984E-04	2.507203E-03	2.983801E-03	3.143565E-03	3.384383E-03	3.416775E-03
40ZR 96	6.360731E-02	5.163256E-02	5.126339E-02	5.075548E-02	5.205054E-02	5.075003E-02
60ND146	3.006580E-02	2.533521E-02	2.517859E-02	2.493390E-02	2.557276E-02	2.493522E-02
58CE142	5.697610E-02	5.135834E-02	5.111419E-02	5.063565E-02	5.194253E-02	5.065229E-02
40ZR 91	6.966247E-05	3.943546E-03	9.773330E-03	1.483701E-02	1.999804E-02	2.241563E-02
46PD106	5.697009E-05	1.224619E-03	3.507765E-03	6.578827E-03	1.217057E-02	1.964210E-02
54XE134	1.058534E-01	9.061265E-02	8.976118E-02	8.892271E-02	9.121463E-02	8.892825E-02
36KR 83	1.894751E-03	2.078666E-03	2.076431E-03	2.058870E-03	2.112783E-03	2.060770E-03
41NB 95	3.357496E-04	6.054919E-03	1.038268E-02	9.994231E-03	6.807326E-03	3.467604E-03
40ZR 95	6.175744E-02	4.303085E-02	3.197797E-02	2.180754E-02	1.277629E-02	6.355166E-03
59PR143	1.155472E-02	2.263353E-02	9.756458E-03	4.884236E-03	2.504718E-03	1.221073E-03
58CE140	2.654355E-04	2.558299E-02	4.395881E-02	4.993549E-02	5.454833E-03	5.481347E-02
58CE141	4.992756E-02	3.999509E-02	2.399107E-02	1.361725E-02	7.131273E-03	3.478135E-03
37RB 85	4.184769E-03	4.546755E-03	4.548331E-03	4.519733E-03	4.658490E-03	4.581603E-03
40ZR 94	5.486192E-02	4.539382E-02	4.509461E-02	4.465188E-02	4.579365E-02	4.465085E-02
60ND147	2.495009E-02	9.525357E-03	3.707719E-03	1.841968E-03	9.444978E-04	4.604515E-04
52TE128	8.562176E-03	7.799594E-03	7.766087E-03	7.694227E-03	7.892002E-03	7.696776E-03
56BA138	7.362589E-02	6.238204E-02	6.200368E-02	6.140299E-02	6.297728E-02	6.140766E-02
40ZR 92	2.414694E-02	3.060137E-02	3.064258E-02	3.040166E-02	3.120993E-02	3.044610E-02
46PD110	7.767847E-03	6.305602E-03	6.261348E-03	6.199174E-03	6.357350E-03	6.198535E-03
37RB 87	1.152102E-02	1.010115E-02	1.004732E-02	9.951795E-03	1.020792E-02	9.953964E-03
54XE136	8.242219E-02	6.692366E-02	6.645176E-02	6.579248E-02	6.747136E-02	6.578569E-02
52TE130	2.981208E-02	2.426273E-02	2.409377E-02	2.385492E-02	2.446381E-02	2.385281E-02
39 Y 89	1.427534E-04	3.149303E-03	7.390553E-03	1.081747E-02	1.408371E-02	1.544649E-02
38SR 88	1.428976E-02	1.411736E-02	1.407590E-02	1.395043E-02	1.431367E-02	1.395970E-02
36KR 86	9.431119E-03	7.661401E-03	7.607748E-03	7.532248E-03	7.724424E-03	7.531492E-03
36KR 85	1.194294E-03	1.273962E-03	1.265471E-03	1.244764E-03	1.257407E-03	1.188601E-03
56BA140	6.869849E-02	2.824190E-02	1.153419E-02	5.752588E-03	2.949850E-03	1.438079E-03
39 Y 91	1.604933E-02	2.139632E-02	1.572961E-02	1.049714E-02	6.025808E-03	2.979228E-03
53 I131	7.309758E-02	2.894779E-02	1.039479E-02	5.148129E-03	2.639729E-03	1.286892E-03
42MO 99	6.932291E-02	8.415324E-03	2.786853E-03	1.379590E-03	7.073957E-04	3.448620E-04
54XE133	2.589754E-02	1.798902E-02	6.100518E-03	3.019999E-03	1.548528E-03	7.549218E-04
61PM149	1.229214E-02	1.363428E-03	4.513227E-04	2.234206E-04	1.145606E-04	5.584938E-05

Table 4 Concentrations of the FPs - ^{241}Pu - 1000 MW(e) reactor

Isotope	1 day	30 days	90 days	180 days	360 days	720 days
38SR 90	1.557189E-02	1.614099E-02	1.601682E-02	1.588367E-02	1.589084E-02	1.587865E-02
40ZR 93	1.578269E-02	3.170059E-02	3.189299E-02	3.173597E-02	3.180450E-02	3.180692E-02
42MO 95	1.433589E-06	1.078060E-03	6.385331E-03	1.479361E-02	2.540869E-02	3.312516E-02
42MO 97	1.561090E-02	4.850927E-02	4.934039E-02	4.922867E-02	4.940015E-02	4.943693E-02
43TC 99	4.299827E-03	5.561927E-02	6.131020E-02	6.231869E-02	6.310574E-02	6.343662E-02
44RU101	5.767428E-02	6.130215E-02	6.086514E-02	6.036753E-02	6.039926E-02	6.035501E-02
44RU102	6.247291E-02	6.526090E-02	6.477038E-02	6.423462E-02	6.426499E-02	6.421650E-02
45RH103	4.745748E-04	1.396100E-02	3.102340E-02	4.311569E-02	5.211335E-02	5.694593E-02
44RU104	6.668201E-02	7.020073E-02	6.968527E-02	6.911169E-02	6.914617E-02	6.909475E-02
46PD105	7.623729E-03	5.793607E-02	6.080773E-02	6.112473E-02	6.156354E-02	6.172174E-02
44RU106	6.138830E-02	6.177785E-02	5.802394E-02	5.309470E-02	4.554422E-02	3.438134E-02
46PD107	5.018731E-02	5.318891E-02	5.280654E-02	5.237407E-02	5.240093E-02	5.236243E-02
47AG109	9.496051E-03	2.248362E-02	2.272231E-02	2.263540E-02	2.269669E-02	2.270477E-02
53 I129	4.650308E-03	7.187473E-03	7.403850E-03	7.499091E-03	7.605240E-03	7.653121E-03
54XE131	9.666633E-04	2.258530E-02	2.574037E-02	3.661271E-02	3.302724E-02	3.351649E-02
55CS133	8.863131E-04	4.753706E-02	6.006571E-02	6.286338E-02	6.454109E-02	6.531558E-02
55CS135	2.164077E-02	7.258505E-02	7.356288E-02	7.333166E-02	7.349445E-02	7.359425E-02
55CS137	6.770087E-02	7.014207E-02	6.947222E-02	6.870010E-02	6.834444E-02	6.752746E-02
60ND143	1.709651E-04	2.147157E-02	3.712572E-02	4.248929E-02	4.540407E-02	4.681625E-02
58CE144	4.362127E-02	4.351352E-02	4.020096E-02	3.593754E-02	2.956602E-02	2.091079E-02
60ND144	5.157856E-05	1.609628E-03	4.571847E-03	8.462314E-03	1.485381E-02	2.347500E-02
60ND145	2.231506E-02	3.451298E-02	3.452441E-02	3.430587E-02	3.435573E-02	3.434640E-02
61PM147	7.130766E-04	1.338773E-02	1.953316E-02	2.077942E-02	2.047292E-02	1.852994E-02
62SM147	1.708394E-07	1.101736E-04	5.516931E-04	1.269179E-03	2.659067E-03	5.120674E-03
62SM149	1.781793E-03	1.418562E-02	1.523408E-02	1.539434E-02	1.554483E-02	1.560458E-02
62SM151	2.259458E-03	9.254794E-03	9.549174E-03	9.552762E-03	9.584877E-03	9.564159E-03
63EU153	8.638438E-04	5.173588E-03	5.487821E-03	5.529959E-03	5.576368E-03	5.594006E-03
63EU155	2.365225E-03	2.502142E-03	2.484045E-03	2.463679E-03	2.464930E-03	2.463111E-03
42MO 98	5.115240E-02	5.287928E-02	5.246954E-02	5.203244E-02	5.205545E-02	5.201540E-02
59PR141	3.246463E-04	1.333794E-02	2.841138E-02	3.785873E-02	4.423363E-02	4.751227E-02
42MO100	6.051906E-02	6.253659E-02	6.092345E-02	6.153409E-02	6.156130E-02	6.151392E-02
62SM150	2.309332E-06	3.040064E-06	2.820430E-06	2.833527E-06	2.836034E-06	2.825962E-06
54XE132	3.327862E-03	3.587667E-02	4.004080E-02	4.081104E-02	4.138112E-02	4.162521E-02
44RU103	6.046361E-02	4.897679E-02	3.140011E-02	1.876909E-02	9.785283E-03	4.897586E-03
62SM152	7.421769E-03	7.785872E-03	7.728111E-03	7.664400E-03	7.668097E-03	7.662346E-03
60ND148	2.012665E-02	2.085647E-02	2.069599E-02	2.052385E-02	2.053307E-02	2.051736E-02
57LA139	5.289416E-02	6.004042E-02	5.969735E-02	5.923060E-02	5.927191E-02	5.923370E-02
46PD108	3.869837E-02	4.016790E-02	3.986034E-02	3.952922E-02	3.954715E-02	3.951690E-02
53 I127	2.487775E-05	7.033986E-04	8.367159E-04	8.829227E-04	9.272491E-04	9.592978E-04
40ZR 96	4.529768E-01	4.680765E-02	4.644223E-02	4.605563E-02	4.607600E-02	4.604029E-02
60ND146	2.784551E-02	2.987839E-02	2.967166E-02	2.943070E-02	2.944685E-02	2.942565E-02
58CE142	4.555680E-02	5.232105E-02	5.203463E-02	5.163068E-02	5.166829E-02	5.163595E-02
40ZR 91	4.234398E-05	3.056760E-03	7.570142E-03	1.151092E-02	1.513565E-02	1.738669E-02
46PD106	5.785983E-05	1.745076E-03	5.006752E-03	9.410885E-03	1.698912E-02	2.810364E-02
54XE134	7.287902E-02	7.951124E-02	7.876312E-02	7.814778E-02	7.819912E-02	7.813456E-02
36KR 83	8.095938E-04	1.135737E-03	1.133764E-03	1.126010E-03	1.127358E-03	1.126912E-03
41NB 95	2.159642E-04	5.043869E-03	8.646453E-03	8.337213E-03	5.540058E-03	2.892153E-03
40ZR 95	4.043895E-02	3.587087E-02	2.663736E-02	1.819481E-02	1.039906E-02	5.301121E-03
59PR143	9.753042E-03	2.432679E-02	1.047859E-02	5.254212E-03	2.628567E-03	1.313269E-03
58CE140	2.767481E-04	3.787838E-02	6.515351E-02	7.415541E-02	7.903583E-02	8.139717E-02
58CE141	3.714474E-02	3.789679E-02	2.271566E-02	1.291414E-02	6.597728E-03	3.297813E-03
37RB 85	2.399464E-03	3.318953E-03	3.317492E-03	3.301706E-03	3.319397E-03	3.344815E-03
40ZR 94	3.511336E-02	3.699278E-02	3.672206E-02	3.642005E-02	3.643811E-02	3.641110E-02
60ND147	2.279964E-02	1.108147E-02	4.310205E-03	2.144737E-03	1.072857E-03	5.360142E-04
52TE128	3.342942E-03	3.789509E-03	3.768176E-03	3.738775E-03	3.741441E-03	3.739042E-03
56BA138	6.505104E-02	7.028086E-02	6.980517E-02	6.924088E-02	6.928017E-02	6.923102E-02
40ZR 92	1.517435E-02	2.451523E-02	2.453051E-02	2.437708E-02	2.441334E-02	2.440722E-02
46PD110	1.154814E-02	1.193480E-02	1.184225E-02	1.174356E-02	1.174878E-02	1.173970E-02
37RB 87	7.086319E-03	7.913784E-03	7.865835E-03	7.803649E-03	7.808751E-03	7.803575E-03
54XE136	6.305462E-02	6.520497E-02	6.469571E-02	6.415745E-02	6.418610E-02	6.413641E-02
52TE130	1.634628E-02	1.694518E-02	1.681489E-02	1.667510E-02	1.668264E-02	1.666985E-02
39 Y 89	7.745210E-05	2.176044E-04	5.102824E-03	7.480972E-03	9.501682E-03	1.067985E-02
38SR 88	8.445390E-03	1.068095E-02	1.064276E-02	1.056514E-02	1.057538E-02	1.057000E-02
36KR 86	6.282758E-03	6.498400E-03	6.448119E-03	6.394438E-03	6.397266E-03	6.392341E-03
36KR 85	6.555225E-04	8.998118E-04	8.933156E-04	8.801545E-04	8.673819E-04	8.402847E-04
56BA140	8.026549E-02	4.200763E-02	1.714344E-02	8.563926E-03	4.284109E-03	2.140401E-03
39 Y 91	9.766231E-03	1.658529E-02	1.218377E-02	8.143942E-03	4.560688E-03	2.310841E-03
53 I131	4.600553E-02	2.060842E-02	7.377672E-03	3.659733E-03	1.830659E-03	9.146228E-04
42MO 99	5.550626E-02	8.578031E-03	2.838623E-03	1.407483E-03	7.040528E-04	3.517547E-04
54XE133	1.887194E-02	1.669632E-02	5.657688E-03	2.805292E-03	1.403266E-03	7.010915E-04
61PM149	1.200094E-02	1.694936E-03	5.606416E-04	2.779847E-04	1.390538E-04	6.947323E-05

Table 5 Concentrations of the FPs - ^{238}U - 1000 MW(e) reactor

Isotope	1 day	30 days	90 days	180 days	360 days	720 days
38SR 90	3.988918E-02	3.252539E-02	3.225490E-02	3.193668E-02	3.192104E-02	3.127162E-02
40ZR 93	3.276627E-02	5.176591E-02	5.204724E-02	5.170982E-02	5.177241E-02	5.076245E-02
42MO 95	2.321828E-06	1.373983E-03	8.133057E-03	1.881338E-02	3.228242E-02	4.126192E-02
42MO 97	2.259735E-02	5.530816E-02	5.622153E-02	5.600654E-02	5.614913E-02	5.508989E-02
43TC 99	5.499350E-03	5.595859E-02	6.164546E-02	6.256106E-02	6.329182E-02	6.237744E-02
44RU101	7.580885E-02	6.338634E-02	6.289492E-02	6.228306E-02	6.225700E-02	6.099254E-02
44RU102	8.025332E-02	6.594835E-02	6.541197E-02	6.476936E-02	6.473924E-02	6.342288E-02
45RH103	6.230605E-04	1.441860E-02	3.202019E-02	4.443123E-02	5.365274E-02	5.747976E-02
44RU104	6.277356E-02	5.198719E-02	5.157307E-02	5.106879E-02	5.104587E-02	5.000860E-02
46PD105	6.407847E-03	3.830659E-02	4.018004E-02	4.032608E-02	4.057752E-02	3.988488E-02
44RU106	3.272067E-02	2.590313E-02	2.431372E-02	2.221344E-02	1.903664E-02	1.408927E-02
46PD107	1.639588E-02	1.366922E-02	1.356241E-02	1.343031E-02	1.342456E-02	1.315187E-02
47AG109	1.669579E-03	3.109648E-03	3.140691E-03	3.123783E-03	3.129288E-03	3.069074E-03
53 I129	8.044722E-03	9.782971E-03	1.006821E-02	1.017988E-02	1.031308E-02	1.017406E-02
54XE131	1.400857E-03	2.561755E-02	2.895302E-02	4.136236E-02	3.717901E-02	3.698396E-02
55CS133	1.151493E-03	4.859071E-02	6.135885E-02	6.411642E-02	6.576555E-02	6.525107E-02
55CS135	2.553171E-02	6.890407E-02	6.980607E-02	6.948239E-02	6.963101E-02	6.830368E-02
55CS137	7.634049E-02	6.222137E-02	6.158841E-02	6.080865E-02	6.043710E-02	5.854462E-02
60ND143	2.092771E-04	2.067619E-02	3.572793E-02	4.082552E-02	4.358514E-02	4.406039E-02
58CE144	5.773672E-02	4.530622E-02	4.183098E-02	3.733618E-02	3.068771E-02	2.127896E-02
60ND144	6.802986E-05	1.675749E-03	4.757014E-03	8.791451E-03	1.541719E-02	2.388810E-02
60ND145	3.161946E-02	3.846979E-02	3.845812E-02	3.815491E-02	3.817436E-02	3.741638E-02
61PM147	9.710428E-04	1.434136E-02	2.091129E-02	2.221080E-02	2.186260E-02	1.940002E-02
62SM147	2.326430E-07	1.180216E-04	5.906201E-04	1.356606E-03	2.839559E-03	5.361133E-03
62SM149	2.375056E-03	1.487530E-02	1.596468E-02	1.610744E-02	1.624958E-02	1.599252E-02
62SM151	2.434868E-03	7.845936E-03	8.090429E-03	8.080803E-03	8.100359E-03	7.924507E-03
63EU153	7.948899E-04	3.746162E-03	3.971216E-03	3.995446E-03	4.025178E-03	3.958820E-03
63EU155	1.671972E-03	1.391503E-03	1.380574E-03	1.367110E-03	1.366518E-03	1.338759E-03
42MO 98	7.481099E-02	6.083703E-02	6.032750E-02	5.973128E-02	5.970159E-02	5.848661E-02
59PR141	4.487019E-04	1.450260E-02	3.087282E-02	4.107424E-02	4.794520E-02	5.049028E-02
42MO100	8.450750E-02	6.869451E-02	6.811850E-02	6.744517E-02	6.741125E-02	6.603983E-02
62SM150	8.737772E-08	3.476042E-07	8.390028E-08	1.262311E-07	1.262055E-07	1.131089E-07
54XE132	5.151259E-03	4.534750E-02	5.060391E-02	5.150200E-02	5.217510E-02	5.145594E-02
44RU103	7.938160E-02	5.058236E-02	3.240888E-02	1.934181E-02	1.007453E-02	4.943489E-03
62SM152	6.561309E-03	5.408610E-03	5.364971E-03	5.312358E-03	5.309945E-03	5.201993E-03
60ND148	2.652808E-02	2.162600E-02	2.144615E-02	2.123441E-02	2.122406E-02	2.079227E-02
57LA139	6.868381E-02	6.133350E-02	6.094478E-02	6.037336E-02	6.035874E-02	5.913822E-02
46PD108	7.772254E-03	6.346427E-03	6.293843E-03	6.231791E-03	6.228769E-03	6.102075E-03
53 I127	8.420109E-06	1.974011E-04	2.348100E-04	2.474207E-04	2.596131E-04	2.633301E-04
40ZR 96	7.307757E-02	5.940131E-02	5.890249E-02	5.832036E-02	5.829147E-02	5.710515E-02
60ND146	4.169995E-02	3.519870E-02	3.493318E-02	3.459520E-02	3.458168E-02	3.387979E-02
58CE142	5.404337E-02	4.883127E-02	4.853357E-02	4.808144E-02	4.807125E-02	4.709982E-02
40ZR 91	1.185601E-04	6.733153E-03	1.666438E-02	2.529960E-02	3.323514E-02	3.743003E-02
46PD106	3.049418E-05	7.314195E-04	2.097712E-03	3.936991E-03	7.100856E-03	1.151642E-02
54XE134	9.702607E-02	8.371904E-02	8.245085E-02	8.172576E-02	8.172683E-02	8.004169E-02
36KR 83	1.556818E-03	1.724085E-03	1.720105E-03	1.705700E-03	1.706143E-03	1.672061E-03
41NB 95	3.498296E-04	6.428460E-03	1.101311E-02	1.060261E-02	7.038776E-03	6.603290E-03
40ZR 95	6.551890E-02	4.571835E-02	3.392854E-02	2.313882E-02	1.321231E-02	4.126192E-02
59PR143	1.193875E-02	2.342558E-02	1.008405E-02	5.048471E-03	2.523265E-03	1.235961E-03
58CE140	2.565487E-04	2.773637E-02	4.768157E-02	5.418527E-02	5.769711E-02	5.825696E-02
58CE141	5.134021E-02	4.120597E-02	2.468371E-02	1.401099E-02	7.151369E-03	3.504524E-03
37RB 85	5.515459E-03	6.001382E-03	5.994911E-03	5.957003E-03	5.983189E-03	5.910700E-03
40ZR 94	6.240599E-02	5.172135E-02	5.131031E-02	5.080872E-02	5.078622E-02	4.975424E-02
60ND147	3.104776E-02	1.187080E-02	4.614322E-03	2.292476E-03	1.145681E-03	5.611845E-04
52TE128	5.990824E-03	5.317652E-03	5.283722E-03	5.234132E-03	5.232853E-03	5.127002E-03
56BA138	7.032753E-02	5.983832E-02	5.939765E-02	5.882556E-02	5.880368E-02	5.761110E-02
40ZR 92	3.672321E-02	4.667850E-02	4.667827E-02	4.631372E-02	4.633902E-02	4.541986E-02
46PD110	1.761682E-03	1.432266E-03	1.420261E-03	1.406219E-03	1.405522E-03	1.376923E-03
37RB 87	1.800612E-02	1.582078E-02	1.571511E-02	1.556644E-02	1.556203E-02	1.524700E-02
54XE136	8.530464E-02	6.941151E-02	6.883272E-02	6.815252E-02	6.811891E-02	6.673286E-02
52TE130	2.293317E-02	1.871132E-02	1.855600E-02	1.837299E-02	1.836401E-02	1.799044E-02
39 Y 89	2.373223E-04	5.245173E-03	1.229219E-02	1.799277E-02	2.283128E-02	2.515946E-02
38SR 88	2.214669E-02	2.205625E-02	2.196402E-02	2.176974E-02	2.177041E-02	2.133305E-02
36KR 86	1.583255E-02	1.288290E-02	1.277516E-02	1.264900E-02	1.264269E-02	1.238547E-02
36KR 85	1.498849E-03	1.620606E-03	1.607932E-03	1.581781E-03	1.557355E-03	1.479150E-03
56BA140	7.472703E-02	3.076500E-02	1.254744E-02	6.258194E-03	3.127711E-03	1.532037E-03
39 Y 91	2.734568E-02	3.653264E-02	2.682047E-02	1.789953E-02	1.001444E-02	4.974776E-03
53 I131	6.811893E-02	2.366527E-02	8.463664E-03	4.191876E-03	2.094874E-03	1.026124E-03
42MO 99	7.099085E-02	8.630356E-03	2.854143E-03	1.412964E-03	7.061295E-04	3.458808E-04
54XE133	2.451936E-02	1.706657E-02	5.779518E-03	2.861219E-03	1.429896E-03	7.004007E-04
61PM149	1.599720E-02	1.777346E-03	9.260415E-04	4.584433E-04	1.453581E-04	7.120020E-05

Table 6 Concentrations of the FPs - ^{235}U - 1000 MW(e) reactor

Isotope	1 day	30 days	90 days	180 days	360 days	720 days
38SR 90	7.454625E-02	6.143831E-02	6.080785E-02	6.011402E-02	5.996323E-02	5.981069E-02
40ZR 93	4.102659E-02	6.550115E-02	6.572766E-02	6.519978E-02	6.514699E-02	6.503664E-02
42MO 95	2.927297E-06	1.742753E-03	1.029446E-02	2.377537E-02	4.071401E-02	5.298390E-02
42MO 97	2.436989E-02	6.005125E-02	6.091979E-02	6.059179E-02	6.062280E-02	6.056003E-02
43TC 99	5.327915E-03	5.479286E-02	6.024266E-02	6.104206E-02	6.163054E-02	6.184340E-02
44RU101	6.275442E-02	5.303108E-02	5.251648E-02	5.192469E-02	5.179816E-02	5.166845E-02
44RU102	5.319134E-02	4.417670E-02	4.373100E-02	4.323400E-02	4.312648E-02	4.301750E-02
45RH103	3.010607E-04	7.041396E-03	1.560644E-02	2.162175E-02	2.605670E-02	2.842242E-02
44RU104	2.289774E-02	1.916506E-02	1.897500E-02	1.876021E-02	1.871390E-02	1.866679E-02
46PD105	1.538271E-03	9.294083E-03	9.729475E-03	9.749629E-03	9.790561E-03	9.798345E-03
44RU106	5.078545E-03	4.063284E-03	3.806469E-03	3.472237E-03	2.969648E-03	2.237811E-03
46PD107	1.769516E-03	1.490987E-03	1.476425E-03	1.459766E-03	1.456192E-03	1.452538E-03
47AG109	1.787317E-04	3.364474E-04	3.391372E-04	3.367857E-04	3.366985E-04	3.362202E-04
53 I129	5.536533E-03	6.800955E-03	6.991266E-03	7.061532E-03	7.141856E-03	7.174860E-03
54XE131	1.236648E-03	2.342701E-02	2.675719E-02	3.794219E-02	3.412568E-02	3.457585E-02
55CS133	1.161697E-03	4.954021E-02	6.243542E-02	6.513970E-02	6.668030E-02	6.736064E-02
55CS135	2.500495E-02	6.636559E-02	6.708157E-02	6.666161E-02	6.666659E-02	6.658302E-02
55CS137	7.874752E-02	6.486278E-02	6.407674E-02	6.316700E-02	6.265385E-02	6.179485E-02
60ND143	2.725676E-04	2.721069E-02	4.692675E-02	5.353876E-02	5.704219E-02	5.871180E-02
58CE144	6.968925E-02	5.526927E-02	5.092942E-02	4.538626E-02	3.722897E-02	2.628374E-02
60ND144	8.333462E-05	2.045283E-03	5.792697E-03	1.068798E-02	1.870442E-02	2.950763E-02
60ND145	3.290270E-02	4.045839E-02	4.036665E-02	3.998600E-02	3.992560E-02	3.984402E-02
61PM147	8.502243E-04	1.269094E-02	1.846853E-02	1.958558E-02	1.923965E-02	1.738270E-02
62SM147	2.036979E-07	1.044401E-04	5.216246E-04	1.196260E-03	2.498886E-03	4.803658E-03
62SM149	1.580307E-03	1.000211E-02	1.071344E-02	1.079241E-02	1.086568E-02	1.088811E-02
62SM151	1.260190E-03	4.103378E-03	4.222909E-03	4.211314E-03	4.212966E-03	4.196395E-03
63EU153	3.209008E-04	1.527574E-03	1.616149E-03	1.623478E-03	1.632251E-03	1.634511E-03
63EU155	3.984095E-04	3.351026E-04	3.318148E-04	3.280670E-04	3.272628E-04	3.264404E-04
42MO 98	7.384984E-02	6.069627E-02	6.006960E-02	5.938336E-02	5.923381E-02	5.908288E-02
59PR141	4.824424E-04	1.575735E-02	3.347778E-02	4.447060E-02	5.180510E-02	5.554601E-02
42MO100	7.820583E-02	6.425023E-02	6.358606E-02	6.285963E-02	6.270142E-02	6.254166E-02
62SM150	3.249002E-07	5.525418E-07	3.139105E-07	3.491602E-07	3.484189E-07	3.380093E-07
54XE132	4.411976E-03	3.787921E-02	4.216694E-02	4.284431E-02	4.331448E-02	4.349243E-02
44RU103	3.835690E-02	2.470208E-02	1.579591E-02	9.412388E-03	4.892639E-03	2.444442E-03
62SM152	3.494293E-02	3.665421E-03	2.772594E-03	2.741153E-03	2.804686E-03	2.762529E-03
60ND148	2.120708E-02	1.747166E-02	1.729218E-02	1.709489E-02	1.705201E-02	1.700862E-02
57LA139	7.356740E-02	6.638860E-02	6.583788E-02	6.511899E-02	6.497177E-02	6.481458E-02
46PD108	8.710444E-04	7.187920E-04	7.114365E-04	7.033256E-04	7.015629E-04	6.997805E-04
53 I127	2.130299E-05	4.721781E-04	5.601233E-04	5.891916E-04	6.169369E-04	6.371231E-04
40ZR 96	7.737105E-02	6.356148E-02	6.290310E-02	6.218464E-02	6.202805E-02	6.187000E-02
60ND146	3.636958E-02	3.102549E-02	3.073092E-02	3.038627E-02	3.031297E-02	3.023733E-02
58CE142	6.723851E-02	6.139022E-02	6.089575E-02	6.023435E-02	6.010002E-02	5.995549E-02
40ZR 91	1.651362E-04	9.476007E-03	2.340661E-02	3.548018E-02	4.651485E-02	5.333768E-02
46PD106	4.937058E-06	1.149019E-04	3.285741E-04	6.155650E-04	1.107873E-03	1.829326E-03
54XE134	9.841083E-02	8.609533E-02	8.431122E-02	8.347391E-02	8.332295E-02	8.307563E-02
36KR 83	2.885440E-03	3.226308E-03	3.212476E-03	3.180584E-03	3.174987E-03	3.168100E-03
41NB 95	4.402891E-04	8.153308E-03	1.393958E-02	1.339890E-02	8.877124E-03	4.626012E-03
40ZR 95	8.221094E-02	5.797835E-02	4.294227E-02	2.924047E-02	1.666263E-02	8.479046E-03
59PR143	1.554807E-02	3.082897E-02	1.324487E-02	6.620573E-03	3.302331E-03	1.646961E-03
58CE140	2.803403E-04	2.931002E-02	5.025263E-02	5.701096E-02	6.058031E-02	6.227781E-02
58CE141	5.519731E-02	4.477093E-02	2.676639E-02	1.516956E-02	7.727062E-03	3.855435E-03
37RB 85	9.681502E-03	1.064687E-02	1.061468E-02	1.053139E-02	1.055688E-02	1.061937E-02
40ZR 94	8.035284E-02	6.729499E-02	6.662867E-02	6.587460E-02	6.571227E-02	6.554661E-02
60ND147	2.780629E-02	1.074222E-02	4.075294E-03	2.021508E-03	1.031013E-03	5.141937E-04
52TE128	4.141433E-03	3.753177E-03	3.722893E-03	3.682456E-03	3.674224E-03	3.665230E-03
56BA138	8.222273E-02	7.065680E-02	6.999713E-02	6.921493E-02	6.904935E-02	6.887789E-02
40ZR 92	4.822067E-02	6.174173E-02	6.161683E-02	6.103986E-02	6.094938E-02	6.082557E-02
46PD110	3.955394E-04	3.249967E-04	3.216390E-04	3.179633E-04	3.171635E-04	3.163562E-04
37RB 87	2.930323E-02	2.598360E-02	2.575853E-02	2.547498E-02	2.541616E-02	2.535410E-02
54XE136	7.730680E-02	6.354785E-02	6.289348E-02	6.217480E-02	6.201831E-02	6.186029E-02
52TE130	2.152134E-02	1.773500E-02	1.755283E-02	1.735253E-02	1.730900E-02	1.726505E-02
39 Y 89	4.090723E-04	9.135340E-03	2.136668E-02	3.122691E-02	3.954409E-02	4.436842E-02
38SR 88	3.817443E-02	3.825122E-02	3.801319E-02	3.761768E-02	3.754225E-02	3.745635E-02
36KR 86	2.444714E-02	2.010268E-02	1.989534E-02	1.966806E-02	1.961862E-02	1.956870E-02
36KR 85	2.670937E-03	2.907781E-03	2.879180E-03	2.827898E-03	2.761286E-03	2.686996E-03
56BA140	7.799257E-02	3.245231E-02	1.320957E-02	6.578193E-03	3.281000E-03	1.636322E-03
39 Y 91	3.808358E-02	5.141461E-02	3.767188E-02	2.510227E-02	1.401594E-02	7.089076E-03
53 I131	5.904543E-02	2.146029E-02	7.665509E-03	3.790655E-03	1.890546E-03	9.428658E-04
42MO 99	6.877768E-02	8.450560E-03	2.789186E-03	1.378657E-03	6.875926E-04	3.429208E-04
54XE133	2.473524E-02	1.740016E-02	5.880909E-03	2.906871E-03	1.449775E-03	7.230416E-04
61PM149	1.064340E-02	1.195077E-03	8.363478E-04	4.133955E-04	9.719710E-05	4.847479E-05

Table 1 Lumped cross-sections - inner core of BBR

Grouped cross-sections of FPs - PF1000
Fuel - ^{233}U
Irradiation time - 600 days
No. of fission products - 28
No. of energy groups - 70

Group	Total	Elastic	Inelastic	(n,2n)	Mu
1	5.998078E+02	1.642761E+01	0.	0.	8.421366E-02
2	2.886630E+02	1.193629E+01	0.	0.	6.420348E-02
3	1.697293E+02	9.820945E+00	0.	0.	5.462710E-02
4	1.273994E+02	8.708629E+00	0.	0.	4.957069E-02
5	1.755534E+02	8.427438E+00	0.	0.	4.829250E-02
6	1.106702E+03	2.004316E+01	0.	0.	1.006275E-01
7	1.844097E+02	8.780244E+00	0.	0.	5.038536E-02
8	6.883583E+01	8.034013E+00	0.	0.	4.703859E-02
9	4.093449E+01	7.506360E+00	0.	0.	4.422969E-02
10	4.556681E+01	7.363801E+00	0.	0.	4.340386E-02
11	1.608102E+02	9.438883E+00	0.	0.	5.280601E-02
12	5.589758E+01	7.860383E+00	0.	0.	4.617637E-02
13	7.094581E+02	5.989345E+01	0.	0.	3.493289E-01
14	6.049201E+01	1.083341E+01	0.	0.	6.318396E-02
15	1.744230E+02	3.007605E+01	0.	0.	1.485027E-01
16	5.834484E+01	2.175817E+01	0.	0.	1.176032E-01
17	8.933888E+02	5.314758E+02	0.	0.	2.735370E+00
18	2.919307E+02	1.314382E+02	0.	0.	6.185109E-01
19	7.575424E+01	1.754604E+01	0.	0.	9.244246E-02
20	1.103847E+02	3.160878E+01	0.	0.	1.564145E-01
21	1.495098E+02	6.422890E+01	0.	0.	3.164149E-01
22	1.121678E+02	4.919930E+01	0.	0.	2.363739E-01
23	1.464055E+02	7.428303E+01	0.	0.	3.550918E-01
24	1.712067E+02	1.251495E+02	0.	0.	5.805090E-01
25	8.789757E+01	4.982788E+01	0.	0.	2.408861E-01
26	7.478223E+01	4.076806E+01	0.	0.	2.021185E-01
27	6.635972E+01	4.034613E+01	0.	0.	1.980876E-01
28	5.683281E+01	3.211660E+01	0.	0.	1.598450E-01
29	9.025060E+01	7.133307E+01	0.	0.	3.450638E-01
30	2.974292E+02	2.193488E+02	0.	0.	1.036327E+00
31	6.011405E+01	4.571047E+01	0.	0.	2.274802E-01
32	5.762260E+01	4.502230E+01	0.	0.	2.274912E-01
33	4.325700E+01	3.332640E+01	0.	0.	1.662067E-01
34	8.224543E+01	7.284790E+01	0.	0.	5.211566E-01
35	5.675296E+01	4.838025E+01	0.	0.	7.634673E-01
36	4.702239E+01	3.991481E+01	0.	0.	1.220409E+00
37	3.560752E+01	2.954390E+01	0.	0.	1.853533E+00
38	3.490747E+01	2.976303E+01	0.	0.	2.374629E+00
39	2.914573E+01	2.476635E+01	0.	0.	2.333484E+00
40	2.905564E+01	2.524380E+01	4.010457E-04	0.	2.296667E+00
41	2.855870E+01	2.524382E+01	2.043536E-03	0.	2.279073E+00
42	2.634628E+01	2.347969E+01	4.268980E-03	0.	2.275907E+00
43	2.305585E+01	2.055346E+01	5.338346E-03	0.	2.292331E+00
44	2.168909E+01	1.950442E+01	5.078148E-03	0.	2.335826E+00
45	2.053471E+01	1.865064E+01	4.729894E-03	0.	2.389750E+00
46	1.955048E+01	1.792171E+01	8.316037E-03	0.	2.454920E+00
47	1.870008E+01	1.729301E+01	1.842211E-02	0.	2.534187E+00
48	1.801989E+01	1.680318E+01	3.060778E-02	0.	2.620168E+00
49	1.745231E+01	1.638503E+01	4.494425E-02	0.	2.721895E+00
50	1.694907E+01	1.599933E+01	6.452351E-02	0.	2.843141E+00
51	1.649358E+01	1.559762E+01	1.225403E-01	0.	2.966357E+00
52	1.616060E+01	1.528649E+01	1.800032E-01	0.	3.072783E+00
53	1.587555E+01	1.501322E+01	2.357255E-01	0.	3.166867E+00
54	1.552406E+01	1.461167E+01	3.683103E-01	0.	3.266043E+00
55	1.520826E+01	1.423467E+01	5.018066E-01	0.	3.332279E+00
56	1.496579E+01	1.393071E+01	6.168510E-01	0.	3.355162E+00
57	1.473901E+01	1.344173E+01	9.421923E-01	0.	3.334453E+00
58	1.451876E+01	1.283136E+01	1.389459E+00	0.	3.265696E+00
59	1.426058E+01	1.225006E+01	1.748326E+00	0.	3.173229E+00
60	1.397343E+01	1.168370E+01	2.041313E+00	0.	3.100432E+00
61	1.355423E+01	1.087005E+01	2.451191E+00	0.	2.994599E+00
62	1.277973E+01	9.794146E+00	2.785149E+00	0.	2.892988E+00
63	1.192984E+01	8.707902E+00	3.056949E+00	0.	2.759204E+00
64	1.080107E+01	7.358768E+00	3.318617E+00	0.	2.571626E+00
65	9.803645E+00	6.169150E+00	3.541066E+00	0.	2.466934E+00
66	8.973086E+00	5.258704E+00	3.694963E+00	0.	2.248873E+00
67	8.262798E+00	4.543329E+00	3.686645E+00	0.	2.018713E+00
68	8.033860E+00	4.380113E+00	3.631329E+00	3.935958E-03	2.072165E+00
69	8.241247E+00	4.728444E+00	3.258278E+00	2.430565E-01	2.383375E+00
70	8.660299E+00	5.304669E+00	2.615583E+00	7.305369E-01	2.616894E+00

Table 1 (cont.)

Elastic scattering matrix

Group I	Group J	Scat. matrix of group I for the group J	J+1
1	1	1.637151E+01	
2	1	6.834288E-01	1.125295E+01
3	2	5.988387E-01	9.262154E+00
4	3	5.014019E-01	8.207250E+00
5	4	4.891779E-01	7.938267E+00
6	5	7.570131E-01	1.928622E+01
7	6	8.094535E-02	8.699296E+00
8	7	2.633760E-01	7.770640E+00
9	8	3.837780E-01	7.123095E+00
10	9	3.935839E-01	6.970219E+00
11	10	3.434130E-01	9.095481E+00
12	11	5.392075E-01	7.321169E+00
13	12	8.492197E-01	5.904456E+01
14	13	7.244311E-01	1.010898E+01
15	14	4.205533E-01	2.965559E+01
16	15	5.720187E-01	2.118600E+01
17	16	2.607522E+00	5.288712E+02
18	17	1.411827E+00	1.300271E+02
19	18	5.078594E-01	1.703837E+01
20	19	6.947342E-01	3.091419E+01
21	20	3.397698E-01	6.388946E+01
22	21	3.994015E-01	4.879852E+01
23	22	2.926742E+00	7.135641E+01
24	23	4.283653E-01	1.247213E+02
25	24	1.806862E+00	4.802060E+01
26	25	6.514064E-01	4.011665E+01
27	26	6.498318E-01	3.969643E+01
28	27	5.706248E-01	3.154607E+01
29	28	1.066553E+00	7.026571E+01
30	29	1.643812E+01	2.029010E+02
31	30	1.885576E+00	4.382500E+01
32	31	1.470358E+00	4.355209E+01
33	32	1.668388E+00	3.165807E+01
34	33	1.284925E+00	7.156271E+01
35	34	6.624190E+00	4.175584E+01
36	35	1.432611E+00	3.848225E+01
37	36	1.660895E+00	2.788300E+01
38	37	1.399856E+00	2.836314E+01
39	38	9.527176E-01	2.381364E+01
40	39	9.901037E-01	2.425374E+01
41	40	1.060094E+00	2.418374E+01
42	41	9.073092E-01	2.257239E+01
43	42	9.527548E-01	1.960070E+01
44	43	9.560672E-01	1.854835E+01
45	44	8.373464E-01	1.781330E+01
46	45	8.213063E-01	1.710041E+01
47	46	7.894694E-01	1.650353E+01
48	47	7.797618E-01	1.602342E+01
49	48	7.942816E-01	1.559075E+01
50	49	7.467491E-01	1.525258E+01
51	50	7.303054E-01	1.486731E+01
52	51	1.052020E+00	1.423443E+01
53	52	8.224789E-01	1.419074E+01
54	53	6.039736E-01	1.400770E+01
55	54	7.800258E-01	1.345465E+01
56	55	8.104422E-01	1.312026E+01
57	56	6.951266E-01	1.274660E+01
58	57	7.536424E-01	1.207771E+01
59	58	5.192204E-01	1.173085E+01
60	59	6.147351E-01	1.106846E+01
61	60	5.255253E-01	1.034451E+01
62	61	4.814213E-01	9.312722E+00
63	62	3.301847E-01	8.377713E+00
64	63	2.904908E-01	7.068259E+00
65	64	3.037960E-01	5.865359E+00
66	65	2.295282E-01	5.029168E+00
67	66	1.993252E-01	4.344003E+00
68	67	1.804902E-01	4.199623E+00
69	68	2.067948E-01	4.521677E+00
70	69	3.959206E-01	4.908766E+00

Inelastic scattering matrix

	21	22	23	24	25	26	27	28	29	30
40	7.006097E-06	2.151536E-07	5.004470E-07	1.020805E-06	1.922329E-06	3.473750E-06	6.395160E-06	1.128687E-05	2.001442E-05	3.474109E-05
41	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
43	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	4.559420E-07	7.478248E-07	1.274519E-06	2.115684E-06	3.143610E-06	4.305476E-06	6.163187E-06	8.690796E-06	1.261266E-05	1.831585E-05
47	2.134396E-08	3.486727E-08	5.921879E-08	9.939617E-08	1.641141E-07	2.699449E-07	4.620957E-07	7.695286E-07	1.257748E-06	2.151938E-06
48	3.943101E-11	6.718891E-11	1.177731E-10	2.024916E-10	3.404989E-10	5.677706E-10	9.821563E-10	1.648760E-09	2.797600E-09	4.660377E-09
49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.616632E-10
51	1.317585E-07	2.133070E-07	3.595166E-07	5.996049E-07	9.850019E-07	1.613617E-06	2.752838E-06	4.571536E-06	7.688637E-06	1.271975E-05
52	3.030093E-08	4.503897E-08	7.053892E-08	1.104602E-07	1.722106E-07	2.703436E-07	4.453303E-07	7.185885E-07	1.181546E-06	1.919848E-06
53	1.983076E-08	3.233078E-08	5.440671E-08	9.065785E-08	1.487064E-07	2.431259E-07	4.142405E-07	6.869423E-07	1.154149E-06	1.907635E-06
54	2.407966E-08	3.935198E-08	6.673728E-08	1.119044E-07	1.847228E-07	3.037196E-07	5.193867E-07	8.643473E-07	1.456225E-06	2.411540E-06
55	3.957547E-10	6.417606E-10	1.090363E-09	1.828448E-09	2.998785E-09	4.902189E-09	8.343392E-09	1.382457E-08	2.321516E-08	3.834326E-08
56	9.842989E-08	1.563607E-07	2.587750E-07	4.245594E-07	6.826113E-07	1.089044E-06	1.805038E-06	2.906874E-06	4.767811E-06	7.741985E-06
57	2.725933E-08	4.469780E-08	7.631634E-08	1.293342E-07	2.161080E-07	3.583643E-07	6.187249E-07	1.040585E-06	1.769203E-06	2.948158E-06
58	1.310501E-08	2.112532E-08	3.532549E-08	5.873212E-08	9.660224E-08	1.589435E-07	2.715083E-07	4.493165E-07	7.526878E-07	1.240156E-06
59	1.889499E-08	3.052985E-08	5.181091E-08	8.697685E-08	1.432609E-07	2.349619E-07	4.007514E-07	6.636383E-07	1.112681E-06	1.835149E-06
60	2.046028E-08	3.274066E-08	5.448745E-08	9.014166E-08	1.471362E-07	2.391246E-07	4.042707E-07	6.632600E-07	1.096651E-06	1.783101E-06
61	3.542511E-09	6.236000E-09	1.084805E-08	1.864340E-08	3.121309E-08	5.121129E-08	8.748774E-08	1.456493E-07	2.456717E-07	4.068101E-07
62	6.571229E-09	1.099853E-08	1.914236E-08	3.205682E-08	5.275806E-08	8.654654E-08	1.478677E-07	2.462928E-07	4.151334E-07	6.881658E-07
63	2.856781E-09	5.421722E-09	9.868159E-09	1.654190E-08	2.728577E-08	4.495187E-08	7.688350E-08	1.279473E-07	2.156814E-07	3.576613E-07
64	7.659105E-09	1.299487E-08	2.238943E-08	3.782924E-08	6.300500E-08	1.038567E-07	1.778036E-07	2.959552E-07	4.982845E-07	8.249524E-07
65	5.230152E-09	8.772270E-09	1.488587E-08	2.496993E-08	4.119992E-08	6.771153E-08	1.158055E-07	1.926426E-07	3.244466E-07	5.371305E-07
66	4.118370E-09	6.946320E-09	1.178748E-08	1.977261E-08	3.262444E-08	5.361766E-08	9.170059E-08	1.525441E-07	2.569134E-07	4.253277E-07
67	4.005687E-09	6.772190E-09	1.149197E-08	1.927694E-08	3.180663E-08	5.227266E-08	8.940210E-08	1.487209E-07	2.504749E-07	4.146698E-07
68	4.029081E-09	6.575560E-09	1.115889E-08	1.871823E-08	3.088480E-08	5.075876E-08	8.681126E-08	1.444113E-07	2.432174E-07	4.026562E-07
69	3.405815E-09	5.592085E-09	9.489830E-09	1.591850E-08	2.626531E-08	4.316473E-08	7.382708E-08	1.228123E-07	2.068413E-07	3.424357E-07
70	2.352327E-09	3.850959E-09	6.935679E-09	1.163481E-08	1.934411E-08	3.179700E-08	5.437311E-08	9.045077E-08	1.523385E-07	2.522055E-07

Table 1 (cont.)

	31	32	33	34	35	36	37	38	39	40
40	5.935333E-05	1.057318E-04	1.561132E-04	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	1.755666E-05	1.859658E-04	3.271726E-04	6.006225E-04	9.120491E-04	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	1.011526E-04	1.188442E-03	2.224636E-03	7.545885E-04
43	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.869649E-03
44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	2.472928E-05	4.126426E-05	6.382209E-05	9.821297E-05	1.526988E-04	2.500561E-04	4.027785E-04	6.639854E-04	1.088499E-03	1.182321E-03
47	3.518579E-06	5.985056E-06	1.066999E-05	1.667962E-05	2.756826E-05	4.718983E-05	7.357887E-05	1.161036E-04	1.834627E-04	6.835542E-04
48	7.545671E-09	1.303727E-08	2.197302E-08	3.643300E-08	6.019640E-08	1.035552E-07	1.736313E-07	2.951497E-07	4.939959E-07	7.529622E-07
49	0.	0.	0.	0.	0.	0.	0.	0.	0.	3.708643E-08
50	8.426770E-09	3.381780E-08	8.326530E-08	1.713087E-07	3.247414E-07	6.142048E-07	1.179725E-06	2.820271E-06	5.928864E-06	2.356083E-05
51	2.074058E-05	3.518827E-05	5.892742E-05	9.460709E-05	1.434460E-04	2.037588E-04	2.850542E-04	4.304883E-04	6.459620E-04	9.834742E-04
52	3.087872E-06	5.181004E-06	8.569046E-06	1.300679E-05	1.882643E-05	3.933005E-05	7.145869E-05	1.062403E-04	1.202145E-04	1.539453E-04
53	3.109387E-06	5.271544E-06	8.837408E-06	1.457873E-05	2.400386E-05	4.112582E-05	6.768364E-05	1.129554E-04	2.088990E-04	3.497828E-04
54	3.936082E-06	6.681121E-06	1.114623E-05	1.746937E-05	2.651529E-05	4.026807E-05	5.592490E-05	7.909760E-05	1.116826E-04	1.582237E-04
55	6.246193E-08	1.058526E-07	1.773814E-07	2.924631E-07	4.804512E-07	8.215467E-07	1.366579E-06	2.301887E-06	3.812174E-06	6.224059E-06
56	1.236973E-05	2.046170E-05	3.357794E-05	5.456327E-05	8.907730E-05	1.515351E-04	2.509474E-04	4.209693E-04	6.944571E-04	1.122769E-03
57	4.890628E-06	8.533816E-06	1.465840E-05	2.453339E-05	4.037485E-05	6.907959E-05	1.149042E-04	1.933916E-04	3.197203E-04	5.256986E-04
58	2.016080E-06	3.411133E-06	5.708309E-06	9.402055E-06	1.543432E-05	2.637833E-05	4.387057E-05	7.392030E-05	1.224610E-04	1.996504E-04
59	2.983343E-06	5.053947E-06	8.472316E-06	1.397851E-05	2.297749E-05	3.933151E-05	6.552732E-05	1.105951E-04	1.836363E-04	3.010015E-04
60	2.867372E-06	4.801251E-06	7.929442E-06	1.266990E-05	1.987483E-05	3.146478E-05	4.944580E-05	7.985748E-05	1.278047E-04	2.028742E-04
61	6.628104E-07	1.122858E-06	1.900020E-06	3.288504E-06	5.635014E-06	9.976578E-06	1.678003E-05	2.813341E-05	4.637138E-05	7.538847E-05
62	1.123865E-06	1.906834E-06	3.196912E-06	5.271888E-06	8.658705E-06	1.479743E-05	2.459159E-05	4.136720E-05	6.838089E-05	1.113682E-04
63	5.841744E-07	9.918114E-07	1.662940E-06	2.741852E-06	4.502272E-06	7.692539E-06	1.278421E-05	2.150478E-05	3.554973E-05	5.788387E-05
64	1.346201E-06	2.284360E-06	3.831472E-06	6.318948E-06	1.037859E-05	1.773642E-05	2.947834E-05	4.856615E-05	6.548138E-05	1.064536E-04
65	8.764550E-07	1.486967E-06	2.493476E-06	4.112489E-06	6.755237E-06	1.154531E-05	1.918874E-05	3.229082E-05	5.339908E-05	8.699915E-05
66	6.940229E-07	1.177459E-06	1.974469E-06	3.256496E-06	5.349179E-06	9.142256E-06	1.519460E-05	2.556104E-05	4.225407E-05	6.881703E-05
67	6.766349E-07	1.147965E-06	1.925024E-06	3.174973E-06	5.215326E-06	8.913619E-06	1.481488E-05	2.492287E-05	4.120042E-05	6.710369E-05
68	6.570346E-07	1.114718E-06	1.869288E-06	3.083073E-06	5.064430E-06	8.655856E-06	1.438676E-05	2.420331E-05	4.001229E-05	6.517145E-05
69	5.587732E-07	9.480154E-07	1.589758E-06	2.622075E-06	4.307242E-06	7.361877E-06	1.223642E-05	2.058650E-05	3.403474E-05	5.543874E-05
70	4.115428E-07	6.982327E-07	1.170906E-06	1.931275E-06	3.172553E-06	5.422655E-06	9.013545E-06	1.516518E-05	2.507361E-05	4.084565E-05

Table 1 (cont.)

	41	42	43	44	45	46	47	48	49	50
40	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
43	3.323602E-03	1.450965E-04	0.	0.	0.	0.	0.	0.	0.	0.
44	1.162578E-05	3.049175E-03	2.017350E-03	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	1.332287E-03	3.397611E-03	0.	0.	0.	0.	0.	0.
46	0.	0.	0.	2.122714E-04	3.390332E-03	6.866225E-04	0.	0.	0.	0.
47	2.507707E-03	3.479739E-03	5.759706E-03	1.792250E-03	0.	2.427189E-03	1.282165E-03	0.	0.	0.
48	3.552062E-06	5.137028E-04	9.057413E-04	6.803429E-03	1.220121E-02	7.209365E-03	1.606378E-03	1.362010E-03	0.	0.
49	9.260249E-07	1.790434E-06	7.609748E-06	2.072298E-05	1.252790E-03	1.152073E-02	2.593414E-02	4.931328E-03	1.273908E-03	0.
50	1.175440E-04	0.	0.	3.927737E-09	1.911660E-05	6.733728E-05	1.719293E-03	3.072366E-02	3.055651E-02	1.284830E-03
51	1.622386E-03	2.819311E-03	4.288535E-03	6.506414E-03	6.267792E-03	6.914849E-03	2.476143E-03	1.642279E-04	2.006299E-02	6.693582E-02
52	2.338108E-04	3.532343E-04	5.424872E-04	9.034990E-04	5.515834E-03	1.090528E-02	2.518256E-02	2.054441E-02	4.525235E-03	5.784024E-03
53	5.893358E-04	7.206025E-04	1.034374E-03	1.743882E-03	3.032807E-03	2.784518E-03	5.215622E-03	1.897959E-02	3.314028E-02	2.992699E-02
54	2.346730E-04	4.944141E-04	8.492400E-04	1.275810E-03	2.157225E-03	5.259570E-03	8.922595E-03	1.281267E-02	2.409145E-02	3.826678E-02
55	1.327193E-05	3.905000E-05	4.796932E-05	1.414661E-04	3.407818E-04	6.337133E-04	1.601987E-03	5.172890E-03	9.718011E-03	2.618093E-02
56	1.842920E-03	3.027037E-03	4.629311E-03	6.438073E-03	8.939023E-03	6.728119E-03	6.624879E-03	2.244196E-03	2.875740E-03	4.282199E-03
57	9.315554E-04	1.580821E-03	2.690305E-03	4.362198E-03	7.465827E-03	1.654603E-02	2.730939E-02	4.225903E-02	5.156006E-02	7.342642E-02
58	3.372332E-04	5.625852E-04	9.254018E-04	1.449856E-03	2.187078E-03	2.640281E-03	5.391814E-03	1.370996E-02	3.124202E-02	4.768930E-02
59	5.096682E-04	8.480415E-04	1.406331E-03	2.312435E-03	3.775083E-03	6.249519E-03	9.317517E-03	1.272012E-02	1.641597E-02	2.320924E-02
60	3.370293E-04	5.555897E-04	8.872970E-04	1.410381E-03	2.374586E-03	3.928997E-03	6.483823E-03	1.104136E-02	1.868661E-02	2.926020E-02
61	1.268562E-04	1.943735E-04	3.256644E-04	5.385133E-04	8.345846E-04	1.326234E-03	2.199319E-03	3.329914E-03	5.270864E-03	9.206980E-03
62	1.884803E-04	3.150381E-04	5.175440E-04	8.561624E-04	1.310758E-03	1.942540E-03	3.156948E-03	4.992065E-03	7.585469E-03	1.210197E-02
63	9.752857E-05	1.627939E-04	2.672924E-04	4.352294E-04	7.336750E-04	1.204546E-03	1.989773E-03	3.211921E-03	5.092615E-03	8.331849E-03
64	1.681270E-04	2.745373E-04	4.511595E-04	7.377572E-04	1.196684E-03	1.852132E-03	3.070820E-03	4.708225E-03	7.324504E-03	1.077022E-02
65	1.472767E-04	2.461827E-04	4.043589E-04	6.607212E-04	1.069801E-03	1.725777E-03	2.873684E-03	4.688599E-03	7.493416E-03	1.237445E-02
66	1.164666E-04	1.948772E-04	3.197627E-04	5.224962E-04	8.868966E-04	1.460561E-03	2.429499E-03	3.956870E-03	6.323722E-03	1.044364E-02
67	1.135728E-04	1.898530E-04	3.118658E-04	5.096489E-04	8.652142E-04	1.425511E-03	2.371121E-03	3.862993E-03	6.176125E-03	1.020507E-02
68	1.103099E-04	1.844108E-04	3.029549E-04	4.951476E-04	8.407307E-04	1.385462E-03	2.305131E-03	3.756798E-03	6.009024E-03	9.934730E-03
69	9.384291E-05	1.568999E-04	2.577944E-04	4.214105E-04	7.156910E-04	1.179753E-03	1.963621E-03	3.201798E-03	5.124516E-03	8.479292E-03
70	6.914857E-05	1.155295E-04	1.900213E-04	3.106987E-04	5.278338E-04	8.704447E-04	1.449570E-03	2.365227E-03	3.788871E-03	6.276325E-03

Table 1 (cont.)

	51	52	53	54	55	56	57	58	59	60
40	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
43	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
51	1.543691E-03	0.	0.	0.	0.	0.	0.	0.	0.	0.
52	1.040581E-01	8.848432E-04	0.	0.	0.	0.	0.	0.	0.	0.
53	1.787108E-02	8.998885E-02	2.985506E-02	0.	0.	0.	0.	0.	0.	0.
54	6.280653E-02	3.019376E-02	8.395171E-02	9.651685E-02	0.	0.	0.	0.	0.	0.
55	4.775903E-02	6.285544E-02	9.117586E-02	1.412408E-01	1.148697E-01	0.	0.	0.	0.	0.
56	1.374494E-02	2.521711E-02	7.188458E-02	1.611445E-01	1.635731E-01	1.308156E-01	0.	0.	0.	0.
57	7.140056E-02	3.624340E-02	1.813724E-02	7.195561E-02	1.489515E-01	1.917804E-01	1.743374E-01	0.	0.	0.
58	9.484902E-02	1.107673E-01	1.923214E-01	2.251634E-01	7.036823E-02	1.128414E-01	2.943824E-01	1.821254E-01	0.	0.
59	3.644186E-02	4.047141E-02	8.417732E-02	1.904822E-01	3.102305E-01	3.235671E-01	1.793861E-01	2.900831E-01	2.158605E-01	0.
60	4.084472E-02	2.989243E-02	4.217593E-02	9.489041E-02	1.200642E-01	2.199545E-01	4.996937E-01	3.939686E-01	3.188266E-01	2.055621E-01
61	1.905474E-02	2.869479E-02	5.284398E-02	1.098593E-01	1.163879E-01	1.467156E-01	2.668067E-01	3.335972E-01	5.363916E-01	5.374926E-01
62	1.953537E-02	1.958688E-02	3.273859E-02	6.272016E-02	6.757500E-02	8.649777E-02	1.466386E-01	2.667081E-01	3.823397E-01	5.024329E-01
63	1.329218E-02	1.379022E-02	2.401761E-02	4.731007E-02	5.496273E-02	7.640668E-02	1.280575E-01	1.549051E-01	2.188623E-01	3.743817E-01
64	1.670068E-02	1.698310E-02	2.838783E-02	5.516620E-02	6.243073E-02	8.265173E-02	1.380457E-01	1.578806E-01	2.050208E-01	2.651098E-01
65	1.981417E-02	2.013159E-02	3.548148E-02	6.878892E-02	7.921915E-02	1.038241E-01	1.710277E-01	2.031304E-01	2.601960E-01	3.142917E-01
66	1.690906E-02	1.781209E-02	3.137414E-02	6.314849E-02	7.444388E-02	1.007219E-01	1.670472E-01	1.979537E-01	2.633378E-01	3.369328E-01
67	1.653369E-02	1.742865E-02	3.072363E-02	6.191868E-02	7.310785E-02	9.936773E-02	1.661563E-01	1.992195E-01	2.676517E-01	3.441973E-01
68	1.610794E-02	1.699347E-02	2.998522E-02	6.052425E-02	7.159912E-02	9.752660E-02	1.635640E-01	1.968582E-01	2.657185E-01	3.438282E-01
69	1.376284E-02	1.453593E-02	2.568327E-02	5.195398E-02	6.162721E-02	8.419802E-02	1.418035E-01	1.715851E-01	2.331397E-01	3.043282E-01
70	1.020210E-02	1.079142E-02	1.910229E-02	3.875370E-02	4.613745E-02	6.327405E-02	1.071274E-01	1.304792E-01	1.786809E-01	2.359857E-01

Table 1 (cont.)

	61	62	63	64	65	66	67	68	69	70
40	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
43	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
51	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
52	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
53	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
54	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
55	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
56	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
58	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
59	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61	2.799449E-01	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	9.200987E-01	2.427536E-01	0.	0.	0.	0.	0.	0.	0.	0.
63	7.592777E-01	7.502828E-01	3.702395E-01	0.	0.	0.	0.	0.	0.	0.
64	4.642907E-01	5.393575E-01	8.919169E-01	2.882122E-01	0.	0.	0.	0.	0.	0.
65	4.745412E-01	3.794563E-01	5.876421E-01	6.020870E-01	1.269233E-01	0.	0.	0.	0.	0.
66	5.255374E-01	4.074428E-01	4.664364E-01	4.106295E-01	3.684658E-01	1.277484E-01	0.	0.	0.	0.
67	5.452045E-01	4.369228E-01	5.039371E-01	3.440813E-01	1.937927E-01	2.645323E-01	6.434610E-02	0.	0.	0.
68	5.499392E-01	4.482144E-01	5.266832E-01	3.609050E-01	1.856142E-01	1.269865E-01	1.033137E-01	2.818407E-02	0.	0.
69	4.935834E-01	4.097315E-01	4.932720E-01	3.502253E-01	1.859160E-01	1.234107E-01	4.864504E-02	2.475390E-02	3.353744E-03	0.
70	3.879169E-01	3.281512E-01	4.044974E-01	2.964545E-01	1.628854E-01	1.127369E-01	4.687095E-02	1.508543E-02	4.215948E-03	5.710475E-04

(n,2n) scattering matrix

	11	12	13	14	15	16	17	18	19	20
68	0.	0.	0.	0.	0.	0.	0.	1.845356E-12	2.191344E-11	3.864228E-11
69	1.432657E-09	2.288406E-11	3.734863E-11	6.338192E-11	1.063223E-10	1.754379E-10	2.894683E-10	5.915178E-10	1.013162E-09	1.939631E-09
70	3.577894E-10	1.013192E-10	0.	0.	0.	0.	1.202427E-12	1.903072E-10	5.322667E-10	1.230020E-09

	21	22	23	24	25	26	27	28	29	30
68	6.398323E-11	1.044170E-10	1.771943E-10	6.438059E-10	1.062267E-09	1.745817E-09	2.985813E-09	4.966902E-09	8.365206E-09	1.384883E-08
69	3.409162E-09	3.543328E-09	3.122345E-09	5.237507E-09	8.641802E-09	1.420266E-08	2.429039E-08	4.040721E-08	6.805366E-08	1.126652E-07
70	2.036645E-09	3.323856E-09	5.809490E-09	9.744937E-09	1.607893E-08	2.642556E-08	4.519511E-08	7.518281E-08	1.266237E-07	2.096323E-07

	31	32	33	34	35	36	37	38	39	40
68	2.259761E-08	3.833839E-08	6.428909E-08	1.060318E-07	1.741691E-07	2.976700E-07	4.947298E-07	8.322499E-07	1.375748E-06	2.240578E-06
69	1.838409E-07	3.119010E-07	5.230277E-07	8.626392E-07	1.417005E-06	2.421838E-06	4.025228E-06	6.771612E-06	1.119433E-05	1.823247E-05
70	3.420712E-07	5.803523E-07	9.732344E-07	1.605223E-06	2.636906E-06	4.507030E-06	7.491430E-06	1.260387E-05	2.083810E-05	3.394434E-05

	41	42	43	44	45	46	47	48	49	50
68	3.791908E-06	6.338124E-06	1.041022E-05	1.700973E-05	2.887115E-05	4.755527E-05	7.907439E-05	1.287704E-04	2.040489E-04	2.607860E-04
69	3.085867E-05	5.158514E-05	8.473852E-05	1.384814E-04	2.351002E-04	3.873568E-04	6.443297E-04	1.049771E-03	1.678430E-03	2.773460E-03
70	5.746177E-05	9.607955E-05	1.578780E-04	2.581097E-04	4.384210E-04	7.228430E-04	1.164442E-03	1.878194E-03	3.006162E-03	4.974366E-03

	51	52	53	54	55	56	57	58	59	60
68	4.085940E-04	4.225157E-04	5.442726E-04	1.002075E-03	1.079700E-03	9.095608E-04	1.340190E-03	8.048555E-04	3.989791E-04	1.222481E-04
69	4.493596E-03	4.736451E-03	7.793765E-03	1.556002E-02	1.770008E-02	2.326310E-02	3.740230E-02	4.314390E-02	5.520029E-02	6.607248E-02
70	8.067506E-03	9.444933E-03	1.477911E-02	2.956094E-02	3.457160E-02	4.652052E-02	7.654919E-02	9.145283E-02	1.200614E-01	1.537783E-01

	61	62	63	64	65	66	67	68	69	70
68	4.761728E-05	0.	0.	0.	0.	0.	0.	0.	0.	0.
69	9.201535E-02	6.010356E-02	4.336077E-02	8.136759E-03	1.021589E-05	0.	0.	0.	0.	0.
70	2.381406E-01	1.892259E-01	2.163769E-01	1.406924E-01	5.623187E-02	2.193043E-02	1.843112E-03	0.	0.	0.

Table 2 Lumped cross-sections - outer core of BBR

Grouped cross-sections of FPs - PF1010
Fuel - ^{239}Pu + ^{241}Pu + ^{238}U + ^{235}U
Irradiation time - 600 days
No. of fission products - 28
No. of energy groups - 70

Group	Total	Elastic	Inelastic	(n,2n)	Mu
1	4.038836E+02	1.378298E+01	0.	0.	7.044986E-02
2	2.093888E+02	1.101185E+01	0.	0.	5.815993E-02
3	1.331615E+02	9.675715E+00	0.	0.	5.209812E-02
4	1.048069E+02	8.938746E+00	0.	0.	4.873152E-02
5	1.332503E+02	8.691611E+00	0.	0.	4.755999E-02
6	7.059120E+02	1.565481E+01	0.	0.	7.891688E-02
7	2.437115E+02	9.703040E+00	0.	0.	5.259053E-02
8	7.813305E+01	8.461003E+00	0.	0.	4.703040E-02
9	8.395040E+01	8.262035E+00	0.	0.	4.566602E-02
10	5.058758E+01	7.921828E+00	0.	0.	4.393112E-02
11	1.542392E+02	9.794138E+00	0.	0.	5.239479E-02
12	1.122651E+02	1.090551E+01	0.	0.	5.850898E-02
13	1.549408E+03	2.603779E+02	0.	0.	1.298549E+00
14	1.681611E+02	2.203114E+01	0.	0.	1.137223E-01
15	1.294760E+02	2.488213E+01	0.	0.	1.233862E-01
16	6.089201E+01	2.057580E+01	0.	0.	1.085443E-01
17	6.855409E+02	4.017578E+02	0.	0.	2.066638E+00
18	2.734585E+02	1.195232E+02	0.	0.	5.602969E-01
19	7.371177E+01	1.656509E+01	0.	0.	8.573031E-02
20	1.089715E+02	3.028496E+01	0.	0.	1.485266E-01
21	2.361069E+02	1.316388E+02	0.	0.	6.390673E-01
22	1.083054E+02	4.589211E+01	0.	0.	2.210139E-01
23	1.416673E+02	7.570031E+01	0.	0.	3.609270E-01
24	1.607262E+02	1.129803E+02	0.	0.	5.229881E-01
25	1.103309E+02	6.884923E+01	0.	0.	3.274736E-01
26	9.583125E+01	5.865662E+01	0.	0.	2.845616E-01
27	8.205779E+01	5.543501E+01	0.	0.	2.669826E-01
28	7.142135E+01	4.616373E+01	0.	0.	2.241181E-01
29	8.627142E+01	6.660866E+01	0.	0.	3.223022E-01
30	1.748036E+02	1.566274E+02	0.	0.	7.415177E-01
31	7.169079E+01	5.625017E+01	0.	0.	2.760541E-01
32	6.212658E+01	4.965800E+01	0.	0.	2.446287E-01
33	5.316802E+01	4.275834E+01	0.	0.	2.093468E-01
34	7.944379E+01	6.358621E+01	0.	0.	7.177873E-01
35	5.742322E+01	4.903539E+01	0.	0.	1.606070E+00
36	5.128509E+01	4.431339E+01	0.	0.	2.925795E+00
37	4.287869E+01	3.692057E+01	0.	0.	4.279646E+00
38	4.040041E+01	3.528932E+01	0.	0.	5.217948E+00
39	3.508170E+01	3.067794E+01	0.	0.	4.842085E+00
40	3.327577E+01	2.943980E+01	1.038326E-02	0.	4.471549E+00
41	3.143053E+01	2.808175E+01	5.290811E-02	0.	4.157143E+00
42	2.871825E+01	2.577410E+01	1.105259E-01	0.	3.882828E+00
43	2.559378E+01	2.299230E+01	1.382123E-01	0.	3.665443E+00
44	2.375042E+01	2.147203E+01	1.314757E-01	0.	3.499972E+00
45	2.210827E+01	2.013089E+01	1.224592E-01	0.	3.352220E+00
46	2.071844E+01	1.900810E+01	1.134912E-01	0.	3.243672E+00
47	1.949974E+01	1.802350E+01	1.105932E-01	0.	3.163246E+00
48	1.849229E+01	1.721536E+01	1.095893E-01	0.	3.106911E+00
49	1.763159E+01	1.652060E+01	1.075396E-01	0.	3.083961E+00
50	1.688105E+01	1.589846E+01	1.172402E-01	0.	3.104856E+00
51	1.621578E+01	1.528296E+01	1.837782E-01	0.	3.133573E+00
52	1.573475E+01	1.480831E+01	2.615377E-01	0.	3.172661E+00
53	1.533713E+01	1.443365E+01	3.083247E-01	0.	3.232384E+00
54	1.487452E+01	1.393888E+01	4.209579E-01	0.	3.302740E+00
55	1.450380E+01	1.351297E+01	5.430087E-01	0.	3.375639E+00
56	1.425676E+01	1.321316E+01	6.434155E-01	0.	3.440108E+00
57	1.407602E+01	1.282272E+01	9.093921E-01	0.	3.487104E+00
58	1.394814E+01	1.236976E+01	1.284480E+00	0.	3.505147E+00
59	1.393793E+01	1.195523E+01	1.620279E+00	0.	3.504150E+00
60	1.373429E+01	1.156616E+01	1.920116E+00	0.	3.515467E+00
61	1.355515E+01	1.097641E+01	2.348813E+00	0.	3.499954E+00
62	1.303043E+01	1.011373E+01	2.719351E+00	0.	3.377270E+00
63	1.736226E+01	9.164657E+00	3.033840E+00	0.	3.131134E+00
64	1.135119E+01	7.821985E+00	3.405743E+00	0.	2.785669E+00
65	1.036246E+01	6.565436E+00	3.705044E+00	0.	2.578186E+00
66	9.436246E+00	5.531584E+00	3.847927E+00	0.	2.337237E+00
67	8.590246E+00	4.698153E+00	3.862143E+00	0.	2.130203E+00
68	8.199785E+00	4.394237E+00	3.770554E+00	1.865664E-02	2.153449E+00
69	8.270616E+00	4.613251E+00	3.318805E+00	3.279553E-01	2.425083E+00
70	8.702427E+00	5.208239E+00	2.625116E+00	8.591865E-01	2.748987E+00

Table 2 (cont.)

Elastic scattering matrix

Group I	Group J	Scattering matrix of group I for the group J	J+1
1	1	1.373586E+01	
2	1	5.988007E-01	1.041311E+01
3	2	5.217391E-01	9.154017E+00
4	3	4.868024E-01	8.451970E+00
5	4	4.850811E-01	8.206545E+00
6	5	7.088102E-01	1.494604E+01
7	6	7.480328E-02	9.628236E+00
8	7	2.645699E-01	8.196440E+00
9	8	3.868699E-01	7.875172E+00
10	9	4.051678E-01	7.516661E+00
11	10	3.454487E-01	9.448700E+00
12	11	5.504905E-01	1.035502E+01
13	12	1.407169E+00	2.589725E+02
14	13	1.398312E+00	2.063286E+01
15	14	5.409888E-01	2.434120E+01
16	15	6.149272E-01	1.996076E+01
17	16	2.125870E+00	3.996342E+02
18	17	1.207581E+00	1.183162E+02
19	18	4.966341E-01	1.606859E+01
20	19	7.081126E-01	2.957698E+01
21	20	3.746431E-01	1.312649E+02
22	21	5.743648E-01	4.531685E+01
23	22	2.578001E+00	7.312247E+01
24	23	9.381757E-01	1.116422E+02
25	24	2.156832E+00	6.669187E+01
26	25	1.090357E+00	5.756622E+01
27	26	1.054238E+00	5.438092E+01
28	27	9.445669E-01	4.521927E+01
29	28	1.291881E+00	6.531628E+01
30	29	1.063640E+01	1.459852E+02
31	30	2.254753E+00	5.399546E+01
32	31	1.712491E+00	4.794561E+01
33	32	1.936255E+00	4.082216E+01
34	33	1.845707E+00	6.174035E+01
35	34	4.855491E+00	4.417975E+01
36	35	1.716781E+00	4.259664E+01
37	36	1.898731E+00	3.502184E+01
38	37	1.588085E+00	3.370118E+01
39	38	1.046479E+00	2.963147E+01
40	39	1.116166E+00	2.832368E+01
41	40	1.112713E+00	2.696906E+01
42	41	9.801449E-01	2.479395E+01
43	42	9.843131E-01	2.200799E+01
44	43	9.805917E-01	2.049144E+01
45	44	8.465864E-01	1.928431E+01
46	45	8.185237E-01	1.818959E+01
47	46	7.775029E-01	1.724599E+01
48	47	7.581270E-01	1.645723E+01
49	48	7.632696E-01	1.575733E+01
50	49	7.093503E-01	1.518911E+01
51	50	6.863077E-01	1.459665E+01
52	51	9.770419E-01	1.383127E+01
53	52	7.585426E-01	1.367510E+01
54	53	5.525733E-01	1.338631E+01
55	54	7.067023E-01	1.280627E+01
56	55	7.294680E-01	1.248369E+01
57	56	6.232938E-01	1.219943E+01
58	57	6.772891E-01	1.169247E+01
59	58	4.671104E-01	1.148813E+01
60	59	5.566936E-01	1.100946E+01
61	60	4.797710E-01	1.049662E+01
62	61	4.469281E-01	9.668603E+00
63	62	3.151031E-01	8.849551E+00
64	63	2.889005E-01	7.533067E+00
65	64	3.129513E-01	6.252491E+00
66	65	2.395224E-01	5.292052E+00
67	66	2.002021E-01	4.497948E+00
68	67	1.736693E-01	4.220564E+00
69	68	1.900675E-01	4.423201E+00
70	69	3.812195E-01	4.827043E+00

Table 2 (cont.)

Inelastic scattering matrix

	21	22	23	24	25	26	27	28	29	30
40	1.813912E-06	5.570428E-06	1.295681E-05	2.642912E-05	4.977001E-05	8.992409E-05	1.654805E-04	2.922225E-04	5.181828E-04	8.994634E-04
41	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
43	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	2.764096E-07	4.533602E-07	7.726623E-07	1.292609E-06	1.905778E-06	2.612571E-06	3.736362E-06	5.268696E-06	7.642283E-06	1.110377E-05
47	1.047960E-07	1.711936E-07	2.907563E-07	4.880218E-07	8.057781E-07	1.325293E-06	2.268827E-06	3.778282E-06	6.371769E-06	1.056573E-05
48	3.948360E-11	6.727852E-11	1.179302E-10	2.027617E-10	3.409530E-10	5.685278E-10	9.834662E-10	1.650959E-09	2.801331E-09	4.666593E-09
49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.195268E-08
51	2.028289E-07	3.290337E-07	5.555225E-07	9.277723E-07	1.525688E-06	2.501413E-06	4.270267E-06	7.095820E-06	1.193843E-05	1.974867E-05
52	2.847339E-08	4.200504E-08	6.531861E-08	1.016128E-07	1.575035E-07	2.460278E-07	4.035574E-07	6.488505E-07	1.063746E-06	1.724343E-06
53	1.465515E-08	2.388598E-08	4.019662E-08	6.698050E-08	1.098686E-07	1.796349E-07	3.060624E-07	5.075525E-07	8.527634E-07	1.409504E-06
54	3.766914E-08	6.144210E-08	1.038883E-07	1.739825E-07	2.865852E-07	4.704175E-07	8.031850E-07	1.335221E-06	2.247656E-06	3.719998E-06
55	6.359359E-10	1.029738E-09	1.749004E-09	2.937745E-09	4.817521E-09	7.874756E-09	1.340410E-08	2.220854E-08	3.729420E-08	6.159979E-08
56	7.126550E-08	1.124099E-07	1.846259E-07	3.005548E-07	4.793205E-07	7.569641E-07	1.240061E-06	1.972022E-06	3.199083E-06	5.148992E-06
57	2.177009E-09	3.565469E-08	6.087353E-08	1.031524E-07	1.720834E-07	2.849869E-07	4.914617E-07	8.256288E-07	1.402517E-06	2.335559E-06
58	1.338293E-08	2.159601E-08	3.619468E-08	6.031453E-08	9.928488E-08	1.632801E-07	2.787694E-07	4.613841E-07	7.731434E-07	1.274274E-06
59	1.223064E-08	1.973979E-08	3.345504E-08	5.617876E-08	9.243288E-08	1.515007E-07	2.582926E-07	4.275548E-07	7.164474E-07	1.180971E-06
60	1.881924E-08	3.017487E-08	5.047682E-08	8.367324E-08	1.370961E-07	2.238277E-07	3.803411E-07	6.273600E-07	1.043414E-06	1.705629E-06
61	2.715455E-09	4.999178E-09	8.804661E-09	1.510134E-08	2.535768E-08	4.157793E-08	7.102962E-08	1.184693E-07	1.997700E-07	3.308390E-07
62	5.863732E-09	9.952270E-09	1.734045E-08	2.929289E-08	4.822199E-08	7.911251E-08	1.351680E-07	2.250978E-07	3.793693E-07	6.288414E-07
63	3.036544E-09	5.722902E-09	1.022816E-08	1.721627E-08	2.858784E-08	4.707611E-08	8.053332E-08	1.339750E-07	2.257437E-07	3.741033E-07
64	9.077840E-09	1.527073E-08	2.618134E-08	4.424400E-08	7.339054E-08	1.208642E-07	2.067963E-07	3.441310E-07	5.794455E-07	9.592854E-07
65	5.069407E-09	8.496103E-09	1.441735E-08	2.418402E-08	3.990317E-08	6.558522E-08	1.121678E-07	1.865907E-07	3.142531E-07	5.202531E-07
66	4.506581E-09	7.564772E-09	1.284041E-08	2.153881E-08	3.553862E-08	5.840703E-08	9.989161E-08	1.661697E-07	2.798611E-07	4.633175E-07
67	4.445849E-09	7.481620E-09	1.269589E-08	2.129641E-08	3.513869E-08	5.774579E-08	9.876764E-08	1.643002E-07	2.767130E-07	4.581067E-07
68	4.401891E-09	7.183934E-09	1.219692E-08	2.045927E-08	3.375746E-08	5.547983E-08	9.488555E-08	1.578427E-07	2.658379E-07	4.401040E-07
69	3.594637E-09	5.922519E-09	1.005458E-08	1.686583E-08	2.782838E-08	4.573557E-08	7.822041E-08	1.301205E-07	2.191493E-07	3.628112E-07
70	2.413699E-09	3.963527E-09	7.120194E-09	1.194990E-08	1.984618E-08	3.261705E-08	5.578428E-08	9.279820E-08	1.562919E-07	2.587501E-07

Table 2 (cont.)

	31	32	33	34	35	36	37	38	39	40
40	1.536345E-03	2.737446E-03	4.041845E-03	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	4.545503E-04	4.814743E-03	8.470655E-03	1.555064E-02	2.341338E-02	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	2.618890E-03	3.076932E-02	5.759889E-02	1.953645E-02
43	0.	0.	0.	0.	0.	0.	0.	0.	0.	4.840610E-02
44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	1.520432E-05	2.501599E-05	3.869141E-05	5.954049E-05	9.257190E-05	1.515936E-04	2.441799E-04	4.025335E-04	6.986777E-04	7.167684E-04
47	1.727574E-05	2.938592E-05	4.944227E-05	8.189470E-05	1.353564E-04	2.216557E-04	3.612624E-04	5.700533E-04	9.009244E-04	1.667006E-03
48	7.655867E-09	1.305466E-08	2.200233E-08	3.648159E-08	6.027669E-08	1.037333E-07	1.738629E-07	2.955433E-07	4.946548E-07	7.539664E-07
49	0.	0.	0.	0.	0.	0.	0.	0.	0.	3.713589E-08
50	2.181731E-07	8.755590E-07	2.155778E-06	4.435264E-06	8.407709E-06	1.590205E-05	3.108892E-05	7.890879E-05	1.708765E-04	3.386409E-04
51	3.221948E-05	5.467333E-05	9.162867E-05	1.485672E-04	2.254689E-04	3.180432E-04	4.393813E-04	6.438850E-04	9.440031E-04	1.389661E-03
52	2.768231E-06	4.637712E-06	7.656245E-06	1.149710E-05	1.633828E-05	3.507715E-05	6.457862E-05	9.453002E-05	1.160026E-04	1.535902E-04
53	2.297463E-06	3.895062E-06	6.529887E-06	1.077221E-05	1.773762E-05	3.040573E-05	5.008809E-05	8.361965E-05	1.513075E-04	2.520024E-04
54	6.068636E-06	1.029691E-05	1.720813E-05	2.746665E-05	4.290457E-05	6.595348E-05	9.061427E-05	1.262835E-04	1.754718E-04	2.444711E-04
55	1.003444E-07	1.700534E-07	2.849660E-07	4.698545E-07	7.718622E-07	1.319877E-06	2.195701E-06	3.698931E-06	6.128817E-06	1.000515E-05
56	8.144222E-06	1.330207E-05	2.158325E-05	3.479231E-05	5.661614E-05	9.607306E-05	1.587866E-04	2.659555E-04	4.382041E-04	7.080313E-04
57	3.893660E-06	6.815516E-06	1.176341E-05	1.974197E-05	3.248501E-05	5.557254E-05	9.242769E-05	1.555497E-04	2.568900E-04	4.200820E-04
58	2.071957E-06	3.506116E-06	5.867736E-06	9.664700E-06	1.586389E-05	2.710756E-05	4.507024E-05	7.589749E-05	1.254554E-04	2.038595E-04
59	1.918925E-06	3.249920E-06	5.447496E-06	8.986869E-06	1.477119E-05	2.528198E-05	4.211607E-05	7.107431E-05	1.179987E-04	1.934492E-04
60	2.754464E-05	4.628701E-06	7.682800E-06	1.243402E-05	1.975157E-05	3.166454E-05	5.010070E-05	8.104657E-05	1.298746E-04	2.062237E-04
61	5.390972E-07	9.133067E-07	1.534265E-06	2.566314E-06	4.270009E-06	7.378907E-06	1.230960E-05	2.067513E-05	3.414519E-05	5.563911E-05
62	1.026963E-06	1.742186E-06	2.921049E-06	4.816785E-06	7.910972E-06	1.351926E-05	2.246677E-05	3.779203E-05	6.246969E-05	1.017387E-04
63	6.108696E-07	1.036957E-06	1.738808E-06	2.866870E-06	4.706866E-06	8.044661E-06	1.337083E-05	2.249579E-05	3.719449E-05	6.057464E-05
64	1.565358E-06	2.656082E-06	4.454652E-06	7.346898E-06	1.206740E-05	2.062321E-05	3.427492E-05	5.620574E-05	7.172973E-05	1.166861E-04
65	8.489129E-07	1.440235E-06	2.415102E-06	3.983208E-06	6.542837E-06	1.118226E-05	1.858497E-05	3.127214E-05	5.170996E-05	8.423781E-05
66	7.560107E-07	1.282622E-06	2.150808E-06	3.547315E-06	5.826847E-06	9.958558E-06	1.655113E-05	2.784270E-05	4.602499E-05	7.495687E-05
67	7.475101E-07	1.268205E-06	2.126642E-06	3.507478E-06	5.761456E-06	9.846896E-06	1.636577E-05	2.753133E-05	4.551127E-05	7.412226E-05
68	7.181372E-07	1.218378E-06	2.043101E-06	3.369724E-06	5.535240E-06	9.460410E-06	1.572371E-05	2.645188E-05	4.372825E-05	7.122121E-05
69	5.920192E-07	1.004417E-06	1.684329E-06	2.778035E-06	4.563393E-06	7.799592E-06	1.296375E-05	2.180971E-05	3.605607E-05	5.872928E-05
70	4.222212E-07	7.163480E-07	1.201280E-06	1.981365E-06	3.254817E-06	5.563221E-06	9.247103E-06	1.555792E-05	2.572255E-05	4.190190E-05

Table 2 (cont.)

	41	42	43	44	45	46	47	48	49	50
40	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
43	8.604963E-02	3.756616E-03	0.	0.	0.	0.	0.	0.	0.	0.
44	3.009970E-04	7.894458E-02	5.223014E-02	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	3.449355E-02	8.796577E-02	0.	0.	0.	0.	0.	0.
46	0.	0.	0.	5.495807E-03	8.777731E-02	1.777698E-02	0.	0.	0.	0.
47	3.599604E-03	2.307081E-03	3.491756E-03	1.086531E-03	0.	6.284107E-02	3.319587E-02	0.	0.	0.
48	1.721412E-05	2.522211E-03	4.447068E-03	1.063264E-02	1.074405E-02	4.370595E-03	4.158988E-02	3.526305E-02	0.	0.
49	9.272600E-07	1.792822E-06	7.619897E-06	2.075061E-05	6.072294E-03	1.820235E-02	2.255870E-02	2.769285E-02	3.298209E-02	0.
50	4.848341E-04	0.	0.	1.016910E-07	5.538056E-05	2.208924E-04	7.997274E-03	3.590903E-02	3.865502E-02	3.326486E-02
51	2.341518E-03	4.321357E-03	6.549152E-03	9.952292E-03	9.921152E-03	1.449099E-02	6.054953E-03	9.034726E-04	2.751972E-02	6.804563E-02
52	2.358260E-04	3.637957E-04	6.120876E-04	1.014232E-03	7.718095E-03	1.481666E-02	4.418851E-02	4.443653E-02	1.201112E-02	1.574037E-02
53	4.247032E-04	5.231882E-04	7.540945E-04	1.275374E-03	2.298038E-03	2.353321E-03	4.840273E-03	2.351285E-02	5.557327E-02	6.099905E-02
54	3.572842E-04	6.295292E-04	1.060970E-03	1.671373E-03	2.871627E-03	6.056888E-03	1.016785E-02	1.091766E-02	1.906937E-02	3.777245E-02
55	1.965648E-05	4.695139E-05	7.258647E-05	1.839329E-04	4.121104E-04	7.941692E-04	1.894409E-03	9.221947E-03	1.517893E-02	3.026629E-02
56	1.163213E-03	1.904970E-03	2.873947E-03	4.009838E-03	5.608864E-03	4.316311E-03	3.852582E-03	3.545727E-03	5.743122E-03	5.499026E-03
57	7.339338E-04	1.243520E-03	2.130807E-03	3.424411E-03	5.850130E-03	1.229308E-02	2.063855E-02	3.060026E-02	3.866317E-02	5.821920E-02
58	3.433144E-04	5.576560E-04	9.040325E-04	1.432584E-03	2.184018E-03	2.856547E-03	5.413656E-03	1.124987E-02	2.325755E-02	3.592526E-02
59	3.274262E-04	5.517762E-04	9.236440E-04	1.541974E-03	2.518712E-03	4.250259E-03	6.457861E-03	9.141408E-03	1.286736E-02	1.982008E-02
60	3.390488E-04	5.484740E-04	8.641282E-04	1.345617E-03	2.255825E-03	3.673385E-03	5.950048E-03	9.864488E-03	1.609572E-02	2.460185E-02
61	9.378237E-05	1.435479E-04	2.417659E-04	4.003779E-04	6.335674E-04	1.031632E-03	1.728428E-03	2.647405E-03	4.292414E-03	7.995925E-03
62	1.721766E-04	2.877508E-04	4.727018E-04	7.923021E-04	1.199854E-03	1.818917E-03	2.991176E-03	4.661215E-03	7.145088E-03	1.149262E-02
63	1.021460E-04	1.705920E-04	2.801667E-04	4.567250E-04	7.716260E-04	1.268409E-03	2.099222E-03	3.400554E-03	5.406381E-03	8.871311E-03
64	1.901308E-04	3.140425E-04	5.159330E-04	8.423614E-04	1.372818E-03	2.094959E-03	3.479260E-03	5.302470E-03	8.221741E-03	1.271372E-02
65	1.425897E-04	2.383370E-04	3.914515E-04	6.395877E-04	1.041740E-03	1.688042E-03	2.809575E-03	4.581233E-03	7.319449E-03	1.208234E-02
66	1.269541E-04	2.120322E-04	3.482520E-04	5.690128E-04	9.657769E-04	1.590730E-03	2.644934E-03	4.306974E-03	6.881667E-03	1.136167E-02
67	1.254461E-04	2.096886E-04	3.444232E-04	5.627998E-04	9.553264E-04	1.573720E-03	2.617087E-03	4.262542E-03	6.812523E-03	1.125146E-02
68	1.205426E-04	2.015059E-04	3.310118E-04	5.409456E-04	9.183643E-04	1.513120E-03	2.516932E-03	4.100727E-03	6.556578E-03	1.083449E-02
69	9.940855E-05	1.661958E-04	2.730481E-04	4.463034E-04	7.578743E-04	1.249089E-03	2.078596E-03	3.388364E-03	5.421269E-03	8.966338E-03
70	7.093478E-05	1.186121E-04	1.949137E-04	3.186794E-04	5.413502E-04	8.926449E-04	1.486347E-03	2.424828E-03	3.883515E-03	6.431315E-03

Table 2 (cont.)

	51	52	53	54	55	56	57	58	59	60
40	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
43	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
51	2.934327E-02	0.	0.	0.	0.	0.	0.	0.	0.	0.
52	9.697944E-02	2.290901E-02	0.	0.	0.	0.	0.	0.	0.	0.
53	2.813313E-02	8.568818E-02	4.133606E-02	0.	0.	0.	0.	0.	0.	0.
54	8.889439E-02	5.698552E-02	9.051066E-02	9.358699E-02	0.	0.	0.	0.	0.	0.
55	4.166684E-02	5.489497E-02	1.204753E-01	1.674338E-01	1.004219E-01	0.	0.	0.	0.	0.
56	2.167688E-02	3.180829E-02	6.899010E-02	1.754558E-01	1.917977E-01	1.133740E-01	0.	0.	0.	0.
57	5.135443E-02	2.459045E-02	2.305901E-02	8.721146E-02	1.550309E-01	2.351525E-01	1.630207E-01	0.	0.	0.
58	7.439114E-02	8.834054E-02	1.437341E-01	1.757419E-01	6.419509E-02	1.193793E-01	3.490622E-01	1.841969E-01	0.	0.
59	3.599535E-02	4.114279E-02	7.805834E-02	1.624629E-01	2.360453E-01	2.526065E-01	1.621678E-01	3.430732E-01	2.497514E-01	0.
60	3.429040E-02	2.500380E-02	3.733590E-02	8.452300E-02	1.203491E-01	1.955310E-01	4.005619E-01	3.140453E-01	3.770442E-01	2.653801E-01
61	1.663777E-02	2.500111E-02	4.614752E-02	9.950633E-02	1.061988E-01	1.310471E-01	2.529760E-01	3.044003E-01	4.534933E-01	5.263335E-01
62	1.866185E-02	1.851210E-02	3.110013E-02	5.932128E-02	6.373001E-02	8.303418E-02	1.343206E-01	2.458651E-01	3.574359E-01	4.893870E-01
63	1.419534E-02	1.482455E-02	2.592719E-02	5.148413E-02	5.943946E-02	8.128918E-02	1.371346E-01	1.621186E-01	2.200732E-01	3.569035E-01
64	1.966640E-02	2.011120E-02	3.405806E-02	6.618685E-02	7.556293E-02	1.000771E-01	1.634534E-01	1.837701E-01	2.337262E-01	2.927843E-01
65	1.937078E-02	2.005278E-02	3.530876E-02	6.987193E-02	8.157173E-02	1.093603E-01	1.823458E-01	2.190632E-01	2.885176E-01	3.586218E-01
66	1.838811E-02	1.936190E-02	3.408645E-02	6.854966E-02	8.072432E-02	1.091801E-01	1.810217E-01	2.144659E-01	2.848441E-01	3.634755E-01
67	1.821801E-02	1.919190E-02	3.380608E-02	6.804626E-02	8.021793E-02	1.088409E-01	1.815516E-01	2.169902E-01	2.903763E-01	3.714379E-01
68	1.755507E-02	1.850711E-02	3.262805E-02	6.576954E-02	7.767158E-02	1.055957E-01	1.766257E-01	2.118528E-01	2.847491E-01	3.663786E-01
69	1.454492E-02	1.535243E-02	2.710625E-02	5.478761E-02	6.486928E-02	8.848209E-02	1.486805E-01	1.793863E-01	2.428758E-01	3.155597E-01
70	1.045024E-02	1.104986E-02	1.955048E-02	3.963378E-02	4.713719E-02	6.458679E-02	1.091981E-01	1.327682E-01	1.814294E-01	2.385523E-01

Table 2 (cont.)

	61	62	63	64	65	66	67	68	69	70
40	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
43	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
46	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
47	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
48	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
51	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
52	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
53	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
54	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
55	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
56	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
57	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
58	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
59	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
61	3.678754E-01	0.	0.	0.	0.	0.	0.	0.	0.	0.
62	8.620995E-01	3.224582E-01	0.	0.	0.	0.	0.	0.	0.	0.
63	7.217143E-01	7.156863E-01	4.034432E-01	0.	0.	0.	0.	0.	0.	0.
64	4.784192E-01	5.014057E-01	8.305765E-01	2.993810E-01	0.	0.	0.	0.	0.	0.
65	5.442992E-01	4.175700E-01	5.616695E-01	5.700308E-01	1.381521E-01	0.	0.	0.	0.	0.
66	5.722763E-01	4.520610E-01	5.154255E-01	3.973984E-01	3.334473E-01	1.268104E-01	0.	0.	0.	0.
67	5.833107E-01	4.625409E-01	5.266800E-01	3.584122E-01	1.939974E-01	2.316025E-01	5.968505E-02	0.	0.	0.
68	5.807629E-01	4.677597E-01	5.412188E-01	3.632501E-01	1.830465E-01	1.234506E-01	8.967617E-02	2.417574E-02	0.	0.
69	5.080784E-01	4.178383E-01	4.971589E-01	3.476908E-01	1.819267E-01	1.192149E-01	4.670694E-02	2.182509E-02	2.809404E-03	0.
70	3.911609E-01	3.291977E-01	4.033436E-01	2.935745E-01	1.604574E-01	1.107837E-01	4.619862E-02	1.506990E-02	4.008037E-03	4.900322E-04

(n,2n) scattering matrix

	11	12	13	14	15	16	17	18	19	20
68	0.	0.	0.	0.	0.	0.	0.	4.777713E-11	1.064690E-10	2.359967E-10
69	1.253219E-09	5.242742E-10	8.556575E-10	1.452080E-09	2.435846E-09	4.019284E-09	6.635068E-09	1.147879E-08	1.913853E-08	3.244671E-08
70	3.582668E-10	1.014543E-10	0.	0.	0.	0.	3.113141E-11	3.564975E-10	7.870907E-10	1.650933E-09

	21	22	23	24	25	26	27	28	29	30
68	3.907437E-10	6.376897E-10	1.082147E-09	2.075127E-09	3.423900E-09	5.627073E-09	9.623702E-09	1.600883E-08	2.696146E-08	4.463446E-08
69	5.384741E-08	4.159199E-08	4.357396E-09	7.309198E-09	1.206001E-08	1.982035E-08	3.389798E-08	5.638909E-08	9.496936E-08	1.572232E-07
70	2.733581E-09	4.461176E-09	7.815524E-09	1.310991E-08	2.163104E-08	3.555023E-08	6.080046E-08	1.011417E-07	1.703421E-07	2.820066E-07

	31	32	33	34	35	36	37	38	39	40
68	7.282961E-08	1.235560E-07	2.071796E-07	3.416803E-07	5.612054E-07	9.590532E-07	1.593748E-06	2.650603E-06	4.430206E-06	7.213166E-06
69	2.565442E-07	4.352394E-07	7.298352E-07	1.203690E-06	1.977145E-06	3.378597E-06	5.615671E-06	9.446317E-06	1.561406E-05	2.542707E-05
70	4.601612E-07	7.806974E-07	1.309146E-06	2.159183E-06	3.546725E-06	6.061717E-06	1.007474E-05	1.694832E-05	2.801694E-05	4.563031E-05

	41	42	43	44	45	46	47	48	49	50
69	1.220306E-05	2.038780E-05	3.346651E-05	5.464084E-05	9.265150E-05	1.524144E-04	2.520093E-04	4.111316E-04	6.293931E-04	8.184572E-04
69	4.302702E-05	7.190775E-05	1.180828E-04	1.928908E-04	3.272888E-04	5.388586E-04	8.954981E-04	1.457225E-03	2.326322E-03	3.836425E-03
70	7.722644E-05	1.290888E-04	2.120377E-04	3.464843E-04	5.881571E-04	9.689137E-04	1.583833E-03	2.564826E-03	4.098532E-03	6.767730E-03

	51	52	53	54	55	56	57	58	59	60
69	1.297863E-03	1.338759E-03	1.767042E-03	3.409908E-03	3.837418E-03	3.652708E-03	5.769696E-03	4.823825E-03	4.301095E-03	3.267837E-03
69	6.199779E-03	6.517855E-03	1.071702E-02	2.131233E-02	2.446561E-02	3.166507E-02	5.131606E-02	5.902958E-02	7.427559E-02	8.873970E-02
70	1.094844E-02	1.145446E-02	2.006028E-02	3.987197E-02	4.618594E-02	6.184749E-02	1.013855E-01	1.190819E-01	1.548096E-01	1.945473E-01

	61	62	63	64	65	66	67	68	69	70
68	1.351225E-03	0.	0.	0.	0.	0.	0.	0.	0.	0.
69	1.236455E-01	7.945207E-02	5.641514E-02	1.197454E-02	3.129004E-04	0.	0.	0.	0.	0.
70	2.874472E-01	2.148449E-01	2.260838E-01	1.360756E-01	5.193644E-02	1.884535E-02	1.495092E-03	0.	0.	0.

Table 3 Lumped cross-sections (^{239}Pu - 1000 MW(e) reactor)

Time (days)	No. of FPs	σ_c	$\sigma_{e\ell}$	σ_{in}
1	28	0,66436	15,16950	0,66488
	71	0,40908	---	---
	193	0,385	16,11	0,506
30	28	0,91068	14,78459	0,71750
	71	0,53686	---	---
	193	0,531	15,91	0,541
360	28	0,95752	14,89431	0,71788
	71	0,58023	---	---
	193	0,567	15,90	0,554
720	28	0,96573	14,96221	0,71749
	71	0,58102	---	---
	193	0,575	15,92	0,554

(in barns)

Table 4 Lumped capture cross-sections (71 FPs - 1000 MW(e) reactor)

Time (days)	Pu-239	Pu-241	U-238	U-235	Mixture
1	0,40908	0,36919	0,38704	0,32966	0,40867
30	0,53686	0,57434	0,50809	0,41130	0,53325
90	0,55825	0,59478	0,52881	0,42716	0,55411
180	0,56964	0,60470	0,53926	0,43598	0,56505
360	0,58023	0,61096	0,54506	0,44056	0,57120
720	0,58102	0,61594	0,54324	0,44475	0,57641

(in barns)

Table 5 Cross-sections calculated from two different libraries

Library	σ_t	$\sigma_{e\ell}$	σ_{in}
ENDF/B-V	17,0806	15,4222	0,6987
JENDL-1	16,6964	15,0147	0,6731

(in barns)

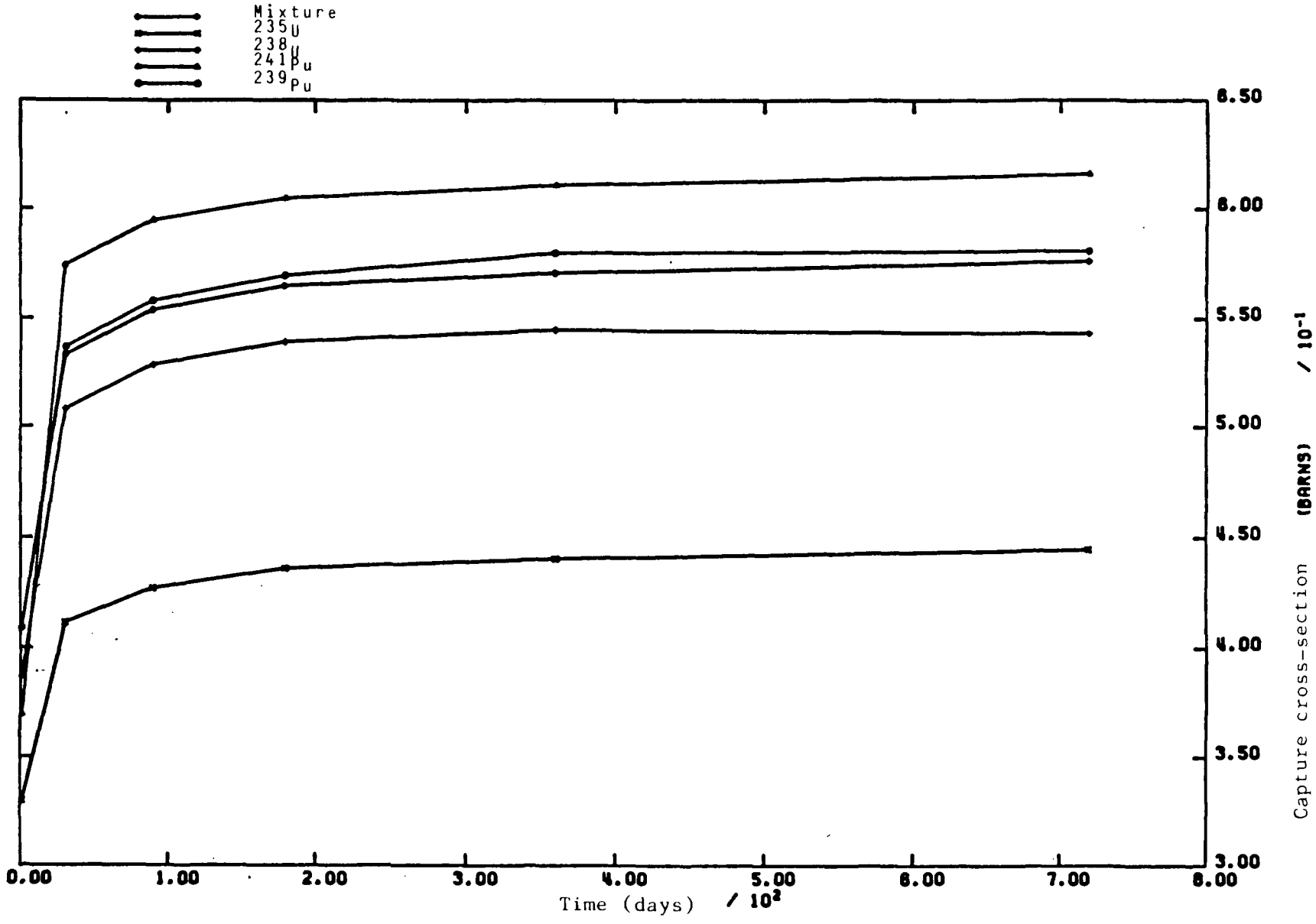


Fig. 1 Capture cross-sections of the lumped FPs