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A Code for Calculating Fine Neutron Spectrum and Multi-Group Cross Sections in Plate Lattice

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ESELEM 4：平板格子系における詳細中性子スペクトル及び多群断面積計算コード

日本原子力研究所　東海研究所

中川正幸・桂木　学・成田秀雄*

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要　旨

高速炉の設計研究や高速臨界集合体における実験の解析においては，多群モデルが用いられている．それ故多群断面積の精度は，その解析精度に重要な影響を及ぼす．ESELEM 4 は，JAERI Fast セットと同じ核データを用いて，精度良い多群定数を作るために開発した計算コードで，積分型輸送方程式を衝突確率法によって解き，平板格子系における詳細中性子スペクトルを求める．その群幅はレサジーで 0.008 である．多群実効断面積は，ポイントデータから詳細中性子束を重みとして計算される．

コード作成に当っては，計算時間の短縮とコアメモリーを減らすために，種々の工夫が行われている．すなわち，減速中性子源の計算では，弾性及び非弾性散乱に対し回帰法を用いている．また，2 MeV 以上では粗群幅を用いており，重い核種の共鳴領域の断面積も粗群で表示している．この断面積は，JAERI Fast セットと同一のものを使う．ライブラリーデータは，ENDF/A 型の核データファイルから PRESM コードによって作成する．各種断面積データは，計算機コアー容量とデータプロセス時間を短縮するため，稠密に主記憶内に貯えられる．プログラムは，融通性を持たせるために可変長変数を用いている．なお，ESELEM 4 と PRESM コードの使用方法も記載した．

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* Century Research Center, Tokyo

ESELEM 4

A Code for Calculating Fine Neutron Spectrum and Multi-Group Cross Sections in Plate Lattice

Masayuki NAKAGAWA, Satoru KATSURAGI
and Hideo NARITA*

Tokai Research Establishment
Japan Atomic Energy Research Institute
Tokai-mura, Naka-gun, Ibaraki-ken

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Abstract

The multi-group treatment has been used in the design study of fast reactors and analysis of experiments at fast critical assemblies. The accuracy of the multi-group cross sections therefore affects strongly the results of these analyses. The ESELEM 4 code has been developed to produce multi-group cross sections with an advanced method from the nuclear data libraries used in the JAERI Fast set. ESELEM 4 solves integral transport equation by the collision probability method in plate lattice geometry to obtain the fine neutron spectrum. A typical fine group mesh width is 0. 008 in lethargy unit. The multi-group cross sections are calculated by weighting the point data with the fine structure neutron flux.

Some devices are applied to reduce computation time and computer core storage required for the calculation. The slowing down sources are calculated with the use of a recurrence formula derived for elastic and inelastic scattering. The broad group treatment is adopted above 2 MeV for dealing with both light any heavy elements. Also the resonance cross sections of heavy elements are represented in a broad group structure, for which we use the values of the JAERI Fast set. The library data are prepared by the PRESM code from ENDF/A type nuclear data files. The cross section data can be compactly stored in the fast computer core memory for saving the core storage and data processing time. The programme uses the variable dimensions to increase its flexibility. The users' guide for ESELEM 4 and PRESM is also presented in this report.

* Century Research Center, Tokyo

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1. Introduction

The multi-group treatment has usually been used for transport or diffusion calculation in the design study of fast reactors and in the analysis of experiments at fast critical assemblies. The accuracy of these multi-group calculations strongly depends on the generating method of the multi-group cross sections. One typical type of the multigroup cross sections is the tabulated constant set such as the YOM[1] and ABBN[2] sets. The JAERI Fast set[3] has been produced as this type of cross section set based on a more advanced concept. When the JAERI Fast set is produced, the fission plus $1/E$ spectrum is used as the weighting function for infinitely dilute media to average microscopic pointwise cross sections for light elements, and an exact ultra fine spectrum is used in the resonance energy region for heavy elements. The composition dependency of the group cross sections is taken into consideration by using a $1/(\sigma_t+\sigma_0)$ spectrum as the weighting function. The effective cross sections are then obtained from the tabulated infinitely dilute cross sections and the resonance shielding factors given as a function of temperature and admixture cross section σ_0. In this type of cross sections, the weighting spectrum used is not the true spectrum in a real reactor and hence the elastic scattering resonances are not adequately treated for light and medium weight elements. That is, the influence from the resonances of another elements can not be taken into consideration because of the assumption of the constant background cross section. Another defect comes from the fact that the self-shielding factors for elastic removal cross sections are assumed to have the same values as for elastic scattering cross sections of light and intermediate nuclei. This is known to cause a significant inaccuracy in the calculation of elastic removal cross sections in the vicinity of the large resonance regions. The EXPANDA-75[4] code, which uses the JAERI Fast set library, is devised to treat analytically the resonance region near 2.85 keV of sodium to overcome this defect. However, the applicable range of this treatment is limited to that resonance.

The heterogeneity effect is significant in the analysis of experiments in fast critical assemblies. Among the codes utilizing the JAERI Fast set, the SLAROM[5] and EXPANDA-75 codes solve the integral transport equation for heterogeneous cell to obtain the cell averaged cross sections and perform diffusion calculations. However, since these codes essentially start from a broad group cross section set, the defects mentioned above can not be overcome. Consequently, a computer code is required to obtain a fine spectrum with composition dependency in heterogeneous systems and to generate accurate multi-group cross sections. In order to overcome such defects, the ESELEM[6] code series has been developed and used to study a suitable production method of group constant set. The ESELEM 4 code is the latest version developed for obtaining the effective cross sections weighted by the composition dependent fine spectrum with heterogeneity effects. This code has a close relation with the JAERI Fast set concerning with the cross section data and hence supports the code system utilizing the JAERI Fast set.

Several codes have already heen developed to calculate fine group neutron spectrum and to produce multi-group cross sections. ELMOE[7] is a representative code at the first stage to study the fine spectrum effect due to the scattering resonances of light elements. MC^2 [8] has a more general capability to produce the multi-group cross sections. In the revised version, MC^2-2[9], advanced methods are incorporated for the calculation of unresolved resonance cross sections, heterogeneity effects and continuous slowing down process. These codes calculate the fundamental mode flux but do not treat explicitly the heterogeneity effects for multi-region cell. On the other hand, the MURALB[10] code solves multi-group transport equations for heterogeneous systems with 1/128 lethargy width. This code treats the resonance heterogeneity effect by the histogram method. However, MURALB is not available for us at present. The similar fine group spectrum code is incorpolated in the DOYC code system[11] which is used to obtain the AGLI data library by adjustig cross sections so as to predict integral experiment data. The DOYC method for solving slowing down equations is based on that in the ESELEM 2[6] code and the resonance heterogeneity is treated on the basis of MURALB method.

In the present paper the authors describe the main functions and user's guide for the ESELEM 4. This code computes the fine spectrum in the heterogeneous plate cell (including a homogeneous system) by solving the integral transport equation with the use of the collision probability method and generates the multi-group cross sections for an arbitrary group structure. The treatment of resonance heterogeneity effect in ESELEM 4 is different from the histogram method used in MURALB and DOYC. In our programme the heterogeneity effect is taken into account by using modified admixture cross sections with the Dancoff factors calculated for multi-region cells.

The reduction of computation time and core storage is an important problem for these fine group calculation programmes. In the ESELEM 4 code the following devices are adopted for it. The very efficient recurrence formula is used in the calculation of elastic and inelastic slowing down source for saving computation time and data storage. Moreover, the broad group treatment is adopted above 2 MeV since the calculation of inelastic slowing down source is very time consuming. As the cross section is comparatively smooth in this energy region, this treatment does not lead to serious errors. The broad group representation is used also for the resonance region, where the cross sections of the JAERI Fast set are adopted for heavy elements. These take into account self-overlapping and interference effects between resonances. For saving the computer core area the cross sections are compactly stored in the fast core memory. Therefore the data processing time becomes short and the flexibility is provided for the maximum numbers of cell regions and spacial meshes used for solving problems.

The nuclear cross section library is prepared by the PRESM code from the general nuclear data file with ENDF/A type format. The same source nuclear data as for the JAERI Fast set is used at present.

This paper consists of six sections and two appendices. In Section **2**, P_0 and P_1 equations are derived from general integral transport equation and the algorithm is explained to solve them by the collision probability method. In Section **3** the recurrence relations are derived respectively for the elastic and inelastic slowing down. Section **4** includes the explanation of the nuclear data treatment and inter- or extra-polation method of pointwise data. Section **5** is devoted to the detailed information of the programe and calculation flow of the ESELEM 4 code. The input and output informations and data formats are described in Section **6**. In Appendix A the library preparation code PRESM is explained from the viewpoint of usage. The sample problems and results are shown in Appendix B.

2. Solution of Integral Transport Equation

2. 1 Basic Equation

The integral form of the Boltzman transport equation is written for the steady state in the following form[12)]

$$\phi(\boldsymbol{r}, E, \boldsymbol{\Omega})=\int_0^{S_0} ds \exp\left[-\int_0^{S} \Sigma(E, \boldsymbol{r}-s'\boldsymbol{\Omega})ds'\right] q(\boldsymbol{r}-s\boldsymbol{\Omega}, E, \boldsymbol{\Omega}), \tag{2. 1}$$

where

$$q(\boldsymbol{r}, E, \boldsymbol{\Omega})=\int d\boldsymbol{\Omega}'\int dE' \Sigma(E'\to E, \boldsymbol{\Omega}'\to\boldsymbol{\Omega}, \boldsymbol{r})\phi(\boldsymbol{r}, E', \boldsymbol{\Omega}')+S(\boldsymbol{r}, E, \boldsymbol{\Omega}).$$

By using the expression

$$\boldsymbol{r}'=\boldsymbol{r}-R\boldsymbol{\Omega}_{\mathrm{R}},\ \boldsymbol{\Omega}_{\mathrm{R}}=\frac{\boldsymbol{r}-\boldsymbol{r}'}{|\boldsymbol{r}-\boldsymbol{r}'|},\ R=|\boldsymbol{r}-\boldsymbol{r}'|,$$

we can rewrite Eq. (2. 1) as

$$\phi(\boldsymbol{r}, E, \boldsymbol{\Omega})=\int_V \frac{d\boldsymbol{r}'}{|\boldsymbol{r}-\boldsymbol{r}'|^2}\delta\left(\boldsymbol{\Omega}, \frac{\boldsymbol{r}-\boldsymbol{r}'}{|\boldsymbol{r}-\boldsymbol{r}'|}\right)$$
$$\cdot\exp\left[-\int_0^{|r-r'|}\Sigma\left(E, \boldsymbol{r}-R'\frac{\boldsymbol{r}-\boldsymbol{r}'}{|\boldsymbol{r}-\boldsymbol{r}'|}\right)dR'\right]\cdot q\left(\boldsymbol{r}', E, \frac{\boldsymbol{r}-\boldsymbol{r}'}{|\boldsymbol{r}-\boldsymbol{r}'|}\right) \tag{2. 2}$$

where

$$\delta\left(\boldsymbol{\Omega}, \frac{\boldsymbol{r}-\boldsymbol{r}'}{|\boldsymbol{r}-\boldsymbol{r}'|}\right)=\delta(\boldsymbol{\Omega}, \boldsymbol{\Omega}_{\mathrm{R}})=\begin{cases}1 & \text{for } \boldsymbol{\Omega}\cdot\boldsymbol{\Omega}_{\mathrm{R}}=1,\\ 0 & \text{otherwise,}\end{cases}$$

and V is the volume of the system.

When we define the optical path length $\lambda(\boldsymbol{r}, \boldsymbol{r}', E)$ as

$$\lambda(\boldsymbol{r}, \boldsymbol{r}', E)=\int_0^{|r-r'|}\Sigma\left(E, \boldsymbol{r}-R'\frac{(\boldsymbol{r}-\boldsymbol{r}')}{|\boldsymbol{r}-\boldsymbol{r}'|}\right)dR', \tag{2. 3}$$

Eq. (2. 2) is reduced to the form

$$\phi(\boldsymbol{r}, E, \boldsymbol{\Omega})=\int_V \frac{d\boldsymbol{r}'}{|\boldsymbol{r}-\boldsymbol{r}'|^2}\delta\left(\boldsymbol{\Omega}, \frac{(\boldsymbol{r}-\boldsymbol{r}')}{|\boldsymbol{r}-\boldsymbol{r}'|}\right)\exp\left[-\lambda(\boldsymbol{r}, \boldsymbol{r}', E)\right]$$
$$\cdot q\left(\boldsymbol{r}, E, \frac{\boldsymbol{r}-\boldsymbol{r}'}{|\boldsymbol{r}-\boldsymbol{r}'|}\right). \tag{2. 4}$$

Equation (2. 4) can be represented in a spherical harmonics series by expanding $\phi(\boldsymbol{r}, E, \boldsymbol{\Omega})$ as

$$\phi(\boldsymbol{r}, E, \boldsymbol{\Omega})=\sum_{l=0}^{\infty}\sum_{m=-l}^{l}\left(\frac{2l+1}{4\pi}\right)^{1/2}\phi_{lm}(\boldsymbol{r}, E)Y_{lm}(\boldsymbol{\Omega}).$$

Similarly, $\Sigma(E'\to E, \boldsymbol{\Omega}'\to\boldsymbol{\Omega}, \boldsymbol{r})$, $S(\boldsymbol{r}, E, \boldsymbol{\Omega})$, $\delta(\boldsymbol{\Omega}, \boldsymbol{\Omega}_{\mathrm{R}})$ and $q(\boldsymbol{r}, E, \boldsymbol{\Omega})$ can be also written in the spherical harmonics[13)]. Then Eq. (2. 4) can be rewritten as follows[12)] :

$$\sum_{l,m}\left(\frac{2l+1}{4\pi}\right)\phi_{lm}(\boldsymbol{r}, E)Y_{lm}(\boldsymbol{\Omega})=\int_V\frac{d\boldsymbol{r}'}{|\boldsymbol{r}-\boldsymbol{r}'|^2}\exp\left[-\lambda(\boldsymbol{r}, \boldsymbol{r}', E)\right]\sum_{l,m}Y_{lm}(\boldsymbol{\Omega})Y_{lm}^*(\boldsymbol{\Omega}_{\mathrm{R}})$$
$$\cdot\sum_{l',m'}\left(\frac{2l+1}{4\pi}\right)^{1/2}\left[\int dE'\sum_{l'}(E'\to E, \boldsymbol{r}')\phi_{l'm'}(\boldsymbol{r}', E')+S_{l'm'}(\boldsymbol{r}', E)\right]Y_{l'm'}(\boldsymbol{\Omega}_{\mathrm{R}}). \tag{2. 5}$$

Now, multiplying Eq. (2. 5) by $Y_{lm}^*(\boldsymbol{\Omega})$ and integrating over $\boldsymbol{\Omega}$, we obtain the following equation from the orthogonal relation,

$$\left(\frac{2l+1}{4\pi}\right)^{1/2}\phi_{lm}(\boldsymbol{r}, E)=\int_V\frac{d\boldsymbol{r}'}{|\boldsymbol{r}-\boldsymbol{r}'|^2}\exp\left[-\lambda(\boldsymbol{r}, \boldsymbol{r}', E)\right]Y_{lm}^*(\boldsymbol{\Omega}_{\mathrm{R}})\sum_{l'm'}\left(\frac{2l+1}{4\pi}\right)^{1/2}$$

$$\cdot\left[\int dE'\Sigma_{l'}(E'\to E,\ \boldsymbol{r}')\phi_{l'm'}(\boldsymbol{r}',\ E')+S_{l'm'}(\boldsymbol{r}',\ E)\right]Y_{l'm'}(\boldsymbol{\Omega}_R). \tag{2.6}$$

The above equation set is the coupled integral transport equations for the angular flux $\phi_{lm}(\boldsymbol{r},\ E)$.

The source term is composed of fixed and fission sources. The scattering term is composed of elastic and inelastic scattering. If we assume that the fission and fixed sources are isotropic as well as inelastic scattering, then

$$S_{l'm'}(\boldsymbol{r},\ E)=0,$$

$$\Sigma_{l'}{}^{in}(E'\to E,\ \boldsymbol{r})=0, \quad \text{for} \quad l'>0.$$

If the scattering is linearly anisotropic, Eq. (2.6) is self-contained concering with ϕ_{00}, ϕ_{10}, ϕ_{11} and ϕ_{1-1}.

Moreover, if the scattering is assumed to be isotropic, Eq. (2.6) becomes self-contained only with ϕ_{00}:

$$\phi_{00}(\boldsymbol{r},\ E)=\int_V\frac{d\boldsymbol{r}'}{|\boldsymbol{r}-\boldsymbol{r}'|}\exp\left[-\lambda(\boldsymbol{r},\ \boldsymbol{r}',\ E')\right]$$

$$\cdot\left\{\int dE'[\Sigma_0{}^e(E'\to E,\ \boldsymbol{r}')+\Sigma_0{}^{in}(E'\to E,\ \boldsymbol{r}')]\phi_{00}(\boldsymbol{r}',\ E')+S_{00}(\boldsymbol{r}',\ E)\right\}. \tag{2.7}$$

The physical meaning of ϕ_{00} is the total flux, that is,

$$\phi_{00}(\boldsymbol{r},\ E)=\int d\boldsymbol{\Omega}\phi(\boldsymbol{r},\ E,\ \boldsymbol{\Omega}), \tag{2.8}$$

and the current $\boldsymbol{J}$ is defined by

$$\boldsymbol{J}(\boldsymbol{r},\ E)=\int d\boldsymbol{\Omega}\cdot\boldsymbol{\Omega}\phi(\boldsymbol{r},\ E,\ \boldsymbol{\Omega}),$$

$$J_x=\frac{1}{\sqrt{2}}(\phi_{1-1}-\phi_{11}),\ J_y=-\frac{i}{\sqrt{2}}(\phi_{1-1}+\phi_{11}),\ J_z=\phi_{10}.$$

We rewrite Eq. (2.7) in the usual form

$$\Sigma(\boldsymbol{r},\ E)\phi(\boldsymbol{r},\ E)=\int_V d\boldsymbol{r}'P(\boldsymbol{r},\ \boldsymbol{r}',\ E)\left[\int dE'\Sigma(E'\to E,\ \boldsymbol{r}')\phi(\boldsymbol{r}',\ E')+S(\boldsymbol{r}'\ E)\right], \tag{2.9}$$

where the suffix of ϕ_{00}, S_{00} and Σ_0 are dropped and $P(\boldsymbol{r},\boldsymbol{r}',E)$ stands for the first flight collision probability:

$$P(\boldsymbol{r},\boldsymbol{r}',E)=\frac{\Sigma(E,\ \boldsymbol{r}')}{4\pi|\boldsymbol{r}-\boldsymbol{r}'|^2}\exp\left[-\lambda(\boldsymbol{r},\ \boldsymbol{r}',\ E)\right].$$

2. 2 Collision Probability Method

(1) Derivation of matrix equation

The integral transport equation is obtained from Eq. (2.9) in one dimensional slab geometry by integrating over y and z coordinates as follows.*

$$\Sigma(x,\ E)\phi(x,\ E)=\int_V dx'\frac{1}{2}\Sigma(x,\ E)E_1[\lambda(x,\ x',\ E)][Q(x',\ E)+S(x',\ E)], \tag{2.10}$$

$$^*\int_v d\boldsymbol{r}'P(\boldsymbol{r},\ \boldsymbol{r}',\ E)=\int_V\frac{\Sigma(x,\ E)}{4\pi}\frac{\exp\left[-\int_0^s\Sigma(s)ds\right]}{|\boldsymbol{r}-\boldsymbol{r}'|^2}d\boldsymbol{r}'$$

$$=\frac{\Sigma(x,\ E)}{4\pi}\int_V dx'\int_0^{2\pi}2\pi RdR\frac{\exp(-\widetilde{\Sigma R})}{R^2}$$

$$=\frac{\Sigma(x,\ E)}{2}\int_V dx'\int_x^{\infty}\frac{\exp(-\widetilde{\Sigma R})}{R}dR,$$

where $\widetilde{\Sigma R}$ denotes the optical path length and we have changed the integral variables by making use of the relation $R^2=r^2+x^2$.

where $E_1[\lambda(x, x', E)]$ is the exponential integral defined by

$$E_n(x)=\int_1^{\infty}\frac{e^{-xu}}{u^n}du,$$

and

$$Q(x', E)=\int_0^{\infty}dE'[(\Sigma_e(E'\to E, x')+\Sigma_{in}(E'\to E, x')]\phi(x', E'),$$

$$S(x', E)=\int_0^{\infty}dE'\chi(E)\nu\Sigma_f(x', E')\phi(x', E')+s(x', E),$$

in which Σ_e, Σ_{in} and $\nu\Sigma_f$ are macroscopic elastic scattering, inelastic scattering and ν times fission cross sections.

When the region V consists of M unit cells and each cell has N regions, the balance equation in the l region of the j cell is written by using the neutron flux $\phi_l^{(j)}$,

$$\Sigma_l^{(j)}\phi_l^{(j)}(x, E)=\sum_{i=1}^{M}\sum_{k=1}^{N}\int_{V_k^{(i)}}dx'\frac{1}{2}\Sigma_l^{(j)}(E)E_1[\lambda(x, x', E)] \cdot[Q_k^{(i)}(x', E)+S_k^{(i)}(x', E)], \tag{2.11}$$

where the suffices of cross section show the cell and region numbers and $V_k^{(i)}$ is the volume of the region k in the cell i. The average neutron flux and source in the region l of the cell j are given by the equations

$$\bar{\phi}_l^{(j)}(E)=\frac{1}{V_l^{(j)}}\int_{V_l^{(j)}}dx\phi_l^{(j)}(x, E),$$

and

$$\bar{S}_l^{(j)}(E)=\frac{1}{V_l^{(j)}}\int_{V_l^{(j)}}dxS_l^{(j)}(x, E).$$

By integrating both the sides of Eq. (2.11) over the region l in the cell j and performing the integration over the volume $V_k^{(i)}$ on the right hand side, we obtain

$$\Sigma_l^{(j)}V_l^{(j)}\bar{\phi}_l^{(j)}(E)=\sum_{i=1}^{M}\sum_{k=1}^{N}V_k^{(i)}P_{ij}^{k\to l}[\bar{Q}_k^{(i)}(E)+\bar{S}_k^{(i)}(E)]. \tag{2.12}$$

The first flight collision probability is defined by using the collision density as the weighting function, that is,

$$P_{ij}^{k\to l}=\frac{\Sigma_l^{(j)}(E)\int dx'\int dx\frac{1}{2}E_1[\lambda(x, x', E)]\Sigma_k^{(i)}\phi_k^{(i)}(x', E)}{\int dx'\Sigma_k^{(i)}\phi_k^{(i)}(x', E)}.$$

If we assume that the cross sections are constant and the neutron flux and source are flat over each region, we have

$$P_{ij}^{k\to l}=\frac{\Sigma_l^{(j)}(E)}{2V_k^{(i)}}\int_{V_k^{(i)}}dx'\int_{V_l^{(j)}}dxE_1[\lambda(x, x', E)]. \tag{2.13}$$

Thus, suppressing variable E, Eq. (2.12) becomes

$$\Sigma_l^{(j)}V_l^{(j)}\bar{\phi}_l^{(j)}=\sum_{i=1}^{M}\sum_{k=1}^{N}V_k^{(i)}P_{ij}^{k\to l}[\bar{Q}_k^{(i)}+\bar{S}_k^{(i)}]. \tag{2.14}$$

If the unit cell is infinitely repeated, the neutron flux of the region l in each cell is all the same. Hence, dropping the suffix of cell, Eq. (2.14) is rewritten as

$$\Sigma_lV_l\bar{\phi}_l=\sum_{i=1}^{\infty}\sum_{k=1}^{N}V_kP_i^{k\to l}[\bar{Q}_k+\bar{S}_k].$$

As we can drop the suffix i for the infinitely repeated cells, this equation is further reduced to

$$\Sigma_lV_l\bar{\phi}_l=\sum_{k=1}^{N}V_kP^{k\to l}[\bar{Q}_k+\bar{S}_k]. \tag{2.15}$$

The neutron conservation law requires the following relation:

$$\sum_{l=1}^{N} P^{k\to l}=1. \tag{2.16}$$

In addition, the following reciprocity relation is used in the calculation of collision probability, which can be derived directly from Eq. (2.13).

$$\Sigma_k V_k P^{k\to l}=\Sigma_l V_l P^{l\to k} \tag{2.17}$$

We now write Eq. (2.15) in the matrix form for the volume integrated flux and source as follows:

$$\boldsymbol{\Sigma\phi}=\boldsymbol{P}(\boldsymbol{Q}+\boldsymbol{S}), \tag{2.18}$$

where $\boldsymbol{\Sigma\phi}$, $\boldsymbol{Q}$ and $\boldsymbol{S}$ are N dimensional vectors and $\boldsymbol{P}$ is $N\times N$ matrix, that is,

$$\begin{pmatrix} \Sigma_1\ \phi_1 \\ \Sigma_2\ \phi_2 \\ \vdots \\ \Sigma_n\ \phi_n \end{pmatrix}=\begin{pmatrix} P_{11} & P_{21} & \cdots & P_{N1} \\ P_{12} & \ddots & & \vdots \\ \vdots & & \ddots & \\ P_{1N} & \cdots & \cdots & P_{NN} \end{pmatrix}\times\left\{\begin{pmatrix} Q_1 \\ Q_2 \\ \vdots \\ Q_N \end{pmatrix}+\begin{pmatrix} S_1 \\ S_2 \\ \vdots \\ S_N \end{pmatrix}\right\}.$$

In the multi-group notation, Q_{ig} is calculated by

$$Q_{ig}=\sum_{g'=1}^{g-1} \Sigma_{ig'\to g}\phi_{i,g'}$$

where the right hand term is equal to $(\Sigma_{t,i,g}-\Sigma_{ig\to g})\phi_{i,g}$. The flux ϕ can be calculated by direct matrix inversion method if $\boldsymbol{P}$ is factorized. Since Eq. (2.18) is given at each energy point or energy group, the neutron flux can be obtained by solving these equations successively from the highest energy group to lower groups, where the slowing down source is calculated from the solution for the higher energy groups.

When the system is finite, neutron leakage from the cell should be considered. For a large system, the fundamental mode approximation may be used and the average leakage from the system is represented by $DB^2\phi$. Since on the other hand the average collision rate is given by $\Sigma_t\phi$, the non-leakage probability is given by $\Sigma_t/(\Sigma_t+DB^2)$. Therefore balance equation (2.15) is written on the basis of the conservation law as

$$\Sigma_l\phi_l=\frac{\Sigma_t}{\Sigma_t+DB^2}\sum_{k=1}^{N} P^{k\to l}[Q_k+S_k],$$

or

$$\left(\Sigma_l+DB^2\frac{\Sigma_l}{\Sigma_t}\right)\phi_l=\sum_{k=1}^{N} P^{k\to l}[Q_k+S_k], \tag{2.19}$$

where ϕ_l, ϕ_k and S_k are respectively the volume integrated values in region l or k.

(2) Calculation of collision probability in slab geometry

The collision probability from the region i to j is calculated numerically from the following equations. By integrating Eq. (2.13) over x and x' we obtain the collision probability as follows:

$$P_{ij}=\frac{1}{2\lambda_i}[E_3(\lambda_0)-E_3(\lambda_0+\lambda_i)-E_3(\lambda_0+\lambda_j)+E_3(\lambda_0+\lambda_i+\lambda_j)], \tag{2.20}$$

where λ_i and λ_j are the optical path length in the region i and j respectively, and λ_0 is the value in between the region i and j. In addition, we have used the recurrence relation for the exponential integral function

$$E_n(x)=\int_x^\infty E_{n-1}(x)dx.$$

Since Eq. (2.20) becomes numerically inaccurate when the optical path length of the region i or j is small, we use the following approximate equations,[19),22)]

a) $\lambda_j<0.005$

$$P_{ij}=\frac{\lambda_j}{2\lambda_i}[E_2(\lambda_0)-E_2(\lambda_0+\lambda_i)], \tag{2.21}$$

b) $\lambda_i<0.005$,

$$P_{ij}=\frac{1}{2}[E_2(\lambda_0)-E_2(\lambda_0+\lambda_j)], \tag{2. 21'}$$

c) $\lambda_i<0.005$ and $\lambda_j<0.005$,

$$P_{ij}=\frac{1}{2}\lambda_j E_1(\lambda_0). \tag{2. 21''}$$

(3) Boundary condition of cell calculation

Two types of boundary conditions should be given in the cell calculation. The first one determines the geometrical stucture of cells. When the symmetric boundary condition is chosen, the unit cell includes its image part and this cell is infinitely repeated. On the other hand the periodic boundary condition means that the same cell pattern is infinitely repeated on both the sides of the assigned cell.

The another boundary condition is concerned with the treatment of neutron path crossing the outer boundary. An isotropic or perfect reflective condition can be chosen in the calculation of collision probability. When the perfect reflective condition is used, neutron passes straightly until it collides in the region j even if it acrosses the cell boundary. In this case the collision probability is calculated by tracing over a number of cells. Under the isotropic condition, on the other hand, the neutron path is traced only in the unit cell, and the probability of collisions at the outside of the unit cell is obtained for the uncollided neutron. The probability P_{i0} that neutron, born in the region i, collides at first at the outside of the unit cell, is presented by

$$P_{i0}=\int_{V_i} dx'\frac{1}{2V_i}E_1[\lambda(x,\ x',\ E)]. \tag{2. 22}$$

On the othe hand we denote the probability that the isotropically incident neutron collides at first in the region i as Q_{0i}. Then collision number in the region i is given by $(S/4)Q_{0i}$, because the current into the region is $S/4$ when the uniform flux ϕ is incident isotropically on the surface S of the cell. From the reciprocity theorem we get the following relation:

$$Q_{0i}=\frac{4V_i}{S}\Sigma_i P_{i0}. \tag{2. 23}$$

Futhermore we represent the probability that the isotropically incident neutron escapes from the cell without any collision, as Q_{00} which is given by the formula

$$Q_{00}=1-\sum_{j=1}^{N} Q_{0j}.$$

Consequently the collision probability P_{ij} is written by using the collision probability $P_{ij}{}^*$ in the unit cell, as

$$P_{ij}=P_{ij}{}^*+P_{i0}\frac{Q_{0i}}{1-Q_{00}} \tag{2. 24}$$

The computation time is required much more for the perfect reflective condition. In this case, however, a sufficient accuracy will be achieved if neutron is traced over the six or seven mean free path length, because the collision probability decreases exponentially with the mean free path length.

3. Recurrence Formula for Slowing Down Equation

The slowing down source from higher energy groups comes both from the elastic and inelastic scattering at discrete and continuum levels. For the multigroup treatment the slowing down source is usually calculated with the use of scattering matrix or probability for elastic and inelastic scattering. If this method is used for the fine group calculation, large computer core memory is required for the inelastic scattering matrix in addition to a long computation time. If the recurrence formula is applied to the source calculation, the scattering matrix becomes unnecessary and hence the storage used for the scattering matrix is saved. As a result of this, the source calculation becomes very simple as explained below.

The recurrence formula is often adopted to solve an ultra-fine group problem in resonance energy region of heavy mass elements, as used in the RABBLE[14] and ERSE[15] codes. In these codes only the elastic slowing down is calculated by the recurrence formula, since these codes are developed to treat the resonance energy region. The contribution from self-group scattering is negligible for so fine group width as to treat the resonance region. In the ESELEM 4 code we use a recurrence relation also for inelastic scattering and take account approximately of the self-group scattering which should not be neglected except for the light mass nuclides, because the slowing down groups are only two or three groups for heavy mass nuclides.

3. 1 Elastic Slowing Down

The slowing down source due to nuclei with mass number A at lethargy u corresponding to energy E is described by the following equation:

$$S^{\mathrm{A}}(u)=\int_{E}^{E/\alpha_{\mathrm{A}}}\frac{\Sigma_{\mathrm{S}}{}^{\mathrm{A}}(u')}{1-\alpha_{\mathrm{A}}}\phi(u')du', \tag{3. 1}$$

where

$$\alpha_{\mathrm{A}}=\left(\frac{1-A}{1+A}\right)^{2}$$

The slowing down source in the group i is assumed to be the average of the values at the upper and lower group boundaries, that is,

$$S_i{}^{\mathrm{A}}=\frac{S_i{}^{\mathrm{A}}(u_{\mathrm{U}}{}^{i})+S_i{}^{\mathrm{A}}(u_L{}^{i})}{2}, \tag{3. 2}$$

where $u_{\mathrm{U}}{}^{i}$ and $u_L{}^{i}$ are the lethargies at the upper and lower boundaries of the group i, respectively. Then the contribution to $S_i{}^{\mathrm{A}}(u_L)$ from the higher groups is obtained from Eq. (3. 1) as

$$\begin{aligned} S_i{}^{\mathrm{A}}(u_L{}^{i}) &= \int_{E_{\mathrm{U}}{}^{i}}^{E_{\mathrm{U}}{}^{i}/\alpha_{\mathrm{A}}}\frac{\Sigma_{\mathrm{S}}{}^{\mathrm{A}}(u')\phi(u')du'}{1-\alpha_{\mathrm{A}}} \\ &= \sum_{l=1}^{L_{\mathrm{A}}-1}\int_{E_L{}^{i-l}}^{E_L{}^{i-l-1}}\frac{\Sigma_{\mathrm{S}}{}^{\mathrm{A}}(u')\phi(u')du'}{1-\alpha_{\mathrm{A}}} \\ &= \sum_{l=1}^{L_{\mathrm{A}}-1}P_{l,\mathrm{A}}\Sigma_{\mathrm{S},\,i-l}{}^{\mathrm{A}}\phi_{i-l}, \end{aligned} \tag{3. 3}$$

where $P_{l,\mathrm{A}}$ is defined by

$$P_{l,\mathrm{A}}=\frac{1}{1-\alpha_{\mathrm{A}}}e^{-(l-1)\Delta u}(1-e^{-\Delta u})\Delta u \tag{3. 4}$$

which is the probability that a neutron is scattered down l groups by elastic scattering collision with nucleus A. The $\Sigma_{S,i-l}{}^A$ is the macroscopic scattering cross section in group $(i-l)$, and L_A is the maximum number of slowing down groups. Here, the cross section and the flux has been assumed to be flat within the group with a lethargy width of Δu. By using the relation $P_{l,A} = e^{-\Delta U}P_{l-1,A}$, Eq. (3. 3) can be transformed to the following recurrence formula:

$$S_i{}^A(u_L)=P_{1,A}\Sigma_{S,i-1}{}^A\phi_{i-1}+e^{-\Delta u}\{S_{i-1}{}^A(u_L)-P_{Lj,A}\Sigma_{S,i-L_A-1}{}^A\phi_{i-L_A-1}\} \tag{3. 5}$$

The calculation of $S_i{}^A(u_L)$ becomes much simpler with this equation than Eq. (3. 3) when the mass number is smaller. When we take the summation over all nuclei contained in the medium, the total slowing down source $S_i(u_L)$ is obtained as follows:

$$S_i(u_L)=\sum_A[P_{1,A}\Sigma_{S,i-1}{}^A\phi_{i-1}+e^{-\Delta u}\{S_i(u_L)-P_{L_A,A}\Sigma_{S,i-L_A-1}{}^A\phi_{i-L_A-1}\}] \tag{3. 6}$$

The source $S_i(u_L)$ at the upper lethargy boundary can be written in the similar form by noting that the self-group scattering contributes it but not the $(i-L_A-1)$th group:

$$S_i(u_U)=\sum_A[P_{1,A}\Sigma_{S,i}{}^A\phi_i+e^{-\Delta u}\{S_{i-1}(u_U)-P_{L_A,A}\Sigma_{S,i-L_A}{}^A\phi_{i-L_A}\}] \tag{3. 7}$$

Accordingly, the average elastic slowing down source into the group i is obtained from Eq. (3. 1) as follows:

$$S_i=\frac{S_i(u_L)+S_i(u_U)}{2}.$$

3. 2 Inelastic Slowing Down

(1) Discrete level contribution

When the isotropic scattering is assumed for the inelastic scattering, the energy transfer probability from E' to E is presented by the equation

$$P(E'\to E)dE'=\frac{dE'}{(E_{max}-E_{min})}, \tag{3. 8}$$

where E_{max} and E_{min} are respectively the maximum and minimum slowing down energy defined by

$$E_{max}=\frac{A^2+1}{(A+1)^2}E'-\frac{A}{A+1}\varepsilon+\frac{2A}{(A+1)^2}\sqrt{E'^2-\frac{A+1}{A}\varepsilon E'},$$

$$E_{min}=\frac{A^2+1}{(A+1)^2}E'-\frac{A}{A+1}\varepsilon-\frac{2A}{(A+1)^2}\sqrt{E'^2-\frac{A+1}{A}\varepsilon E'}. \tag{3. 9}$$

In this equation, ε stands for the excitation energy of the discrete level of nucleus A, that is, ε is equal to $-Q$. Equation (3. 8) can be discretized for the scattering from the group i to j as follows:

$$P(i\to j)=\frac{1-R}{1-R^{n_j-m_j+1}}R^{(j-i-m_j)}, \tag{3. 10*}$$

where

$$m_j=\left[\ln\frac{E'}{E_{max}}\bigg/\Delta u\right],$$

$$n_j=\left[\ln\frac{E'}{E_{min}}\bigg/\Delta u\right],$$

$$R=e^{-\Delta u},\quad \Delta E=E'(1-R).$$

Since the slowing down source to the group j consists of the contributions from all the discrete levels, we can write

$$S_j{}^A=\sum_{\text{level}}\sum_{i=j-m_j{}^A}^{j-n_j{}^A}\frac{1-R}{1-R^{n_j{}^A-m_j{}^A+1}}R^{j-i-m_j{}^A}\Sigma_i{}^A\phi_i, \tag{3. 11}$$

* This representation is due to the discussion with Dr. J. Rawlands (U. K. AEE Winfrith)

where $\Sigma_i{}^A$ is the macroscopic inelastic cross section of discrete levels in group i. If the m_j is zero, $S_j{}^A$ includes the source due to the self-group scattering. From Eq. (3.11) the source at the group $j+1$ can be written in the following recurrence formula:

$$S_{j+1}{}^A=\sum_{\text{level}}\sum_{i=j+1-m_j{}^A}^{j-n_j{}^A+1}\frac{1-R}{1-R^{n_j{}^A-m_j{}^A+1}}R^{j+1-i-m_j{}^A}\Sigma_i{}^A\phi_i$$

$$=\sum_{\text{level}}\left(RS_j{}^A+\frac{1-R}{1-R^{n_j{}^A-m_j{}^A+1}}\Sigma_{j+1-m_j{}^A}\phi_{j+1-m_j{}^A}-\frac{1-R}{1-R^{n_j{}^A-m_j{}^A+1}}R^{n_j{}^A-m_j{}^A+1}\Sigma_{j-n_j{}^A}\phi_{j-n_j{}^A}\right).$$

If we denote $\sum_{\text{level}} S_j{}^A$ simply by $S_j{}^A$ and omit the suffix A, we have

$$S_{j+1}=e^{-\Delta u}S_j+\sum_{\text{level}}\frac{1-R}{1-R^{n_j-m_j+1}}\Sigma_{j+1-m_j}\phi_{j+1-m_j}-\frac{1-R}{1-R^{n_j-m_j+1}}R^{n_j-m_j+1}\Sigma_{j-n_j}\phi_{j-n_j}. \tag{3.12}$$

(2) Continuum level contribution

The neutron energy distribution due to the scattering by the continuum level is assumed to be approximately given by using the evapolation model. That is, the transfer probability is presented by

$$P(E'\rightarrow E)=bEe^{-E/a\sqrt{E'}}, \tag{3.13}$$

where b is a normalization factor and a is a constant. When the probability is normalized between E_0 and E_1, we have

$$b=1/a\sqrt{E'}\left\{\exp\left(-\frac{E_0}{a\sqrt{E'}}(a\sqrt{E'}+E_0)\right)-\exp\left(-\frac{E_1}{a\sqrt{E'}}(a\sqrt{E'}+E_1)\right)\right\}.$$

In this case, the transfer probability from the group i to j is written in the discrete form:

$$P(i\rightarrow j)=bE_je^{-E_j/a\sqrt{E_i}}\Delta E_j\Delta E_i.$$

The recurrence relation is then obtained as follows:

$$P(i\rightarrow j+1)=P(i\rightarrow j)e^{-\Delta E_j/a\sqrt{E_i}}\frac{E_{j+1}}{E_i}\frac{\Delta E_{i+1}}{\Delta E_i}$$

$$=P(i\rightarrow j)\frac{1+\Delta E_j/2T_i}{1-\Delta E_j/2T_i}R^2. \tag{3.14}$$

for which we have used the following approximations:

$$\frac{E_{j+1}}{E_j}\frac{\Delta E_{i+1}}{\Delta E_i}=\frac{E_j-\Delta E_j}{E_j}\frac{E_{i+1}}{E_{i+1}+\Delta E_{i+1}}=R\frac{1}{(1+\Delta E_{i+1}/E_{i+1})}\approx R^2$$

and denoting $a\sqrt{E_i}$ by T_i and using the relation $\Delta E_j \ll T_i$,

$$e^{-\Delta E_j/T_i}=1+\frac{\Delta E_j}{T_i}+\left(\frac{\Delta E_j}{T_i}\right)^2+\dots\approx\left(1+\frac{\Delta E_j}{2T_i}\right)^2$$

$$\approx\frac{1+\Delta E_j/2T_i}{1-\Delta E_j/2T_i}.$$

Therefore, from Eq. (3.14) the slowing down source is obtained by

$$S_j=\sum_{i=j}^{1}P(i\rightarrow j)\Sigma_i\phi_i$$

$$=\sum_{i=j-1}^{1}P(i\rightarrow j-1)\frac{1+\Delta E_{j-1}/2T_i}{1-\Delta E_{j-1}/2T_i}R^2\Sigma_i\phi_i. \tag{3.15}$$

where the summation over i is taken from the highest group to the threshold group when E_j is below the threshold energy. The self-scattering term is neglected in the calculation of S_j but it is considered after the flux ϕ_j is obtained for the use of the S_{j+1} calculation. As we have shown above, the transfer probability can be calculated with the use of recurrence formula but the slowing down source can not be represented by recurrence relation. Hence much computation time will be needed for the calculation of the slowing down source due to continuum levels.

4. Nuclear Data Treatment

4.1 Broad Group Cross Section

The neutron spectrum above a few MeV is mainly determined by the shape of fission spectrum and depends only weakly on the reactor composition. Therefore the broad group treatment will give a satisfactory result in this energy range with a reasonable computation time. The energy range above 1.9 MeV is devided into 7 groups with the same group structure as the JAERI Fast set. The cross sections of the JAERI Fast set are used at present for these groups. The transfer cross sections from these broad groups to fine groups should be prepared for the calculation of slowing down source. These are obtained from the broad group tranfer matrices as follows. The scattering probability from a broad group to a fine group is calculated by interpolating linearly the scattering probability between the broad groups. The summation of these probabilities should therefore be normalized to the value between the broad groups. This method is used also for the calculation of the transfer probability of $(n, 2n)$ reaction. Since the elastic scattering slows down neutron energies only up to the second lower group in the broad group structure, the transfer cross section from the broad group I to the fine group j is written as follows:

$$
\begin{aligned}
\sigma^{I\to j} &= \sigma_{in}{}^{I\to j} + \sigma_{2n}{}^{I\to j} + \sigma_e{}^{I\to j}, \quad \text{for } j \in I+1,\ I+2, \\
&= \sigma_{in}{}^{I\to j} + \sigma_{2n}{}^{I\to j}, \quad \text{for } j \notin I+1,\ I+2.
\end{aligned} \tag{4.1}
$$

4.2 Fission Spectrum and Released Fission Neutron Number

The fission spectrum is given by the Maxwell distribution function:

$$\chi(E) = C\sqrt{E}e^{-E/T}, \tag{4.2}$$

where C and T denote respectively a normalization factor and a nuclear temperature, which are given by the library data. The fission spectrum for each fine energy mesh can be calculated with the use of recurrence formula. For the first group χ_1 is obtained by the equation

$$
\begin{aligned}
\chi_1 &= \int_{E_0-\Delta E_0}^{E_0} \chi(E)dE \approx \chi(E_0)\Delta E_0 \\
&= C\sqrt{E_0}\cdot E_0 \exp(-E_0/T)\frac{1-R}{R}, \quad R = e^{-\Delta u},
\end{aligned}
$$

and for the succeeding lower groups, we have

$$
\begin{aligned}
\chi_{i+1} &= \int_{E_{i+1}}^{E_i} \chi(E)dE \\
&= C(E_i - \Delta E_i)^{1/2} \exp\left(-\frac{E_i - \Delta E_i}{T}\right)\cdot \Delta E_i \\
&= \chi_i R^{3/2} \frac{1+\Delta E_i/2T}{1-\Delta E_i/2T}.
\end{aligned} \tag{4.3}
$$

The released fission neutron number $\nu(E)$ is presented by the polynomial,

$$\nu(E) = b_0 + \sum_{l=1}^{n} b_l E^l. \tag{4.4}$$

In the present code the coefficient b_l can be given up to the fifth term for each nuclide.

4. 3 Fine Group Data Management

The cross section data in the library is arranged in the descending order of energy for the energy points given in the nuclear data file. The data include energy, elastic scattering, absorption, fission, inelastic scattering for each discrete level and inelastic scattering for a continuum level. As the fine group calculation proceeds these data at the corresponding energy point are processed successively. The cross section of a fine group is represented by the average value in the group width, which is calculated by using an $1/E$ spectrum. The cross sections are then obtained by the linear interpolation in the log-log scale as explained below. We write the energy and cross section at the nth point as (E_n, σ_n). The gradient of the cross section curve is presented in the log-log scale as

$$A_n = \ln(\sigma_n/\sigma_{n+1})/(u_{n+1} - u_n), \tag{4.5}$$

where u_n and u_{n+1} are the lethargies corresponding to energy E_n and E_{n+1} respectively. Therefore the cross section at energy E is given by

$$\sigma(E) = \sigma_n \exp[A_n(u - u_n)].$$

When the fine group i lies in the interval between E_n an E_{n+1} as shown in **Fig. 4.1**(a), the average cross section of the group i is given by

$$\langle\sigma_i\rangle = \frac{\int_{\Delta E_i} \sigma(E) \cdot \frac{1}{E} dE}{\int_{\Delta E_i} \frac{1}{E} dE} = \frac{1}{A_n \Delta u} \{\sigma(u_{i-1}) - \sigma(u_i)\}, \tag{4.6}$$

where Δu is the fine group lethargy width. When $|A_n|$ is very small, Eq. (4. 6) can be approximated by

$$\langle\sigma_i\rangle = \sigma(u_i). \tag{4.7}$$

The criteria is set as $|A_n| < 0.01$ in the code. If k energy points are included in the fine group i as shown in **Fig. 4.1**(b), the average cross section is represented by

$$\langle\sigma_i\rangle = \left\{\frac{\sigma(u_{i-1}) - \sigma(u_{n+1})}{A_n} + \sum_{j=1}^{k} \frac{\sigma(u_{n+j}) - \sigma(u_{n+j+1})}{A_{n+j}} + \frac{\sigma(u_{n+k}) - \sigma(u_{n+k+1})}{A_{n+k+1}}\right\} \Big/ \Delta u. \tag{4.8}$$

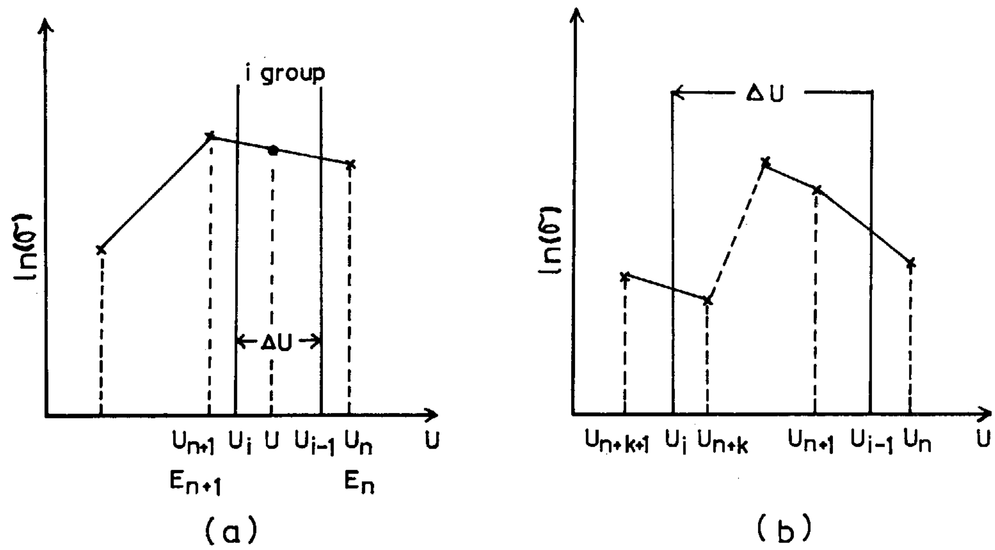

Fig. 4.1 Interpolation scheme of point cross section.

4. 4 Resonance Shielding Effect of Heavy Mass Nuclide

In the resonance region of heavy mass nuclide the resonance self-shielding effect is very important. For example there exist several resonances of ^{238}U in the fine group lethargy width of 0.008 about 10 keV and more for ^{235}U or ^{239}Pu. Therefore it should be neccessary to use an ultra fine group structure of about 0.0001 lethargy width if we want to use infinitely dilute cross sections. However this method is very time consuming. In ESELEM 4 we therefore adopt the broad group cross sections and their shielding factors taken from the JAERI Fast set. As noted in Ref. (3), the broad group treatment for heavy mass nuclide is considerably good for the group lethargy width of 0.25. Moreover the resonance self-overlap and mutual-shielding effects have been taken into consideration in the JAERI Fast set.

The heterogeneity effect on the resonance shielding is considered by using the rational approximation. Theoretical works for this effect have recently been performed for multi-fuel region plate cells[16]. In ESELEM 4 the approximate formula derived by Levine is adopted, where the effective admixture cross section, $\sigma_0{}^*$ is represented by

$$\sigma_0{}^* = \sigma_0 + \frac{S_0}{4NV_0}\frac{(1-C)a}{1+(a-1)C}, \tag{4.9}$$

where a is the Levine factor, S_0 and V_0 are the surface area and the volume of fuel region, respectively. The σ_0 is the homogenized admixture cross section given by $\sigma_0 = \sum_{j \neq i} \Sigma_t{}^j/N_i$. Though the Levine factor generally depends on the strength of each resonance, constant values are usually adopted, that is, 1.20-1.25 for a plate cell and 1.30 for a pin cell. For the Dancoff factor C, the following expression proposed by Meneghetti[17] is adopted.

$$C = E_3(\underset{k}{\mathrm{Sum}}(\Sigma_t T)_k) + E_3(\underset{l}{\mathrm{Sum}}(\Sigma_t T)_l), \tag{4.10}$$

where T is the thickness of the region k or l and $E_3(x)$ is the exponential integral function of order 3. Each argument is the summation of the mean chord length over all the cell regions between the regions involving the concerning nuclides. Equation (4. 10) is a convenient formula for neutron transport codes using the collision probability method, because such codes necessarily include the subroutine calculating the $E_3(x)$ function.

We should note that when the broad group cross section is used, the discontinuities of the cross sections appear at the group boundaries. This sometimes causes sharp peaks or dips to the neutron spectrum. To avoid such a defect, we use a linear interpolation of the cross section, which interpolates the broad group values over a few fine group widths on both the sides of the broad group boundary. Since the discontinuities are large for fertile materials, this effect is noticeable in the blanket region. We have compared the effective cross sections obtained for three different interpolation widths. TABLE 4.1 presents the results for the blanket region of the ZPR III-53 assembly[21]. We adopt the value $\delta=0.01$ for interpolation width because the effective cross sections are nearly equal to the values for the smaller δ value and the peaks or dips are already considerably small.

TABLE 4.1 Dependence of effective cross sections of ZPR III-53 blanket on interpolation width (10^{-2} cm^{-1}) ($\Delta u = \Delta U \times 2\delta$)

E	Cross section	$\delta=0.1$	$\delta=0.01$	$\delta=0.001$
1.29～	Σ_a	3.11	3.11	3.11
1.0 keV	Σ_{er}	1.27	1.27	1.27
129～	Σ_a	6.33	6.63	6.67
100 eV	Σ_{er}	1.52	1.50	1.49
27.8～	Σ_a	5.61	5.67	5.75
21.5 eV	Σ_{er}	1.42	1.32	1.29

4. 5 Data Library Form

The data library for ESELEM 4 consists of three parts. The first is the information on nuclides included. The second is the cross section for broad groups. The last consists of integers to define the position of cross sections and of pointwise cross sections. The contents of data are shown in TABLE 4. 2. The point cross sections are stored in one dimensional array, SIG,

TABLE 4. 2 Contents of data library

Part 1. Information for library

Variable	Content
JJA	number of nuclides in library
JAJ	number of fissionable nuclides in library
NNN	total number of fine group data
JFISS	code number of the first fissionable nuclide
JINC	code number of the first nuclide having inelastic continuum level
LEVEL	maximum number of inelastic scattering levels
MEX	sum of NPCN over all nuclides (see Part 3)
Q (I, J)	Q values of inelastic scattering
B0(J), B1(J), B2(J)	coefficients for calculation of fission neutron number
C (J)	normalization factor of fission spectrum
T (J)	nulcear temperature

Part 2. Broad group data

Variable	Content
JA	code number of nuclides
IX	number of broad groups
IIX	maximum number of slowing down group from broad group
XBT (I, J)	transfer cross section of broad group
XBTR (I)	transport cross section
XBTT (I)	total cross section
XBR (I)	removal cross section
XBY (I)	nu* fission cross section
XBK (I)	fission spectrum
XBS (I)	scattering cross section
XBA (I)	absorption cross section
XBE (I)	elastic scattering cross section
XBF (I)	fission cross section
SIGBG (I, J)	transfer matrix from broad group to fine group

Part 3. Fine group data

Variable	Content
LFDA (I)	location of the first data for each nuclide
NIDL (I)	number of discrete levels
NPCN (I)	total number of reaction types and inelastic levels
LLEX (I)	(LLEX+1) is the location of elastic scattering cross section in EXSEC (M)
INIC (I)	indicator of continuum level
ITHI (I)	threshold group of continuum level
JCAP (I)	indicator of capture cross section
MINU (J, I)	the highest energy point of cross section type J
MAXU (J, I)	the lowest energy point of cross section type J
AM (I)	atomic mass
AC (I)	constant for evapolation model
SIG (N)	array for fine group cross sections (NNN)

where the cross sections are sequentially arranged in the order of E, σ_s, σ_c, σ_f, $\sigma_{in}{}^1$, $\sigma_{in}{}^2$, $\cdots$, $\sigma_{in}{}^c$ for each energy point from higher to lower energy. This set is repeated for all nuclides. For energies below the threshold of an inelastic discrete level, the succeeding data are arranged compactly to fill that position. Therefore the data can be stored in fast core memories and data processing time is significantly saved.

When the JAERI Fast set is to be used as mentioned in Section **4. 4**, the code requires the standard data library with the 70 group structure.

5. Description of ESELEM 4 Code

5.1 Hierarchy of Subroutines

The ESELEM 4 code consists of eight overlay segments as shown in **Fig. 5.1**. The main programme calls six segments and subroutine ESELEM in the segment 4 calls the segment 6. The segment 2 is the input module for input cards and library data. The segment 3 calculates self-shielding factors for heavy mass nuclides. The segment 4, 5 and 6 are the main parts to prepare point cross sections and to calculate neutron fluxes and average cross sections. The segment 7 is the output module for line printer or output files, and the segment 8 is used for plotting the neutron spectrum. The function of each subroutine is described in Section **5.3**. The programme is written by FORTRAN IV for using on CDC 6600 and FACOM 230/60 computers. The conversion to FACOM 230/75 has been completed.

Since important variables are stored in the block with an adjustable size, the required core memories depend on a problem type to be solved. For a problem that has NREG regions, NNN fine data, JJB nuclides, NMS mesh points, IGMAX fine groups, ICOLP collapsed groups and NMAX, the sum of the number of nuclides in each region, the amount of core storage in words required for variables is given by the following:

$$A = NREG*777,$$
$$B = NNN + 359*JJB + 2580,$$
$$C = NNN + NMS*(2*NMS + 1817 + IGMAX) + NREG*2405 + NMAX*(ICOLP*ICOLP + 8) + ICOLP,$$
$$Memory = Max(A+B,\ A+C).$$

The size of variable array is set in the blank common in the main programme. The used core storage is printed out in the output list.

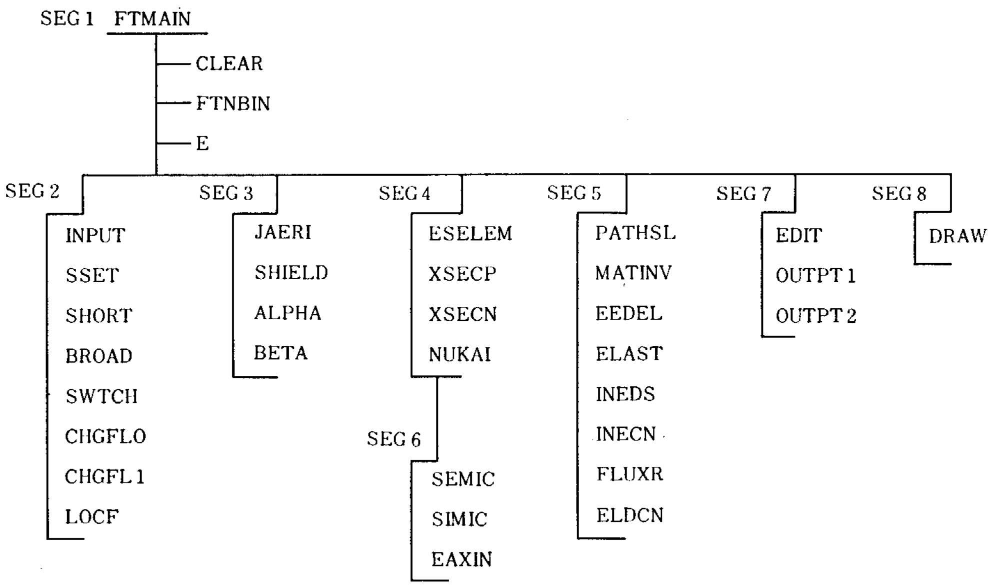

Fig. 5.1 Hierarchy of subroutines.

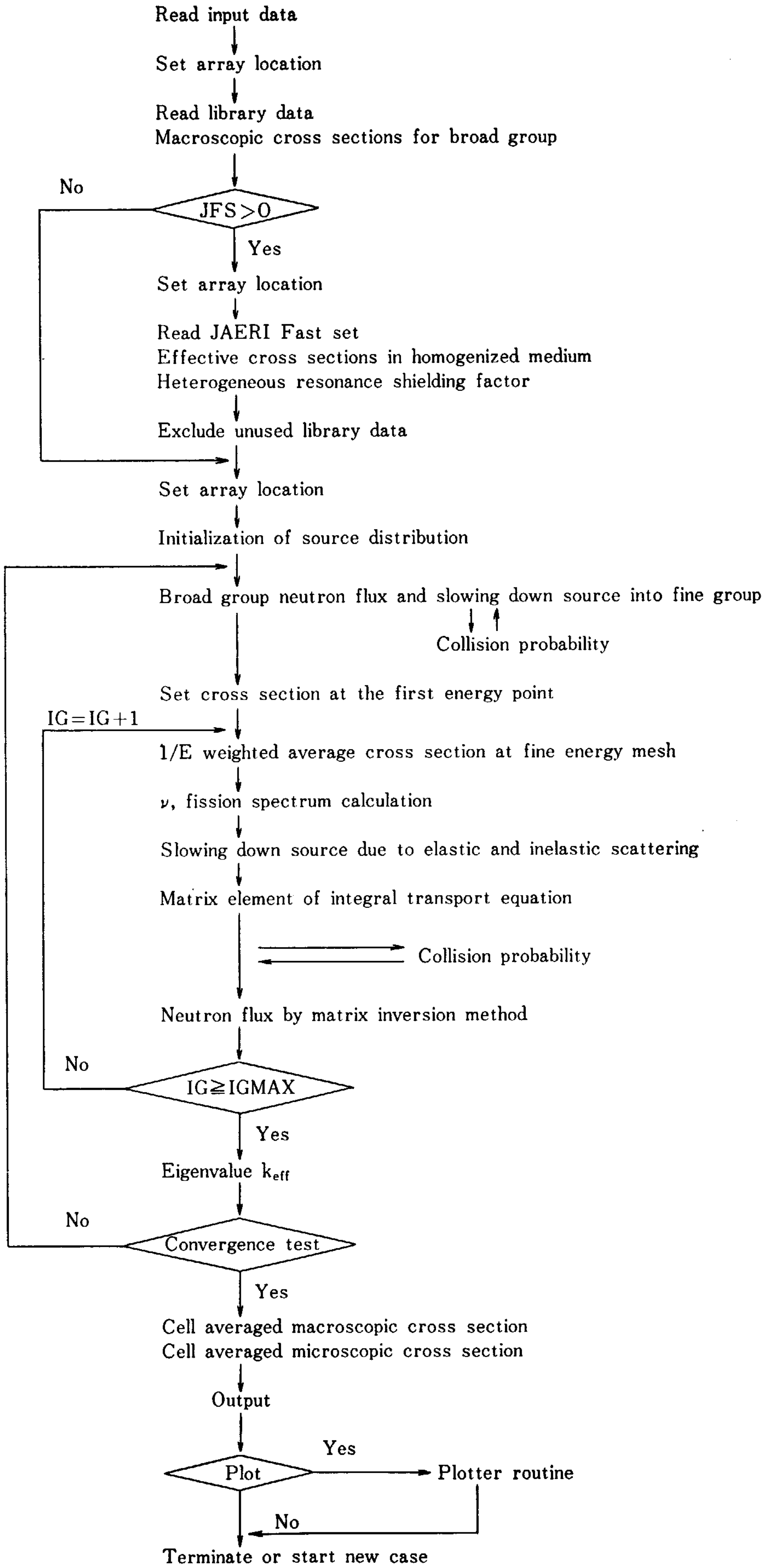

Fig. 5.2 Calculation flow of ESELEM 4.

5. 2 Calculation Flow

Figure 5. 2 shows the flow of calculations. The first locations of variable arrays are defined in the subroutine SSET which consists of four entries. The locations are determined at four stages of the calculation in order to save core memories. In the case where the resonance shielding effect of heavy elements is not necessary to take into consideration, the routine to calculate the shielding factors is bypassed.

The initial fission source distribution can be given by the input, otherwise the flat source distribution is assumed. The calculation of neutron flux consists of two loops for broad groups and fine groups. The maximum number of slowing down groups from broad groups to fine groups is permitted up to 700. The subroutines to compute the average point cross sections, ν value and fission spectrum are called at every fine group energy point. Then the slowing down source from upper groups is computed on the basis of the recurrence relations. Since the fine group data are kept in the fast core memory, data access time is very short.

After each outer iteration, the multiplication factor is calculated and the convergence test is performed. If the outer iteration is converged, the edit routine is called from the main programme.

5. 3 Function of Subroutines

The main function of subroutines is explained below.

1. FTMAIN —assignes the unit number for scratch files and controls the flow of calculation.
   Calls: FTNBIN, CLEAR, CLOCKM, INPUT, SSET, BROAD, JAERI, SHORT, ESELEM, EDIT
2. CLEAR —sets variables to be a constant value.
3. E —calculates $Ei(x)$ function. The approximate representations are used for small variable ranges.
4. INPUT —reads and writes out input data.
   Calls: CLEAR
5. SSET —consists of 4 entries, SSET, TSET, USET and VSET, and identifies the first location of variable arrays and calculates the required total size of core memories.
   Calls: CHGFLO, CHGFL1
6. SHORT —excludes the storage for cross sections of unused nuclides.
7. BROAD —reads cross section library and calculates macroscopic cross sections for broad groups.
   Calls: CLEAR, SWTCH
8. JAERI —reads the JAERI Fast set library and calculates resonance shielding factors of heavy nuclides for homogenized media and heterogeneous plates.
   Calls: CLEAR, SHIELD, E
9. SHIELD —computes shielding factors for a given σ_0 value from the table by inter- or extra-polation. This subroutine is referred to the EXPANDA-4 code[18].
   Calls: ALPHA, BETA
10. ESELEM —calculates fission and slowing down source, coefficients of matrix equation, multiplication factor, normalized fission source distribution and cell averaged effective cross sections, and edits neutron flux and iteration information.
    Calls: CLEAR, PATHSL, MATINV, XSECP, XSECN, NUKAI, INEDS, INECN, FLUXR, ELDCN, CLOCKM, SEMIC, SIMIC
11. XSECP —sets the energy point of cross section data to the first fine group, obtains the

gradient of cross sections and reads in shielding factors from scratch file.

12. XSECN —interpolates cross sections at an energy mesh point and reads in shielding factors obtained in the subroutine JAERI if necessary.
13. NUKAI —calculates ν value and fission spectrum at an energy mesh point.
14. PATHSL —calculates mean chord length and collision probability[22].
    Calls : EEDEL
15. MATINV—solves matrix equation.
16. EEDEL —controls computation flow of $Ei(x)$ function for small chord length.
    Calls : E
17. ELAST —calculates elastic slowing down source for each region.
18. INEDS —calculates inelastic slowing down source from discrete levels and its contribution to removal cross section.
    Calls : EXIN
19. INECN —calculates inelastic slowing down source from a continuum level and its contribution to removal cross section.
20. FLUXR —calculates macroscopic effective total, transport, removal and ν times fission cross sections.
21. ELDCN —calculates correction for elastic and inelastic scattering slowing down sources from the highest and lowest group.
22. SEMIC —computes collapsed macroscopic elastic scattering cross section and matrix.
23. SIMIC —computes collapsed macroscopic capture, fission, ν times fission cross sections and also inelastic scattering cross sections and matrix.
    Calls : EAXIN
24. EAXIN —computes the maximum and minimum slowing down energy with use of Q value.
25. EDIT —edits for neutron fluxes and collapsed effective cross sections.
    Calls : CLEAR, OUTPT 1, OUTPT 2
26. OUTPT 1
    OUTPT 2 —prints input and output.
27. DRAW —plots neutron spectrum by Calcomp plotter.
    Calls : GPLOT 1

The input and output devices are summarized in TABLE 5.1 where the standard amount of space needed for the scratch data sets is also shown, though the values depend on the particular problem being run.

TABLE 5.1 Input and output devices

Logical number	Name	Space (track)	Function
1	ISCR	600	Scratch
2	IPHI	600	Scratch (flux)
3	JSCR	600	Scratch
4	LTES	40	Scratch
5	IOIN		Input (card)
6	IOUT		Output (print)
7	IPNC		Output (punch)
8	JAER		JAERI Fast set library
9		40	Scratch (cross sections)
10			ESELEM 4 library
12		40	Scratch
Plot			Plotter

6. Input and Output

6. 1 Input Data Format

Input data for ESELEM 4 is described below, together with their formats in parentheses.

Card 1 (18 A 4)

Title card

Card 2 (12 I 6)

1.	JJB	Number of nuclides
2.	JBJ	Position of the first fissionable element appeared in the library data
3.	JKAI	Position of the element for which fission spectrum is used
4.	JFS	Number of heavy elements to be used from the JAERI Fast set

Card 3 (12 I 6)

NEL (I), (I=1, JJB)

Define the code numbers in the library data. If you set an element to K, K is the code number.

Card 4 (4 (I 6, E 12. 0)) omit if JFS=0

1.	ITEMP (I)	Code number of element
2.	TEMP (I)	Upper limit of energy where the JAERI Fast set is used

(I=1, JFS)

Card 5 (12 I 6)

1.	NREG	Number of cross section regions
2.	NMS	Number of meshes
3.	NCELL	Maximum number of cells traversed by neutron in the collision probability calculation
4.	IBOUND	Boundary condition
	0	Isotropic reflection
	1	Reflective
5.	JBI	Number of broad groups
6.	IL 1	
	0	No effect
	1	Read guess of fission source distribution
7.	IL 2	Plotter option to write neutron spectrum
	0	Not used
	1	Used
8.	ICOLP	Number of cross section groups to be collapsed from fine group structure.
9.	JTERT	Outer iteration maximum
10.	IOPT	Type of input group boundary
	0	In fine group number
	1	In energy unit (eV)
11.	ICASE	Not used (set ICASE=0)
12.	ISY	Cell structure
	0	Symmetric cell

1 Periodic cell

Card 6 (12 I 6) Option for output

1. IPR 1
   - 0 No effect
   - 1 Print slowing down source from broad groups
2. IPR 2
   - 0 No effect
   - 1 Print fine group neutron flux
3. IPR 3
   - 0 No effect
   - 1 Write neutron flux on unit 2.
4. IPR 4
   - 0 No effect
   - 1 Punch macroscopic multi-group corss sections for each region and group.
5. IPR 5
   - 0 No effect
   - 1 Punch macroscopic cell averaged cross sections
6. IPR 6
   - 0 No effect
   - 1 Write effective cross sections of each nuclide on unit 9

Card 7 (6 E 12. 0)

1. CONT Starting energy of calculations ($=1.05\times 10^{7}$ eV)
2. B Buckling value
3. AIPS Convergence precision for the multiplication factor
4. DELU Lethargy width of fine groups ($=0.008$)
5. TE Temperature (°K)
6. AINP Levine factor

Card 8 (12 I 6)

NOELM (I), (I=1, NREG)

Number of nuclides in regions

Card 9 (6 E 12. 0)

RMAX (I), (I=1, NREG)

Dimension of each region (cm)

Card 10 (12 I 6)

MAT (I), (I=1, NMS)

Identification of region number for each mesh

Card 11 (12 I 6) Omit if IOPT=1

ML (I), (I=1, ICOLP+1)

Number of fine groups corresponding to the boundaries of collapsed groups.

Card 12 (6 E 12. 0) Omit if IOPT=0

ETEP (I), (I=1, ICOLP+1)

Boundary energy of collapsed groups (eV)

In Card 11 or 12 the values should be written in the descending order of energy.

Card 13 (4 (I 6, E 12. 0))

NRJ (I, J) Code number of nuclide I in region J

DEN (I, J) Atomic number density of nuclide I in region J ($\times 10^{24}/cm^{3}$)

((I=1, NOELM (J)), J=1, NREG)

Input for each region must start on a new card.

Card 14 (6 E 12. 5)

(S (I), I=1, NMS)

Omit if IL 1=0

Guess of source neutron distribution

The following cards are omitted if IL 2=0.

Gard 15 (12 I 6)

NSPEC Number of neutron spectra to be written

IREG (I), (I=1, NSPEC)

Identification of mesh numbers to be written

All these spectra are written on the same sheet.

Card 16 (2 E 12. 5)

WITHX Size of x coordinate (mm)

WITHY Size of y coordinate (mm)

Card 17 (10 A 4) Title of x coordinate

Card 18 (10 A 4) Title of y coordinate

Card 19 (10 A 4) Title of this graph

6. 2 Detailed Data Notes

We present here more datailed definitions of parameters and a guide to use the JAERI Fast fine data library.

(1) JJB, JBJ, JKAI and JFS

The total number of nuclides, JJB is 11 in the present available library and the first fissionable nuclide is ^{235}U. TABLE 6. 1 shows nuclides and their order stored in the library. This order is set as the code number, NEL. For heavy elements the upper energy of resonance region is shown also in TABLE 6. 1.

TABLE 6. 1

	Nuclide	Fission spectrum	Upper energy of resonance region
1	C		
2	O		
3	Na		
4	Al		
5	Cr		
6	Fe		
7	Ni		
8	^{235}U	yes	10 keV
9	^{238}U		21. 5 keV
10	^{239}Pu	yes	10 keV
11	^{240}Pu		21. 5 keV

(2) NREG, NMS and NCELL

The number of regions NREG corresponds to the number of different materials. One region may be divided into some meshes if the region width is large compared to one mean free path of neutron. For NCELL, six or seven mean free path length will be sufficient. The number of broad groups is seven above 1. 9 MeV in the JAERI Fast library.

If an input guess for fission source distribution is not defined, a flat source guess is set internally. It will be helpful to use the SLAROM code[5] to obtain a suitable fission source distribution and an appropriate buckling value.

6. 3 Output

The following data are printed out.

1. Input data
   Collapsed group boundary is written in the fine group number, lethargy and energy unit.
2. Core memory
   If the core memories are short, the message is printed out and execution is terminated.
3. Fission spectrum of broad groups
4. Outer iteration convergence which, includes CPU time, eigenvalue and convergence criteria.
5. Broad group flux for each mesh.
6. Cell averaged cross sections of the broad groups:
   $$\langle \Sigma_x{}^I \rangle = \mathop{\mathrm{Sum}}_{k=1}^{\mathrm{NMS}} \Sigma_{x,k}{}^I \phi_k{}^I V_k / \mathop{\mathrm{Sum}}_{k=1}^{\mathrm{NMS}} \phi_k{}^I V_k.$$
   Transfer cross sections from a broad group to fine groups is collapsed as follows:
   $$\langle \Sigma_s{}^{I\to J} \rangle = \mathop{\mathrm{Sum}}_{j\in J} \mathop{\mathrm{Sum}}_{k=1}^{\mathrm{NMS}} \Sigma_{s,k}{}^{I\to j} \phi_k{}^I V_k / \mathop{\mathrm{Sum}}_{k=1}^{\mathrm{NMS}} \phi_k{}^I V_k.$$
   I, J: Energy group in broad group structure
   x: Reaction type
   k: Mesh region
   j: Energy group in fine group structure
   The maximum number of slowing down groups is limited to be 30. The above-mentioned notations will be used below.
7. Fine group neutron flux and collapsed neutron flux for each mesh and region, together with collapsed group flux per unit volume.
8. Fission spectrum normalized to unity.
9. Cell averaged effective cross sections where total, capture, fission, elastic scattering and total inelastic scattering cross sections are defined by
   $$\langle \Sigma_x{}^I \rangle = \mathop{\mathrm{Sum}}_{i\in I} \mathop{\mathrm{Sum}}_{k=1}^{\mathrm{NMS}} \Sigma_{x,k}{}^i \phi_k{}^i V_k / \mathop{\mathrm{Sum}}_{i\in I} \mathop{\mathrm{Sum}}_{k=1}^{\mathrm{NMS}} \phi_k{}^i V_k.$$
   Transport cross section is defined by
   $$1/\langle \Sigma_{tr}{}^I \rangle = \mathop{\mathrm{Sum}}_{i\in I} \mathop{\mathrm{Sum}}_{k=1}^{\mathrm{NMS}} \frac{1}{[\Sigma_a{}^i + \Sigma_{in}{}^i + \Sigma_e{}^i(1-\mu)]_k} \phi_k{}^i V_k / \mathop{\mathrm{Sum}}_{i\in I} \mathop{\mathrm{Sum}}_{k=1}^{\mathrm{NMS}} \phi_k{}^i V_k.$$
   Elastic and inelastic scattering matrices are given by
   $$\langle \Sigma_x{}^{I\to J} \rangle = \mathop{\mathrm{Sum}}_{i\in I} \mathop{\mathrm{Sum}}_{j\in J} \mathop{\mathrm{Sum}}_{k=1}^{\mathrm{NMS}} \Sigma_{x,k}{}^{i\to j} \phi_k{}^i V_k / \mathop{\mathrm{Sum}}_{i\in I} \mathop{\mathrm{Sum}}_{k=1}^{\mathrm{NMS}} \phi_k{}^i V_k.$$
   Microscopic effective cross sections are also defined by similar equations and are stored on a tape.
10. Graphic plot of fine group neutron flux
    The x coordinate is neutron energy in eV and y coordinate is neutron flux. The neutron fluxes of NSPEC regions are plotted on the same graph.

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Appendix A. Library Preparation Code: PRESM

The PRESM code produces the data library tape for the ESELEM 4 code from the ENDF/A[20] type nuclear data file. The ENDF/A type data is given in the BCD mode. Nuclei and their reaction type are selected by finding heading cards. When a nuclide is assigned in input, the PRESM code reads its elastic and inelastic scattering, fission and capture cross sections given in the DCC1 type. Since the energy points must be the same for all the reaction types, those for elastic scattering are adopted as the standard points. If such energy points are not given in other reactions, the cross sections are interpolated to those energy points. The number of inelastic scattering levels is limited up to 9 discrete levels and one continuum level for each nuclide. The broad group data are prepared separately and edited into the library tape by this code. A brief description of the code and input format are given below.

A. 1 Description of code

Figure A.1 shows the structure of the PRESM code. The main program, PRESM calls six subroutines. The subroutine INPT is the input module. The DATAIN block reads the ENDF/A type tape, picks up and stores the data if necessary. The ENDF block reads the stored binary data and arranges or interpolates the data points. The explanation of each subroutine is described below.

1.	PRESM	Main routine to control calculation flow.
2.	CLEAR	sets arrays to a constant value.
3.	INPT	reads and writes out input data.
4.	SET	calculates array locations for variable dimensions.
5.	DATAIN	reads in the ENDF/A type file and converts it to binary data.
6.	CHCK	selects nuclide, reaction type and data type.
7.	COMENT	reads and writes out heading cards of the ENDF/A data.
8.	DCC1	reads energies and cross sections given by DCC1 type.
9.	DICT16	sets data card format.
10.	ENDF	reads binary data written in DATAIN and composes energy and cross sections for each nuclide.
11.	DICT	finds the dictionaries 4-8 of the ENDF/A file.
12.	CHANG	arranges energy points in the descending order of energy.
13.	FITE	adjusts energy points to those of elastic scattering cross sections.
14.	TRAC	searches energy range of cross section data.
15.	EDIT	converts the point data produced in ENDF to the format which can be read by the ESELEM 4 code.
16.	FINAL	edits library tape from fine and broad group data.

A. 2 Input format

Card 1 (18A4)	Title of this job.
Card 2 (12I6)	
IOIN	Logical number of the ENDF/A type file

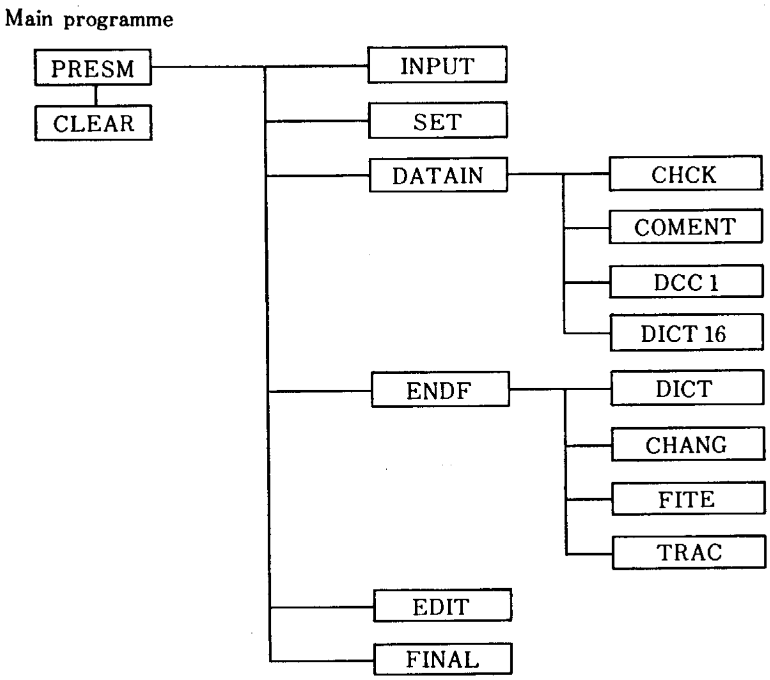

Fig. A. 1 Structure of the PRESM code.

IOUT	Logical number of line printer
NIN	Logical number of input by cards 3 and 4
IBANK	Scratch unit
JBANK	Scratch unit (IBANK$\neq$JBANK)
KBANK	Logical number of broad group data file
LIBL	Logical number of output library
LENX	Number of total energy points for which we should assign a number more than the maximum number of energy points
MTMX	Number of nuclides to be included in library

Card 3 (12I6) Option for print out. If positive integer, the following items are printed out:

IPR1	List of heading cards of ENDF/A type file
IPR2	Error detection in editing energy points and cross sections
IPR3	Cross sections of each nuclide
IPR4	Library data for the ESELEM 4 code

Card 4 (12 (A2, I3, 1X))

(CEMS(I), Chemical symbol of nuclide
MSSN(I), Mass number of nuclide
I=1, MTMX)

A. 3 List of error messages

The following symbols are used for error messages.

**	Fatal error
*	Caution
CHEMS	Chemical symbol
MASSN	Mass number
J, K	Energy point of error detected

TEMP	Previous energy point
ENRG	Energy point for elastic scattering cross section
ENER	Energy point for another type of reaction cross section
REAC	Reaction type

Error level message and explanation

**	/ENDF/ ARRAY SIZE OUT OF RANGE CHEMS MASSN J TEMP The maximum number of energy points is greater than LENX.
**	/ENDF/ ENCOUNTERED SAME ENERGY POINT CHEMS MASSN J TEMP The same energy points exist for elastic scattering.
**	/ENDF/ ILLEGAL ENERGY CHEMS MASSN J TEMP The order of energy points is illegal.
*	/ENDF/ NO. OF ENERGY POINT UNMATCHED CHEMS MASSN J TEMP Total number of energy points is missmatched.
*	/ENDF/ MAXIMUM ENERGY POINT NOT 2.0 MEV CHEMS MASSN J TEMP The maximum energy for elastic scattering is not 2.0MeV.
**	/ENDF/ MAXIMUM ENERGY POINT LESS THAN 2 MEV CHEM MASSN The maximum energy for elastic scattering is less than 2.0MeV.
*	UNMATCHED ENERGY CHEMS MASSN REAC ENRG ENER J K The energy point for another reaction does not exist in the energy points for elastic scattering.

Appendix B. Sample Problems

1. Core cell of the FCA V-1 assembly

A sample problem is run for the cell of the core in the fast critical assembly FCA V-1. The unit cell consists of 13 plates and drawers with symmetry at the center line as shown in **Figure B. 1**. The fine group calculation is performed for the energy range from 1.9 MeV to 10 eV. The effective cross sections in this range are collapsed into 48 broad groups. The neutron spectrum in the Pu plate region is shown in **Figure B. 2**. The sample output list is shown in **TABLE B. 1**.

2. Blanket of the ZPR III-53 assembly

As mentioned in Section **4. 4**, broad group representation is used for the resonance region of heavy elements. Since the group cross sections of heavy elements show a large variation between neighbouring groups below about 100 eV, sharp flux peaks or dips appear at the group boundaries. Such a shape is especially pronounced for fertile material riched composition such as a depleted uranium blanket. **Figure B. 3** is such an example, which shows the neutron spectrum in the blanket of the ZPR-III-53 assembly. However it does not affect significantly the effective cross sections (less than a few percents at about 100 eV). In keV region such peaks or dips do not appear because the variation of group cross sections are not large between neighbouring groups.

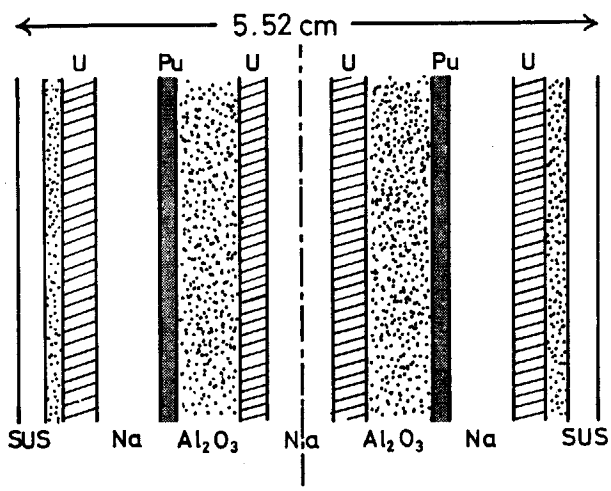

Fig. B. 1 Cell structure of the FCA V-1 assembly.

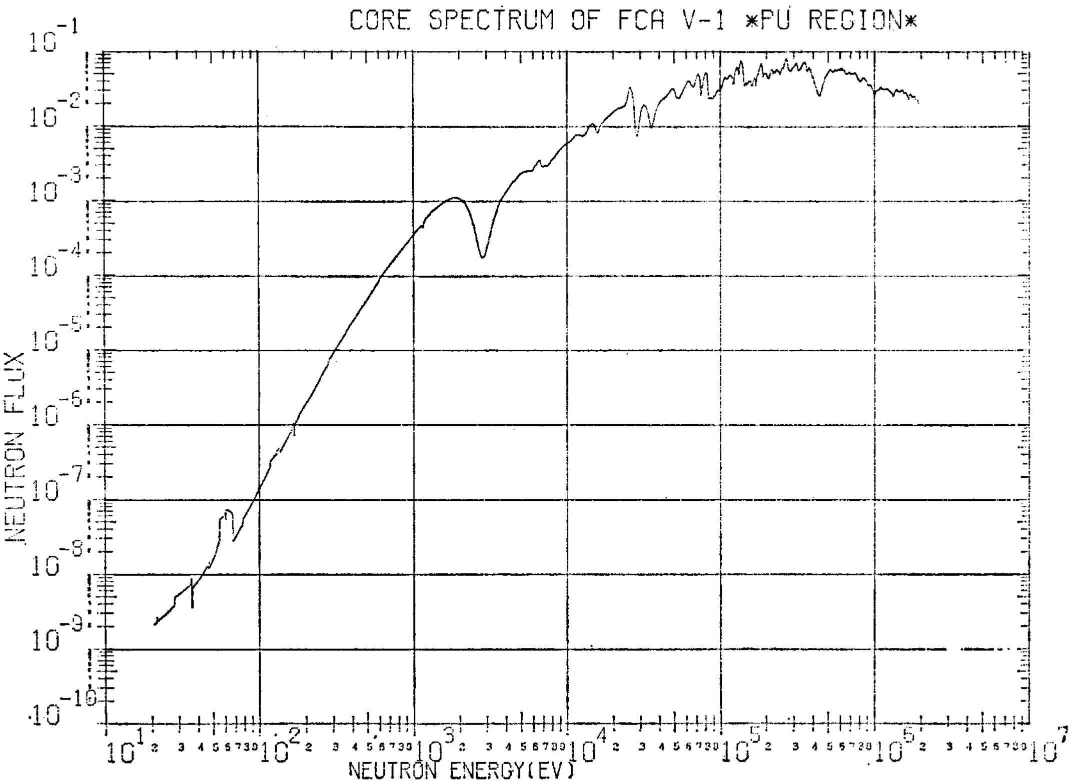

Fig. B. 2 Neutron spectrum in Pu plate region of the FCA V-1 assembly.

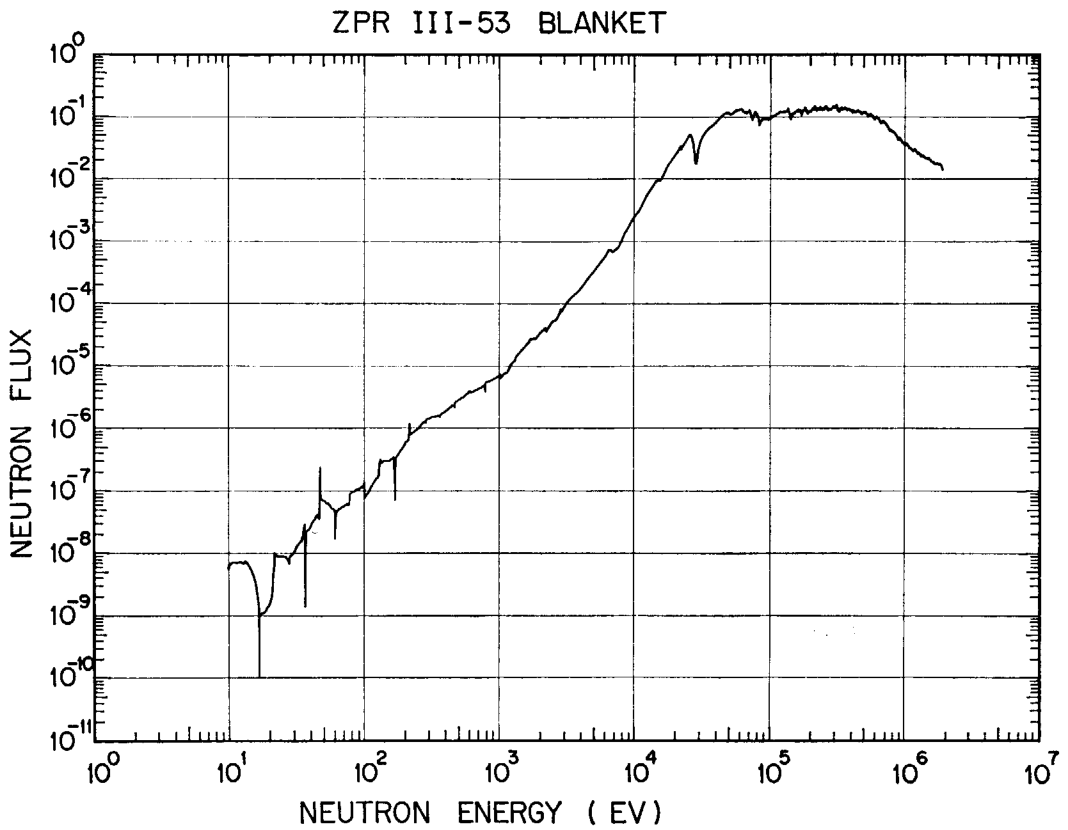

Fig. B. 3 Calculated neutron spectrum in the blanket region of the ZPR III-53 assembly.

TABLE B. 1 Sample output list

```
***** ESELEM-4 *****

INPUT LIST
 *ESELEM 4*  SAMPLE PROBLEM  *FCA V-1 CORE CELL*        75/12/15

JJB     NUMBER OF ELEMENTS                                    11
JBJ     FIRST FISSIONABLE ELEMENT ON LIBLARY TAPE              8
JKAI    ELEMENT CODE NUMBER FOR FISSION SPECTRUM             -10
JFS     NO. OF ELEMENT TO USE JAERI FAST SET                   4

ELEMENT CODE NUMBER
                 1    2    3    4    5    6    7    8    9   10   11
NREG    NUMBER OF REGIONS                                      8
NMS     NUMBER OF MESHES                                       8
NCELL   NUMBER OF CELLS FOR COLLISION PROBABILITY              6
IBOUND  BOUNDARY CONDITION(0/ISOTROPIC,1/REFLECT.)             0
JBT     NUMBER OF BROAD GROUPS                                 7
IL1     OPTION TO SOURCE DISTRIBUTION INPUT.                   1
IL2     1/PLOTTER                                              1
ICOLP   NUMBER OF COLLAPSED BROAD GROUPS                      48
JTERT   ITERATION COUNT LIMIT                                  2
IOPT    OPTION TO USE COLLAPSED ENERGY BOUNDARY                1
ICASE   1/TRANSPORT APPROXIMATION.                             0
ISYM    0/SYMMETRIC,1/PERIODIC                                 0
IPR1    SOURCE PRINT OPTION                                    0
IPR2    FLUX PRINT OPTION                                      1
IPR3    OPTION TO PUNCH SOURCE DISTRIBUTION.                   0
IPR4    COLLAPSED SIGMA(REGION,GROUP) PUNCH OPTION             0
IPR5    COLLAPSED SIGMA(GROUP) PUNCH OUT OPTION                0
IPR6    OPTION TO WRITE SIGMA TO TAPE UNIT 9                   0
CONT    MAXIMUM ENERGY                               1.05000E+07
B       BUCKLING                                     4.90000E-02
EIPS    CONVERGENCE CRITERION                        1.00000E-03
DELU    LETHARGY WIDTH OF FINE GROUP                 8.00000E-03
TE      TEMPERATURE                                  3.00000E+02
AINP    LEVIN FACTOR                                 1.15000E+00

ELEMENT CODE NUMBER AND UPPER ENERGY TO USE JAERI FAST SET
                 1         0.0
                 2         0.0
                 3         0.0
                 4         0.0
                 5         0.0
                 6         0.0
                 7         0.0
                 8         1.00000E+04
                 9         2.15000E+04
                10         1.00000E+04
                11         2.15000E+04

MAP (FOR EACH MESH)
         1* 2* 3* 4* 5* 6* 7* 8*

REGION INFORMATION
       REGION     NO. OF    NO. OF      MESH WIDTH       REGION
                   MAT.     MESHES                        WIDTH
          1          3         1       2.62700E-01    2.62700E-01
          2          5         1       1.58750E-01    1.58750E-01
          3          5         1       3.17500E-01    3.17500E-01
          4          4         1       6.15000E-01    6.15000E-01
          5          5         1       1.46000E-01    1.46000E-01
          6          5         1       6.15000E-01    6.15000E-01
          7          5         1       3.17500E-01    3.17500E-01
          8          4         1       3.07500E-01    3.07500E-01

INPUT ENERGY BOUNDARY FOR COLLAPSED BROAD GROUPS
                 1         1.90000E+06
                 2         1.40000E+06
                 3         1.10000E+06
                 4         8.00000E+05
                 5         6.30000E+05
                 6         5.00000E+05
                 7         4.00000E+05
                 8         3.10000E+05
                 9         2.50000E+05
                10         2.00000E+05
                11         1.50000E+05
                12         1.20000E+05
                13         1.00000E+05
                14         7.73000E+04
                15         5.98000E+04
                16         4.65000E+04
                17         3.60000E+04
                18         2.78000E+04
                19         2.15000E+04
                20         1.66000E+04
                21         1.29000E+04
                22         1.00000E+04
                23         7.73000E+03
                24         5.98000E+03
                25         4.65000E+03
                26         3.60000E+03
                27         2.78000E+03
                28         2.15000E+03
                29         1.66000E+03
                30         1.29000E+03
                31         1.00000E+03
                32         7.73000E+02
                33         5.98000E+02
                34         4.65000E+02
                35         3.60000E+02
                36         2.78000E+02
                37         2.15000E+02
                38         1.66000E+02
                39         1.29000E+02
                40         1.00000E+02
                41         7.73000E+01
                42         5.98000E+01
                43         4.65000E+01
                44         3.60000E+01
                45         2.78000E+01
                46         2.15000E+01
                47         1.66000E+01
                48         1.29000E+01
                49         1.00000E+01

COLLAPSED BROAD GROUP INFORMATION
          BROAD     FINE      LETHARGY         ENERGY
          GROUP     GROUP     BOUNDARY         BOUNDARY
            1        213     1.70400E+00     1.91052E+06
            2        251     2.00800E+00     1.40970E+06
            3        282     2.25600E+00     1.10007E+06
            4        321     2.56800E+00     8.05232E+05
            5        351     2.80800E+00     6.33418E+05
            6        380     3.04000E+00     5.02266E+05
            7        408     3.26400E+00     4.01469E+05
            8        440     3.52000E+00     3.10794E+05
            9        467     3.73600E+00     2.50418E+05
           10        495     3.96000E+00     2.00163E+05
           11        531     4.24800E+00     1.50074E+05
           12        558     4.46400E+00     1.20920E+05
           13        581     4.64800E+00     1.00598E+05
```

Table 1 continued

14	613	4.90800E+00	7.78770E+04
15	646	5.16800E+00	5.98075E+04
16	677	5.41600E+00	4.66714E+04
17	709	5.67200E+00	3.61303E+04
18	741	5.92800E+00	2.79699E+04
19	773	6.18400E+00	2.16527E+04
20	806	6.44800E+00	1.66287E+04
21	837	6.69600E+00	1.29764E+04
22	869	6.95200E+00	1.00456E+04
23	901	7.20800E+00	7.77669E+03
24	933	7.46400E+00	6.02026E+03
25	965	7.72000E+00	4.66054E+03
26	997	7.97600E+00	3.60792E+03
27	1029	8.23200E+00	2.79304E+03
28	1061	8.48800E+00	2.16221E+03
29	1094	8.75200E+00	1.66052E+03
30	1125	9.00000E+00	1.29580E+03
31	1157	9.25600E+00	1.00314E+03
32	1189	9.51200E+00	7.76569E+02
33	1221	9.76800E+00	6.01175E+02
34	1253	1.00240E+01	4.65395E+02
35	1285	1.02800E+01	3.60282E+02
36	1317	1.05360E+01	2.78909E+02
37	1349	1.07920E+01	2.15915E+02
38	1381	1.10480E+01	1.67149E+02
39	1413	1.13040E+01	1.29397E+02
40	1445	1.15600E+01	1.00172E+02
41	1477	1.18160E+01	7.75471E+01
42	1509	1.20720E+01	6.00325E+01
43	1540	1.23200E+01	4.68469E+01
44	1572	1.25760E+01	3.62662E+01
45	1605	1.28400E+01	2.78515E+01
46	1637	1.30960E+01	2.15610E+01
47	1669	1.33520E+01	1.66913E+01
48	1701	1.36080E+01	1.29214E+01
49	1733	1.38640E+01	1.00030E+01

NUCLIDE DENSITY

	CODE NO.	NUCLIDE DENSITY
REGION 1	5	1.12190E-02
	6	3.89340E-02
	7	4.08890E-03
REGION 2	2	5.72920E-02
	4	3.84760E-02
	5	8.50700E-04
	6	2.95200E-03
	7	3.10100E-04
REGION 3	5	8.50700E-04
	6	2.95200E-03
	7	3.10100E-04
	8	6.51940E-03
	9	3.38210E-02
REGION 4	3	1.80800E-02
	5	3.64500E-03
	6	1.33850E-02
	7	2.19600E-03
REGION 5	5	6.17300E-03
	6	2.26620E-02
	7	2.58390E-03
	10	1.99530E-02
	11	1.78230E-03
REGION 6	2	5.72920E-02
	4	3.84760E-02
	5	8.50700E-04
	6	2.95200E-03
	7	3.10100E-04
REGION 7	5	8.50700E-04
	6	2.95200E-03
	7	3.10100E-04
	8	8.51940E-03
	9	3.38210E-02
REGION 8	3	1.80800E-02
	5	3.64500E-03
	6	1.33850E-02
	7	2.19300E-03

INPUT SOURCE DISTRIBUTION

1	0.0	2	0.0	3	3.10000E-01	4	0.0
5	3.80000E-01	6	0.0	7	3.10000E-01	8	0.0

THIS PROBLEM REQUIRED 141701 WORDS (FOR JAERI 41953 ,FOR ESELEM 141701)

UPKAI = 0.41192E+00 UPKF = 0.10207E+01

FISSION SPECTRUM OF UPPER GROUPS

4.91059E-03	1.53105E-02	3.31703E-02	5.60402E-02	8.73170E-02	8.96361E-02
1.23536E-01					

Table 1 continued

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

ITERATION	TIME MIN.SEC.	BROAD GROUP EIGEN VALUE	EIGEN VALUE	CONVERGENCE CRITERION	BUCKLING	CHI
1	13.47	0.1596262194	1.0032323301	1.00000E+00	4.76100E-03	5.91954E-01
2	27. 2	0.1604573987	1.0045686662	1.33026E-03	4.76100E-03	5.91954E-01

ITERATION COUNT LIMIT EXCEEDED 2

SOURCE DISTRIBUTION

0.0	0.0	3.09283E-01	0.0	3.80994E-01	0.0	3.09724E-01	0.0

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

FLUX OF BROAD GROUP

GRP.	MESH 1	MESH 2	MESH 3	MESH 4	MESH 5	MESH 6	MESH 7	MESH 8
1	5.4302E-03	3.3317E-03	6.9274E-03	1.3432E-02	3.3788E-03	1.3320E-02	6.9917E-03	6.6214E-03
2	1.7281E-02	1.0611E-02	2.2034E-02	4.2767E-02	1.0742E-02	4.2431E-02	2.2227E-02	2.1077E-02
3	3.7940E-02	2.3302E-02	4.8334E-02	9.4102E-02	2.3570E-02	9.3306E-02	4.8746E-02	4.6307E-02
4	6.4508E-02	3.9644E-02	8.2354E-02	1.6070E-01	4.0233E-02	1.5868E-01	8.2939E-02	7.8904E-02
5	9.9371E-02	5.0996E-02	1.2670E-01	2.4746E-01	6.1761E-02	2.4133E-01	1.2649E-01	1.2073E-01
6	1.2499E-01	7.6467E-02	1.5599E-01	3.0564E-01	7.6068E-02	3.0644E-01	1.5699E-01	1.5003E-01
7	1.8172E-01	1.1069E-01	2.2556E-01	4.4272E-01	1.0960E-01	4.3959E-01	2.2598E-01	2.1693E-01

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

BROAD GROUP CROSS SECTIONS

GRP	TOTAL	NU*FISSION	REMOVAL	SCATTERING	CAPTURE	TRANSPORT	ELASTIC REM.	FISSION
1	1.5984E-01	3.4794E-02	8.1762E-02	6.3453E-02	8.0917E-03	9.3099E-02	7.2838E-03	1.4598E-02
2	1.7814E-01	4.0544E-02	8.3636E-02	1.0188E-01	5.1499E-03	9.9720E-02	9.5306E-03	1.3398E-02
3	1.9158E-01	3.1032E-02	8.3726E-02	1.2042E-01	1.9557E-03	1.0520E-01	1.4414E-02	9.5006E-03
4	2.0363E-01	2.7785E-02	8.7629E-02	1.3242E-01	2.0179E-03	1.1640E-01	1.7816E-02	8.9817E-03
5	2.2567E-01	2.7149E-02	8.9259E-02	1.5089E-01	5.9301E-04	1.3957E-01	2.5013E-02	9.1743E-03
6	2.0251E-01	2.6462E-02	8.1236E-02	1.4431E-01	4.5026E-04	1.2426E-01	2.3216E-02	9.2372E-03
7	2.0216E-01	2.5902E-02	7.6963E-02	1.4715E-01	4.9095E-04	1.3911E-01	2.2337E-02	9.3061E-03

TRANSFER MATRIX FROM BROAD GROUPS

	1	2	3	4	5	6	7
1	4.3869E-02	0.0	0.0	0.0	0.0	0.0	0.0
2	1.1636E-02	5.4459E-02	0.0	0.0	0.0	0.0	0.0
3	4.0516E-03	1.3589E-02	6.1140E-02	0.0	0.0	0.0	0.0
4	5.5861E-03	3.9025E-03	1.6691E-02	1.1600E-01	0.0	0.0	0.0
5	1.3222E-02	4.0086E-03	3.5997E-03	2.1425E-02	1.3643E-01	0.0	0.0
6	1.0351E-02	3.9623E-03	4.7009E-03	2.9269E-03	3.0417E-02	1.2107E-01	0.0
7	1.1764E-02	8.5729E-03	6.6462E-03	6.1816E-03	6.5300E-03	2.9802E-02	1.2519E-01
8	4.5697E-03	1.0450E-02	8.4442E-03	1.1461E-02	5.9582E-03	1.0905E-02	3.0468E-02
9	2.6619E-03	7.1069E-03	6.3218E-03	6.4968E-03	5.2029E-03	4.6787E-03	7.7955E-03
10	3.0698E-03	7.8166E-03	8.5512E-03	8.5232E-03	8.5396E-03	5.7602E-03	8.5967E-03
11	1.4480E-03	3.5947E-03	4.5307E-03	4.9783E-03	5.2057E-03	4.0136E-03	4.7635E-03
12	9.4835E-04	2.3264E-03	3.3306E-03	3.7079E-03	4.2044E-03	3.5846E-03	3.1694E-03
13	6.4931E-04	1.5696E-03	2.4413E-03	2.9144E-03	3.3502E-03	2.9748E-03	2.5667E-03
14	5.5034E-04	1.3307E-03	2.1695E-03	2.6762E-03	3.1744E-03	2.9902E-03	2.4712E-03
15	2.8515E-04	7.0397E-04	1.1598E-03	1.4372E-03	1.6239E-03	1.7363E-03	1.6012E-03
16	2.0461E-04	5.2446E-04	8.8112E-04	1.1239E-03	1.4173E-03	1.3645E-03	1.2663E-03
17	2.0082E-04	5.2580E-04	8.6822E-04	1.1152E-03	1.4630E-03	1.4476E-03	1.4353E-03
18	7.9967E-05	2.1182E-04	3.6469E-04	4.7538E-04	6.2267E-04	5.8839E-04	9.7749E-04
19	3.8877E-05	1.0379E-04	1.8302E-04	2.3724E-04	3.1441E-04	3.1069E-04	3.4366E-04
20	4.4241E-05	1.1784E-04	2.1277E-04	2.8143E-04	3.7233E-04	3.9306E-04	4.4834E-04
21	2.6994E-05	7.7839E-05	1.4195E-04	1.8797E-04	2.3816E-04	2.7396E-04	7.3522E-04
22	1.6157E-05	4.3818E-05	8.0278E-05	1.1276E-04	1.2828E-04	1.7824E-04	2.0182E-04
23	1.0377E-05	2.7990E-05	5.1522E-05	6.9701E-05	8.2345E-05	1.2349E-04	9.4665E-05
24	6.9143E-06	1.7153E-05	6.6911E-05	4.2240E-05	4.9366E-05	6.9203E-05	5.8942E-05
25	3.8400E-06	1.0569E-05	1.9666E-04	2.5348E-05	2.9668E-05	4.2307E-05	3.5348E-05
26	2.3039E-06	7.5315E-06	3.6974E-05	1.5749E-05	1.8284E-05	2.7261E-05	2.2353E-05
27	1.2398E-06	4.2350E-06	6.6605E-06	8.7689E-06	9.9899E-06	1.6348E-05	1.2856E-05
28	7.6970E-07	2.2448E-06	4.1526E-06	5.5258E-06	6.3668E-06	1.1540E-05	8.2771E-06
29	3.5632E-07	1.2870E-06	2.5013E-06	3.3573E-06	3.8320E-06	6.7268E-06	5.1275E-06
30	0.0	2.8681E-07	5.4595E-07	7.4999E-07	8.4450E-07	1.5679E-06	1.1461E-06

Table 1 continued

ESELEN 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

FLUX OF FINE GROUP

GRP.	MESH 1	MESH 2	MESH 3	MESH 4	MESH 5	MESH 6	MESH 7	MESH 8
COARSE GROUP 1								
213	4.7493E-03	2.8835E-03	5.9504E-03	1.1713E-02	2.8949E-03	1.1236E-02	5.8797E-03	5.6688E-03
214	5.3295E-03	3.2341E-03	6.6435E-03	1.3039E-02	3.2107E-03	1.2620E-02	6.5813E-03	6.3406E-03
215	5.4639E-03	3.3213E-03	6.7954E-03	1.3316E-02	3.2853E-03	1.3045E-02	6.7594E-03	6.4976E-03
216	5.5811E-03	3.3916E-03	6.9322E-03	1.3562E-02	3.3473E-03	1.3317E-02	6.8994E-03	6.6256E-03
217	5.5261E-03	3.3425E-03	6.8503E-03	1.3394E-02	3.2974E-03	1.2959E-02	6.7701E-03	6.5160E-03
218	5.5084E-03	3.3165E-03	6.8062E-03	1.3307E-02	3.2711E-03	1.2749E-02	6.6887E-03	6.4485E-03
219	6.0682E-03	3.6664E-03	7.4264E-03	1.4525E-02	3.5823E-03	1.4314E-02	7.3625E-03	7.0785E-03
220	6.1487E-03	3.7069E-03	7.5176E-03	1.4681E-02	3.6178E-03	1.4416E-02	7.4365E-03	7.1509E-03
221	6.1267E-03	3.6961E-03	7.5039E-03	1.4639E-02	3.6066E-03	1.4342E-02	7.4192E-03	7.1322E-03
222	6.0084E-03	3.6297E-03	7.3433E-03	1.4391E-02	3.5483E-03	1.4093E-02	7.3049E-03	7.0165E-03
223	5.8516E-03	3.5440E-03	7.2237E-03	1.4066E-02	3.4736E-03	1.3801E-02	7.1619E-03	6.8687E-03
224	5.9159E-03	3.5808E-03	7.2929E-03	1.4218E-02	3.5074E-03	1.3936E-02	7.2266E-03	6.9386E-03
225	6.2077E-03	3.7390E-03	7.5912E-03	1.4832E-02	3.6450E-03	1.4448E-02	7.4860E-03	7.2128E-03
226	6.4038E-03	3.8513E-03	7.8128E-03	1.5264E-02	3.7465E-03	1.4844E-02	7.6912E-03	7.4241E-03
227	6.5016E-03	3.9311E-03	7.9770E-03	1.5614E-02	3.8295E-03	1.5308E-02	7.9011E-03	7.6163E-03
228	6.4191E-03	3.8993E-03	7.9318E-03	1.5520E-02	3.8102E-03	1.5292E-02	7.8948E-03	7.5978E-03
229	6.3387E-03	3.8488E-03	7.8471E-03	1.5330E-02	3.7630E-03	1.5053E-02	7.7980E-03	7.5037E-03
230	5.8669E-03	3.5404E-03	7.2848E-03	1.4228E-02	3.4792E-03	1.3553E-02	7.1594E-03	6.9110E-03
231	5.5178E-03	3.3146E-03	6.8602E-03	1.3392E-02	3.2725E-03	1.2514E-02	6.6853E-03	6.4618E-03
232	6.0458E-03	3.6538E-03	7.4343E-03	1.4475E-02	3.5662E-03	1.4141E-02	7.3410E-03	7.0538E-03
233	6.2755E-03	3.8006E-03	7.6759E-03	1.4655E-02	3.6892E-03	1.4648E-02	7.6257E-03	7.2766E-03
234	6.4856E-03	3.9271E-03	7.9378E-03	1.5418E-02	3.8114E-03	1.5335E-02	7.8875E-03	7.5514E-03
235	6.6946E-03	4.0522E-03	8.2693E-03	1.6050E-02	3.9390E-03	1.5606E-02	8.1466E-03	7.8464E-03
236	6.8465E-03	4.1451E-03	8.4108E-03	1.6471E-02	4.0282E-03	1.6153E-02	8.3437E-03	8.0523E-03
237	6.9302E-03	4.1974E-03	8.5250E-03	1.6702E-02	4.0779E-03	1.6351E-02	8.4572E-03	8.1674E-03
238	6.7662E-03	4.1169E-03	8.3869E-03	1.6408E-02	4.0114E-03	1.6130E-02	8.3560E-03	8.0523E-03
239	6.6161E-03	4.0391E-03	8.2432E-03	1.6110E-02	3.9441E-03	1.5890E-02	8.2368E-03	7.9264E-03
240	6.8383E-03	4.1589E-03	8.4624E-03	1.6554E-02	4.0472E-03	1.6298E-02	8.4356E-03	8.1291E-03
241	7.2063E-03	4.3624E-03	8.8366E-03	1.7292E-02	4.2222E-03	1.7008E-02	8.7766E-03	8.4704E-03
242	7.4398E-03	4.4949E-03	9.0645E-03	1.7763E-02	4.3360E-03	1.7482E-02	9.0069E-03	8.6953E-03
243	7.5598E-03	4.5614E-03	9.2231E-03	1.8048E-02	4.3960E-03	1.7685E-02	9.1296E-03	8.8251E-03
244	7.5378E-03	4.5473E-03	9.2069E-03	1.8011E-02	4.3832E-03	1.7601E-02	9.1072E-03	8.8061E-03
245	7.3496E-03	4.4427E-03	9.0119E-03	1.7593E-02	4.2686E-03	1.7226E-02	8.9287E-03	8.6167E-03
246	7.0939E-03	4.3011E-03	8.7438E-03	1.7066E-02	4.1659E-03	1.6742E-02	8.6849E-03	8.3716E-03
247	6.9979E-03	4.2487E-03	8.6532E-03	1.6863E-02	4.1191E-03	1.6548E-02	8.6032E-03	8.2907E-03
248	7.0646E-03	4.2770E-03	8.7043E-03	1.6964E-02	4.1387E-03	1.6577E-02	8.6283E-03	8.3246E-03
249	7.1651E-03	4.3231E-03	8.7895E-03	1.7142E-02	4.1724E-03	1.6656E-02	8.6818E-03	8.3842E-03
250	7.2710E-03	4.3786E-03	8.8900E-03	1.7328E-02	4.2170E-03	1.6823E-02	8.7651E-03	8.4663E-03
251	7.4004E-03	4.4524E-03	9.0122E-03	1.7524E-02	4.1746E-03	1.7102E-02	8.8845E-03	8.5655E-03
COARSE GROUP 2								
252	7.5823E-03	4.5627E-03	9.2411E-03	1.8038E-02	4.3840E-03	1.7536E-02	9.1067E-03	8.8096E-03
253	7.6956E-03	4.6341E-03	9.4016E-03	1.8397E-02	4.4570E-03	1.7814E-02	9.2678E-03	8.9829E-03
254	7.6019E-03	4.5785E-03	9.3063E-03	1.8189E-02	4.4059E-03	1.7570E-02	9.1690E-03	8.8828E-03
255	7.3716E-03	4.4423E-03	9.0490E-03	1.7669E-02	4.2823E-03	1.7027E-02	8.9112E-03	8.6269E-03
256	7.1082E-03	4.2853E-03	8.7561E-03	1.7087E-02	4.1407E-03	1.6387E-02	8.6140E-03	8.3374E-03
257	6.7905E-03	4.0903E-03	8.3836E-03	1.6378E-02	3.9674E-03	1.5579E-02	8.2245E-03	7.9691E-03
258	6.5137E-03	3.9204E-03	8.0798E-03	1.5776E-02	3.8142E-03	1.4835E-02	7.9023E-03	7.6614E-03
259	6.2335E-03	3.7477E-03	7.7606E-03	1.5159E-02	3.6604E-03	1.4097E-02	7.5645E-03	7.3404E-03
260	6.2355E-03	3.7553E-03	7.7620E-03	1.5164E-02	3.6646E-03	1.4179E-02	7.5788E-03	7.3507E-03
261	6.6051E-03	3.9972E-03	8.1911E-03	1.5988E-02	3.8777E-03	1.5321E-02	8.0637E-03	7.7999E-03
262	6.8714E-03	4.1713E-03	8.5154E-03	1.6600E-02	4.0352E-03	1.6126E-02	8.4294E-03	8.1344E-03
263	6.9852E-03	4.2482E-03	8.6664E-03	1.6868E-02	4.1047E-03	1.6466E-02	8.6047E-03	8.2887E-03
264	7.0576E-03	4.2916E-03	8.7491E-03	1.7019E-02	4.1427E-03	1.6658E-02	8.6908E-03	8.3677E-03
265	7.1791E-03	4.3552E-03	8.8662E-03	1.7248E-02	4.1958E-03	1.6853E-02	8.7901E-03	8.4697E-03
266	7.2779E-03	4.4022E-03	8.9457E-03	1.7422E-02	4.2353E-03	1.6977E-02	8.8453E-03	8.5353E-03
267	7.4659E-03	4.5046E-03	9.1524E-03	1.7602E-02	4.3201E-03	1.7286E-02	9.0286E-03	8.7159E-03
268	7.6278E-03	4.5895E-03	9.3182E-03	1.8119E-02	4.3912E-03	1.7531E-02	9.1682E-03	8.8582E-03
269	7.7880E-03	4.6734E-03	9.4823E-03	1.8439E-02	4.4622E-03	1.7774E-02	9.3057E-03	9.0005E-03
270	7.9259E-03	4.7450E-03	9.6227E-03	1.8730E-02	4.5252E-03	1.7980E-02	9.4209E-03	9.1255E-03
271	8.0251E-03	4.7967E-03	9.7252E-03	1.8942E-02	4.5707E-03	1.8127E-02	9.5046E-03	9.2161E-03
272	7.9511E-03	4.7613E-03	9.6873E-03	1.8810E-02	4.5405E-03	1.8020E-02	9.4585E-03	9.1617E-03
273	7.9242E-03	4.7501E-03	9.6446E-03	1.8744E-02	4.5288E-03	1.7998E-02	9.4440E-03	9.1369E-03
274	7.8609E-03	4.7274E-03	9.5930E-03	1.8616E-02	4.5080E-03	1.8005E-02	9.4224E-03	9.0962E-03
275	7.7348E-03	4.6693E-03	9.4699E-03	1.8371E-02	4.4603E-03	1.7905E-02	9.3353E-03	8.9962E-03
276	7.7543E-03	4.6876E-03	9.4956E-03	1.8400E-02	4.4744E-03	1.8029E-02	9.3791E-03	9.0247E-03
277	7.8252E-03	4.7387E-03	9.5962E-03	1.8543E-02	4.5146E-03	1.8269E-02	9.5015E-03	9.1204E-03
278	7.8226E-03	4.7512E-03	9.6257E-03	1.8566E-02	4.5273E-03	1.8397E-02	9.5618E-03	9.1586E-03
279	7.8033E-03	4.7478E-03	9.6119E-03	1.8513E-02	4.5237E-03	1.8447E-02	9.5708E-03	9.1498E-03
280	7.8535E-03	4.7799E-03	9.6575E-03	1.8578E-02	4.5485E-03	1.8610E-02	9.6292E-03	9.1916E-03
281	8.0492E-03	4.8902E-03	9.8582E-03	1.8963E-02	4.6422E-03	1.9019E-02	9.8224E-03	9.3784E-03
282	8.2489E-03	5.0016E-03	1.0085E-02	1.9411E-02	4.7406E-03	1.9384E-02	1.0030E-02	9.5916E-03
COARSE GROUP 3								
283	8.2288E-03	4.9806E-03	1.0050E-02	1.9354E-02	4.7226E-03	1.9235E-02	9.9737E-03	9.5485E-03
284	8.1107E-03	4.8966E-03	9.8755E-03	1.9006E-02	4.6415E-03	1.8836E-02	9.7745E-03	9.3582E-03
285	7.9323E-03	4.8013E-03	9.7248E-03	1.8684E-02	4.5571E-03	1.8474E-02	9.6367E-03	9.2198E-03
286	7.5871E-03	4.6228E-03	9.4255E-03	1.8099E-02	4.4080E-03	1.7884E-02	9.3865E-03	8.9697E-03
287	7.5345E-03	4.5793E-03	9.3567E-03	1.8007E-02	4.3703E-03	1.7618E-02	9.2926E-03	8.9051E-03
288	7.5113E-03	4.5482E-03	9.3153E-03	1.7968E-02	4.3447E-03	1.7371E-02	9.2092E-03	8.8554E-03
289	7.5227E-03	4.5302E-03	9.2947E-03	1.7963E-02	4.3311E-03	1.7138E-02	9.1334E-03	8.8178E-03
290	7.5771E-03	4.5285E-03	9.3015E-03	1.8069E-02	4.3331E-03	1.6930E-02	9.0708E-03	8.8005E-03
291	7.4515E-03	4.4401E-03	9.1543E-03	1.7628E-02	4.2616E-03	1.6485E-02	8.8904E-03	8.6498E-03
292	7.1305E-03	4.2506E-03	8.8008E-03	1.7190E-02	4.1030E-03	1.5746E-02	8.5291E-03	8.3146E-03
293	6.9213E-03	4.1314E-03	8.5929E-03	1.6748E-02	3.9934E-03	1.5269E-02	8.3286E-03	8.1090E-03
294	6.8203E-03	4.0809E-03	8.4845E-03	1.6469E-02	3.9361E-03	1.5118E-02	8.2402E-03	7.9963E-03
295	6.8437E-03	4.1204E-03	8.5333E-03	1.6471E-02	3.9554E-03	1.5424E-02	8.3418E-03	8.0516E-03
296	7.0264E-03	4.2504E-03	8.7704E-03	1.6920E-02	4.0706E-03	1.6065E-02	8.6202E-03	8.3065E-03
297	7.3620E-03	4.4579E-03	9.1680E-03	1.7732E-02	4.2627E-03	1.6928E-02	9.0307E-03	8.7145E-03
298	7.7948E-03	4.7093E-03	9.6422E-03	1.8693E-02	4.4892E-03	1.7893E-02	9.4931E-03	9.1777E-03
299	8.4604E-03	5.0680E-03	1.0300E-02	1.9999E-02	4.7991E-03	1.9121E-02	1.0088E-02	9.7765E-03
300	8.8118E-03	5.2637E-03	1.0637E-02	2.0617E-02	4.9604E-03	1.9848E-02	1.0407E-02	1.0072E-02
301	8.9460E-03	5.3673E-03	1.0836E-02	2.0869E-02	5.0403E-03	2.0353E-02	1.0649E-02	1.0250E-02
302	8.9631E-03	5.3959E-03	1.0871E-02	2.0818E-02	5.0522E-03	2.0577E-02	1.0728E-02	1.0269E-02
303	9.0078E-03	5.4335E-03	1.0917E-02	2.0821E-02	5.0741E-03	2.0810E-02	1.0806E-02	1.0299E-02
304	8.9727E-03	5.4325E-03	1.0901E-02	2.0736E-02	5.0707E-03	2.0944E-02	1.0836E-02	1.0291E-02
305	8.9167E-03	5.4232E-03	1.0882E-02	2.0705E-02	5.0739E-03	2.1076E-02	1.0868E-02	1.0305E-02
306	8.8909E-03	5.4347E-03	1.0918E-02	2.0651E-02	5.1085E-03	2.1309E-02	1.0959E-02	1.0401E-02
307	9.2321E-03	5.6331E-03	1.1309E-02	2.1707E-02	5.2980E-03	2.2069E-02	1.1338E-02	1.0809E-02
308	9.8064E-03	5.9626E-03	1.1979E-02	2.3066E-02	5.5947E-03	2.3225E-02	1.1973E-02	1.1467E-02
309	1.0175E-02	6.1837E-03	1.2448E-02	2.4019E-02	5.8024E-03	2.4043E-02	1.2432E-02	1.1939E-02
310	1.0316E-02	6.2800E-03	1.2670E-02	2.4474E-02	5.9022E-03	2.4455E-02	1.2670E-02	1.2179E-02
311	1.0566E-02	6.4227E-03	1.2955E-02	2.5048E-02	6.0314E-03	2.4959E-02	1.2942E-02	1.2456E-02
312	1.0915E-02	6.6087E-03	1.3307E-02	2.5752E-02	6.1912E-03	2.5555E-02	1.3250E-02	1.2776E-02
313	1.1133E-02	6.7292E-03	1.3543E-02	2.6219E-02	6.2979E-03	2.5961E-02	1.3465E-02	1.2995E-02
314	1.1192E-02	6.7621E-03	1.3609E-02	2.6360E-02	6.3309E-03	2.6074E-02	1.3524E-02	1.3058E-02
315	1.1280E-02	6.8107E-03	1.3724E-02	2.6540E-02	6.3672E-03	2.6193E-02	1.3628E-02	1.3154E-02
316	1.1181E-02	6.7556E-03	1.3631E-02	2.6314E-02	6.3113E-03	2.5962E-02	1.3541E-02	1.3057E-02
317	1.1017E-02	6.6626E-03	1.3455E-02	2.5939E-02	6.2240E-03	2.5602E-02	1.3365E-02	1.2886E-02
318	1.0666E-02	6.4661E-03	1.3067E-02	2.5131E-02	6.0425E-03	2.4899E-02	1.3036E-02	1.2515E-02
319	1.0335E-02	6.2751E-03	1.2716E-02	2.4339E-02	5.8621E-03	2.4153E-02	1.2663E-02	1.2143E-02
320	1.0170E-02	6.1757E-03	1.2503E-02	2.3873E-02	5.7609E-03	2.3612E-02	1.2478E-02	1.1921E-02
321	1.0153E-02	6.1808E-03	1.2455E-02	2.3770E-02	5.7625E-03	2.3998E-02	1.2462E-02	1.1890E-02
COARSE GROUP 4								
322	1.0431E-02	6.3450E-03	1.2755E-02	2.4246E-02	5.6937E-03	2.4656E-02	1.2779E-02	1.2139E-02
323	1.0634E-02	6.4655E-03	1.2931E-02	2.4575E-02	5.9924E-03	2.5158E-02	1.2986E-02	1.2307E-02

Table 1 continued

1622	8.9260E-10	5.1407E-10	9.3763E-10	1.9667E-09	4.2523E-10	1.6588E-09	8.8249E-10	8.9653E-10
1623	8.8030E-10	5.0688E-10	9.2459E-10	1.8613E-09	4.1301E-10	1.6302E-09	8.6944E-10	8.8339E-10
1624	8.6827E-10	4.9966E-10	9.1164E-10	1.8345E-09	4.1296E-10	1.8025E-09	8.5674E-10	8.7057E-10
1625	8.5645E-10	4.9296E-10	8.9892E-10	1.8062E-09	4.0701E-10	1.7752E-09	8.4426E-10	8.5796E-10
1626	8.4490E-10	4.8621E-10	8.8652E-10	1.7827E-09	4.0120E-10	1.7486E-09	8.3207E-10	8.4574E-10
1627	8.3364E-10	4.7963E-10	8.7448E-10	1.7582E-09	3.9556E-10	1.7225E-09	8.2021E-10	8.3389E-10
1628	8.2261E-10	4.7318E-10	8.6269E-10	1.7341E-09	3.9003E-10	1.6969E-09	8.0856E-10	8.2224E-10
1629	8.1179E-10	4.6685E-10	8.5111E-10	1.7106E-09	3.8460E-10	1.6718E-09	7.9711E-10	8.1078E-10
1630	8.0116E-10	4.6063E-10	8.3973E-10	1.6874E-09	3.7925E-10	1.6470E-09	7.8584E-10	7.9951E-10
1631	7.9072E-10	4.5452E-10	8.2856E-10	1.6646E-09	3.7400E-10	1.6227E-09	7.7476E-10	7.8843E-10
1632	7.8046E-10	4.4851E-10	8.1757E-10	1.6423E-09	3.6883E-10	1.5987E-09	7.6366E-10	7.7754E-10
1633	7.7037E-10	4.4260E-10	8.0678E-10	1.6204E-09	3.6375E-10	1.5751E-09	7.5313E-10	7.6684E-10
1634	7.6045E-10	4.3679E-10	7.9616E-10	1.5988E-09	3.5875E-10	1.5518E-09	7.4257E-10	7.5631E-10
1635	7.5069E-10	4.3106E-10	7.8571E-10	1.5776E-09	3.5382E-10	1.5289E-09	7.3216E-10	7.4594E-10
1636	7.4120E-10	4.2552E-10	7.7556E-10	1.5571E-09	3.4909E-10	1.5072E-09	7.2216E-10	7.3592E-10
1637	7.6253E-10	4.4007E-10	8.1714E-10	1.6521E-09	3.6380E-10	1.6072E-09	7.7413E-10	7.7986E-10
COARSE GROUP 46								
1638	6.6284E-10	3.7322E-10	6.4796E-10	1.4236E-09	3.3689E-10	1.3835E-09	6.0154E-10	6.3004E-10
1639	6.4582E-10	3.6320E-10	6.2849E-10	1.3864E-09	3.3011E-10	1.3465E-09	5.8163E-10	6.1035E-10
1640	6.3503E-10	3.5746E-10	6.1973E-10	1.3643E-09	3.2463E-10	1.3249E-09	5.7320E-10	6.0040E-10
1641	6.2271E-10	3.5067E-10	6.0836E-10	1.3398E-09	3.1901E-10	1.3013E-09	5.6258E-10	5.8860E-10
1642	6.1052E-10	3.4399E-10	5.9729E-10	1.3156E-09	3.1354E-10	1.2784E-09	5.5238E-10	5.7715E-10
1643	5.9824E-10	3.3726E-10	5.8614E-10	1.2918E-09	3.0806E-10	1.2555E-09	5.4216E-10	5.6566E-10
1644	5.8590E-10	3.3052E-10	5.7498E-10	1.2676E-09	3.0260E-10	1.2327E-09	5.3198E-10	5.5422E-10
1645	5.7258E-10	3.2330E-10	5.6300E-10	1.2415E-09	2.9668E-10	1.2085E-09	5.2115E-10	5.4190E-10
1646	5.6042E-10	3.1662E-10	5.5177E-10	1.2167E-09	2.9102E-10	1.1854E-09	5.1094E-10	5.3056E-10
1647	5.5082E-10	3.1119E-10	5.4251E-10	1.1966E-09	2.8628E-10	1.1656E-09	5.0240E-10	5.2153E-10
1648	5.4183E-10	3.0609E-10	5.3365E-10	1.1777E-09	2.8181E-10	1.1468E-09	4.9438E-10	5.1309E-10
1649	5.3312E-10	3.0115E-10	5.2549E-10	1.1593E-09	2.7746E-10	1.1285E-09	4.8664E-10	5.0493E-10
1650	5.2467E-10	2.9635E-10	5.1737E-10	1.1414E-09	2.7323E-10	1.1106E-09	4.7911E-10	4.9700E-10
1651	5.1648E-10	2.9166E-10	5.0946E-10	1.1240E-09	2.6909E-10	1.0932E-09	4.7175E-10	4.8926E-10
1652	5.0855E-10	2.8715E-10	5.0177E-10	1.1070E-09	2.6505E-10	1.0761E-09	4.6457E-10	4.8174E-10
1653	5.0095E-10	2.8278E-10	4.9433E-10	1.0906E-09	2.6113E-10	1.0595E-09	4.5760E-10	4.7445E-10
1654	4.9366E-10	2.7857E-10	4.8714E-10	1.0747E-09	2.5732E-10	1.0433E-09	4.5082E-10	4.6739E-10
1655	4.8660E-10	2.7446E-10	4.8014E-10	1.0592E-09	2.5359E-10	1.0274E-09	4.4418E-10	4.6050E-10
1656	4.7975E-10	2.7051E-10	4.7334E-10	1.0441E-09	2.4995E-10	1.0119E-09	4.3771E-10	4.5378E-10
1657	4.7312E-10	2.6667E-10	4.6673E-10	1.0294E-09	2.4643E-10	9.9692E-10	4.3143E-10	4.4725E-10
1658	4.6663E-10	2.6291E-10	4.6023E-10	1.0149E-09	2.4296E-10	9.8222E-10	4.2524E-10	4.4079E-10
1659	4.6032E-10	2.5925E-10	4.5391E-10	1.0008E-09	2.3957E-10	9.6788E-10	4.1923E-10	4.3455E-10
1660	4.5418E-10	2.5569E-10	4.4778E-10	9.8726E-10	2.3629E-10	9.5395E-10	4.1341E-10	4.2859E-10
1661	4.4818E-10	2.5221E-10	4.4179E-10	9.7403E-10	2.3308E-10	9.4031E-10	4.0773E-10	4.2278E-10
1662	4.4233E-10	2.4880E-10	4.3593E-10	9.6109E-10	2.2994E-10	9.2696E-10	4.0217E-10	4.1710E-10
1663	4.3659E-10	2.4547E-10	4.3018E-10	9.4841E-10	2.2686E-10	9.1386E-10	3.9672E-10	4.1153E-10
1664	4.3097E-10	2.4220E-10	4.2455E-10	9.3599E-10	2.2384E-10	9.0102E-10	3.9138E-10	4.0608E-10
1665	4.2547E-10	2.3900E-10	4.1903E-10	9.2381E-10	2.2087E-10	8.8843E-10	3.8613E-10	4.0074E-10
1666	4.2006E-10	2.3585E-10	4.1361E-10	9.1168E-10	2.1796E-10	8.7607E-10	3.8099E-10	3.9550E-10
1667	4.1476E-10	2.3276E-10	4.0829E-10	9.0017E-10	2.1511E-10	8.6394E-10	3.7594E-10	3.9037E-10
1668	4.0950E-10	2.2969E-10	4.0301E-10	8.8856E-10	2.1226E-10	8.5166E-10	3.7050E-10	3.8527E-10
1669	2.7064E-10	1.3937E-10	1.3559E-10	5.5228E-10	1.3384E-10	5.3127E-10	1.1024E-10	1.6478E-10
COARSE GROUP 47								
1670	4.4240E-10	2.5570E-10	4.8142E-10	9.1859E-10	1.9436E-10	8.6718E-10	4.4018E-10	4.3914E-10
1671	4.3580E-10	2.5111E-10	4.7058E-10	9.0316E-10	1.9152E-10	8.5323E-10	4.3192E-10	4.3220E-10
1672	4.2849E-10	2.4606E-10	4.5869E-10	8.8629E-10	1.6846E-10	8.3784E-10	4.2248E-10	4.2424E-10
1673	4.2522E-10	2.4391E-10	4.5407E-10	8.7744E-10	1.6639E-10	8.2840E-10	4.1797E-10	4.2042E-10
1674	4.2248E-10	2.4210E-10	4.5022E-10	8.6971E-10	1.6454E-10	8.1994E-10	4.1409E-10	4.1715E-10
1675	4.2016E-10	2.4055E-10	4.4696E-10	8.6285E-10	1.6286E-10	8.1226E-10	4.1069E-10	4.1433E-10
1676	4.1809E-10	2.3915E-10	4.4396E-10	8.5647E-10	1.6128E-10	8.0500E-10	4.0753E-10	4.1172E-10
1677	4.2006E-10	2.3980E-10	4.4452E-10	8.5764E-10	1.6105E-10	8.0289E-10	4.0723E-10	4.1277E-10
1678	4.2191E-10	2.4045E-10	4.4526E-10	8.5922E-10	1.8095E-10	8.0129E-10	4.0714E-10	4.1380E-10
1679	4.1941E-10	2.3897E-10	4.4245E-10	8.5330E-10	1.7959E-10	7.9484E-10	4.0419E-10	4.1096E-10
1680	4.1661E-10	2.3731E-10	4.3921E-10	8.4680E-10	1.7810E-10	7.8790E-10	4.0085E-10	4.0775E-10
1681	4.1386E-10	2.3566E-10	4.3592E-10	8.4033E-10	1.7661E-10	7.8094E-10	3.9744E-10	4.0450E-10
1682	4.1115E-10	2.3403E-10	4.3267E-10	8.3397E-10	1.7514E-10	7.7411E-10	3.9407E-10	4.0130E-10
1683	4.0847E-10	2.3243E-10	4.2946E-10	8.2773E-10	1.7370E-10	7.6742E-10	3.9075E-10	3.9815E-10
1684	4.0580E-10	2.3084E-10	4.2629E-10	8.2157E-10	1.7228E-10	7.6085E-10	3.8748E-10	3.9503E-10
1685	4.0304E-10	2.2921E-10	4.2307E-10	8.1531E-10	1.7086E-10	7.5429E-10	3.8420E-10	3.9186E-10
1686	4.0006E-10	2.2749E-10	4.1969E-10	8.0876E-10	1.6939E-10	7.4764E-10	3.8085E-10	3.8862E-10
1687	3.9703E-10	2.2577E-10	4.1631E-10	8.0219E-10	1.6795E-10	7.4136E-10	3.7759E-10	3.8541E-10
1688	3.9397E-10	2.2404E-10	4.1292E-10	7.9561E-10	1.6651E-10	7.3510E-10	3.7435E-10	3.8220E-10
1689	3.9083E-10	2.2223E-10	4.0943E-10	7.8890E-10	1.6503E-10	7.2847E-10	3.7100E-10	3.7891E-10
1690	3.8776E-10	2.2048E-10	4.0609E-10	7.8266E-10	1.6363E-10	7.2215E-10	3.6763E-10	3.7590E-10
1691	3.8470E-10	2.1874E-10	4.0276E-10	7.7641E-10	1.6223E-10	7.1588E-10	3.6467E-10	3.7286E-10
1692	3.8155E-10	2.1694E-10	3.9931E-10	7.6970E-10	1.6077E-10	7.0943E-10	3.6135E-10	3.6955E-10
1693	3.7839E-10	2.1515E-10	3.9564E-10	7.6301E-10	1.5931E-10	7.0303E-10	3.5805E-10	3.6624E-10
1694	3.7523E-10	2.1336E-10	3.9239E-10	7.5635E-10	1.5787E-10	6.9668E-10	3.5477E-10	3.6295E-10
1695	3.7208E-10	2.1157E-10	3.8896E-10	7.4973E-10	1.5644E-10	6.9039E-10	3.5152E-10	3.5969E-10
1696	3.6894E-10	2.0980E-10	3.8555E-10	7.4315E-10	1.5502E-10	6.8416E-10	3.4829E-10	3.5645E-10
1697	3.6582E-10	2.0803E-10	3.8215E-10	7.3660E-10	1.5361E-10	6.7798E-10	3.4509E-10	3.5323E-10
1698	3.6272E-10	2.0627E-10	3.7878E-10	7.3008E-10	1.5221E-10	6.7187E-10	3.4191E-10	3.5003E-10
1699	3.5962E-10	2.0452E-10	3.7542E-10	7.2358E-10	1.5081E-10	6.6581E-10	3.3875E-10	3.4684E-10
1700	3.5601E-10	2.0245E-10	3.7101E-10	7.1536E-10	1.4900E-10	6.5863E-10	3.3460E-10	3.4279E-10
1701	3.4092E-10	1.9256E-10	3.4569E-10	6.7419E-10	1.3894E-10	6.1982E-10	3.1038E-10	3.2171E-10
COARSE GROUP 48								
1702	3.2877E-10	1.8481E-10	3.2699E-10	6.4213E-10	1.3117E-10	5.8896E-10	2.9150E-10	3.0495E-10
1703	3.2385E-10	1.8204E-10	3.2163E-10	6.3161E-10	1.2892E-10	5.7945E-10	2.8658E-10	2.9982E-10
1704	3.1891E-10	1.7927E-10	3.1670E-10	6.2137E-10	1.2684E-10	5.7039E-10	2.8164E-10	2.9481E-10
1705	3.1413E-10	1.7663E-10	3.1192E-10	6.1165E-10	1.2491E-10	5.6196E-10	2.7754E-10	2.9017E-10
1706	3.0929E-10	1.7396E-10	3.0712E-10	6.0189E-10	1.2298E-10	5.5355E-10	2.7328E-10	2.8553E-10
1707	3.0439E-10	1.7126E-10	3.0226E-10	5.9204E-10	1.2105E-10	5.4512E-10	2.6901E-10	2.8086E-10
1708	2.9941E-10	1.6852E-10	2.9740E-10	5.8210E-10	1.1909E-10	5.3663E-10	2.6472E-10	2.7620E-10
1709	2.9468E-10	1.6591E-10	2.9274E-10	5.7270E-10	1.1724E-10	5.2846E-10	2.6061E-10	2.7176E-10
1710	2.9050E-10	1.6357E-10	2.8857E-10	5.6444E-10	1.1558E-10	5.2099E-10	2.5689E-10	2.6782E-10
1711	2.8666E-10	1.6141E-10	2.8473E-10	5.5686E-10	1.1404E-10	5.1397E-10	2.5344E-10	2.6420E-10
1712	2.8294E-10	1.5931E-10	2.8101E-10	5.4952E-10	1.1255E-10	5.0714E-10	2.5009E-10	2.6069E-10
1713	2.7932E-10	1.5727E-10	2.7739E-10	5.4237E-10	1.1109E-10	5.0044E-10	2.4682E-10	2.5727E-10
1714	2.7577E-10	1.5526E-10	2.7385E-10	5.3537E-10	1.0966E-10	4.9383E-10	2.4361E-10	2.5391E-10
1715	2.7232E-10	1.5330E-10	2.7039E-10	5.2852E-10	1.0825E-10	4.8733E-10	2.4045E-10	2.5062E-10
1716	2.6896E-10	1.5139E-10	2.6701E-10	5.2185E-10	1.0688E-10	4.8094E-10	2.3736E-10	2.4741E-10
1717	2.6570E-10	1.4953E-10	2.6371E-10	5.1534E-10	1.0553E-10	4.7465E-10	2.3432E-10	2.4426E-10
1718	2.6253E-10	1.4771E-10	2.6049E-10	5.0898E-10	1.0421E-10	4.6847E-10	2.3134E-10	2.4117E-10
1719	2.5942E-10	1.4593E-10	2.5733E-10	5.0274E-10	1.0292E-10	4.6240E-10	2.2842E-10	2.3814E-10
1720	2.5638E-10	1.4418E-10	2.5424E-10	4.9662E-10	1.0165E-10	4.5648E-10	2.2555E-10	2.3516E-10
1721	2.5340E-10	1.4247E-10	2.5120E-10	4.9061E-10	1.0041E-10	4.5066E-10	2.2274E-10	2.3224E-10
1722	2.5047E-10	1.4079E-10	2.4822E-10	4.8474E-10	9.9184E-11	4.4494E-10	2.1997E-10	2.2938E-10
1723	2.4761E-10	1.3914E-10	2.4530E-10	4.7902E-10	9.7988E-11	4.3932E-10	2.1727E-10	2.2660E-10
1724	2.4479E-10	1.3753E-10	2.4245E-10	4.7343E-10	9.6814E-11	4.3379E-10	2.1461E-10	2.2387E-10
1725	2.4203E-10	1.3594E-10	2.3964E-10	4.6794E-10	9.5656E-11	4.2834E-10	2.1200E-10	2.2119E-10
1726	2.3931E-10	1.3437E-10	2.3687E-10	4.6254E-10	9.4520E-11	4.2296E-10	2.0942E-10	2.1856E-10
1727	2.3663E-10	1.3283E-10	2.3415E-10	4.5722E-10	9.3397E-11	4.1765E-10	2.0688E-10	2.1595E-10
1728	2.3398E-10	1.3130E-10	2.3146E-10	4.5198E-10	9.2289E-11	4.1241E-10	2.0437E-10	2.1339E-10
1729	2.3137E-10	1.2980E-10	2.2882E-10	4.4683E-10	9.1197E-11	4.0723E-10	2.0190E-10	2.1087E-10
1730	2.2881E-10	1.2832E-10	2.2621E-10	4.4174E-10	9.0119E-11	4.0211E-10	1.9946E-10	2.0837E-10
1731	2.2627E-10	1.2686E-10	2.2363E-10	4.3673E-10	8.9055E-11	3.9706E-10	1.9705E-10	2.0592E-10
1732	2.2397E-10	1.2551E-10	2.2122E-10	4.3554E-10	8.9036E-11	3.9429E-10	1.9501E-10	2.0388E-10
1733	2.7624E-09	1.6227E-09	2.7002E-09	5.5183E-09	1.3515E-09	6.3388E-09	2.5871E-09	2.6677E-09

Table 1 continued

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

COLLAPSED FLUX*VOLUME (GROUP/MESH)

	1	2	3	4	5	6	7	8
1	2.51120E-01	1.51923E-01	3.09067E-01	6.03728E-01	1.46017E-01	5.90243E-01	3.06137E-01	2.94882E-01
2	2.30770E-01	1.39297E-01	2.63279E-01	5.50552E-01	1.35646E-01	5.34229E-01	2.79346E-01	2.69479E-01
3	3.46464E-01	2.10655E-01	4.27157E-01	8.23168E-01	1.96739E-01	8.07442E-01	4.23119E-01	4.06703E-01
4	3.84109E-01	2.31853E-01	4.64591E-01	8.91472E-01	2.14192E-01	8.92816E-01	4.63094E-01	4.44530E-01
5	4.15818E-01	2.50854E-01	5.06352E-01	9.91323E-01	2.33422E-01	9.60496E-01	5.05227E-01	4.93152E-01
6	2.60539E-01	1.57008E-01	3.22016E-01	6.19669E-01	1.46123E-01	5.91613E-01	3.16932E-01	3.08592E-01
7	4.97001E-01	3.00465E-01	5.97794E-01	1.15607E+00	2.75794E-01	1.16743E+00	5.98344E-01	5.77824E-01
8	4.45699E-01	2.69421E-01	5.37414E-01	1.04053E+00	2.47361E-01	1.04590E+00	5.37935E-01	5.20416E-01
9	3.75965E-01	2.27295E-01	4.54662E-01	8.77597E-01	2.08559E-01	8.80786E-01	4.55391E-01	4.40033E-01
10	4.35806E-01	2.62802E-01	5.27093E-01	1.02851E+00	2.42415E-01	1.01531E+00	5.27131E-01	5.13972E-01
11	3.67300E-01	2.21811E-01	4.38976E-01	8.49868E-01	2.02689E-01	8.64625E-01	4.40942E-01	4.26052E-01
12	2.49661E-01	1.51662E-01	3.02519E-01	5.89343E-01	1.40078E-01	5.97831E-01	3.04862E-01	2.95345E-01
13	2.64342E-01	1.58760E-01	3.15406E-01	6.11167E-01	1.44853E-01	6.11346E-01	3.15164E-01	3.05730E-01
14	3.29511E-01	1.99435E-01	3.95695E-01	7.66557E-01	1.82570E-01	7.79462E-01	3.97927E-01	3.84476E-01
15	2.28928E-01	1.38459E-01	2.75568E-01	5.35412E-01	1.27118E-01	5.40522E-01	2.76511E-01	2.68010E-01
16	1.71754E-01	1.03352E-01	2.07212E-01	4.06248E-01	9.52363E-02	3.98193E-01	2.06434E-01	2.02280E-01
17	1.01913E-01	6.54042E-02	1.28131E-01	2.49274E-01	6.22660E-02	2.86461E-01	1.39154E-01	1.30224E-01
18	1.87631E-01	1.10218E-01	2.16401E-01	4.23297E-01	9.94731E-02	4.11419E-01	2.11936E-01	2.09089E-01
19	1.17995E-01	7.18356E-02	1.42139E-01	2.77787E-01	6.62270E-02	2.84959E-01	1.43614E-01	1.39022E-01
20	7.47424E-02	4.52315E-02	8.94534E-02	1.75399E-01	4.17755E-02	1.78752E-01	9.02560E-02	8.77033E-02
21	5.87341E-02	3.54608E-02	7.00168E-02	1.37453E-01	3.26293E-02	1.39152E-01	7.02319E-02	6.84362E-02
22	3.74203E-02	2.28377E-02	4.51036E-02	8.87671E-02	2.12324E-02	9.17944E-02	4.59784E-02	4.45870E-02
23	2.52961E-02	1.51912E-02	2.98603E-02	5.67300E-02	1.40143E-02	5.98592E-02	3.00723E-02	2.93150E-02
24	2.04299E-02	1.22158E-02	2.38106E-02	4.64112E-02	1.10313E-02	4.70603E-02	2.35245E-02	2.28928E-02
25	1.22735E-02	7.37494E-03	1.41908E-02	2.72479E-02	6.63270E-03	2.88498E-02	1.41450E-02	1.34914E-02
26	3.90229E-03	2.33882E-03	4.21914E-03	7.14843E-03	2.03250E-03	9.36701E-03	4.23142E-03	3.50468E-03
27	3.91637E-03	2.37227E-03	4.93156E-03	1.08219E-02	2.34538E-03	9.55845E-03	5.07661E-03	5.43062E-03
28	8.89418E-03	5.34910E-03	1.08937E-02	2.27248E-02	5.06086E-03	2.08497E-02	1.09401E-02	1.13331E-02
29	6.91815E-03	4.16638E-03	8.23665E-03	1.66911E-02	3.84879E-03	1.63975E-02	8.26921E-03	8.28891E-03
30	4.11576E-03	2.49152E-03	4.85913E-03	9.80615E-03	2.30464E-03	1.00164E-02	4.92168E-03	4.87222E-03
31	2.19815E-03	1.32357E-03	2.55678E-03	5.09954E-03	1.19384E-03	5.26217E-03	2.58079E-03	2.54464E-03
32	1.11905E-03	6.73475E-04	1.29650E-03	2.58632E-03	6.09035E-04	2.66127E-03	1.30503E-03	1.28486E-03
33	5.10965E-04	3.06847E-04	5.83727E-04	1.16930E-03	2.74635E-04	1.22592E-03	5.87764E-04	5.80464E-04
34	2.25594E-04	1.35480E-04	2.57810E-04	5.18221E-04	1.22692E-04	5.44080E-04	2.59603E-04	2.55973E-04
35	9.74714E-05	5.85085E-05	1.10882E-04	2.21858E-04	5.21194E-05	2.34281E-04	1.11819E-04	1.10317E-04
36	3.83762E-05	2.30294E-05	4.32045E-05	6.55185E-05	1.97104E-05	9.16750E-05	4.37817E-05	4.32718E-05
37	1.41310E-05	6.46603E-06	1.57517E-05	3.20077E-05	7.56747E-06	3.42612E-05	1.58616E-05	1.57306E-05
38	5.44143E-06	3.26660E-06	6.13556E-06	1.23570E-05	2.91846E-06	1.32067E-05	6.18971E-06	6.10945E-06
39	2.15367E-06	1.28573E-06	2.39754E-06	5.01718E-06	1.21725E-06	5.31498E-06	2.39923E-06	2.37814E-06
40	7.93645E-07	4.73344E-07	8.79306E-07	1.77364E-06	4.14022E-07	1.90395E-06	8.86831E-07	8.80889E-07
41	3.70715E-07	2.21050E-07	4.24807E-07	9.09319E-07	2.35962E-07	9.36326E-07	4.24919E-07	4.17965E-07
42	2.43998E-07	1.42847E-07	2.66963E-07	5.93268E-07	1.47844E-07	6.05014E-07	2.61447E-07	2.62689E-07
43	8.21733E-08	4.82640E-08	8.54350E-08	1.80896E-07	4.31087E-08	1.93776E-07	8.36640E-08	8.40741E-08
44	4.95044E-08	2.87114E-08	5.36566E-08	1.16153E-07	2.91838E-08	1.15337E-07	5.15722E-08	5.18181E-08
45	2.92010E-08	1.68131E-08	3.07019E-08	6.20650E-08	1.39747E-08	6.09719E-08	2.88857E-08	2.93526E-08
46	1.61832E-08	9.10606E-09	1.57837E-08	3.50509E-08	6.37646E-09	3.39736E-08	1.45782E-08	1.52079E-08
47	1.27286E-08	7.25669E-09	1.34073E-08	2.58466E-08	5.42639E-09	2.40168E-08	1.21992E-08	1.24087E-08
48	1.11149E-08	6.31884E-09	1.09911E-08	2.20227E-08	4.66570E-09	2.12207E-08	9.94119E-09	1.03426E-08

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

COLLAPSED FLUX (GROUP/MESH)

	1	2	3	4	5	6	7	8
1	9.55920E-01	9.56994E-01	9.73440E-01	9.81671E-01	1.01381E+00	9.59744E-01	9.64211E-01	9.58967E-01
2	8.78454E-01	8.77459E-01	8.92219E-01	8.95206E-01	9.15384E-01	8.68665E-01	8.79836E-01	8.76355E-01
3	1.32647E+00	1.32696E+00	1.34541E+00	1.33652E+00	1.36122E+00	1.31291E+00	1.33266E+00	1.32261E+00
4	1.46216E+00	1.46049E+00	1.46422E+00	1.44955E+00	1.46707E+00	1.45173E+00	1.45857E+00	1.44563E+00
5	1.58286E+00	1.58018E+00	1.60111E+00	1.61191E+00	1.59878E+00	1.56178E+00	1.59127E+00	1.60374E+00
6	9.91772E-01	9.89029E-01	1.01423E+00	1.00759E+00	1.00084E+00	9.62297E-01	1.00451E+00	1.00355E+00
7	1.89190E+00	1.89269E+00	1.88282E+00	1.87979E+00	1.86900E+00	1.89826E+00	1.88455E+00	1.87910E+00
8	1.69661E+00	1.69714E+00	1.69264E+00	1.69192E+00	1.69425E+00	1.70064E+00	1.69428E+00	1.69242E+00
9	1.43116E+00	1.43178E+00	1.43201E+00	1.42764E+00	1.42649E+00	1.43217E+00	1.43430E+00	1.43100E+00
10	1.65895E+00	1.65545E+00	1.66014E+00	1.67238E+00	1.66038E+00	1.65092E+00	1.66025E+00	1.67145E+00
11	1.39817E+00	1.39724E+00	1.38260E+00	1.38193E+00	1.38826E+00	1.40589E+00	1.38879E+00	1.38553E+00
12	9.50443E-01	9.56614E-01	9.52817E-01	9.58281E-01	9.59439E-01	9.72083E-01	9.60258E-01	9.60472E-01
13	1.00625E+00	1.00006E+00	9.93604E-01	9.93801E-01	9.92144E-01	9.94059E-01	9.92644E-01	9.94245E-01
14	1.25432E+00	1.25629E+00	1.24628E+00	1.24643E+00	1.25048E+00	1.26742E+00	1.25331E+00	1.25034E+00
15	8.71444E-01	8.72186E-01	8.67300E-01	8.70589E-01	8.70675E-01	8.78897E-01	8.70901E-01	8.71579E-01
16	6.53803E-01	6.51039E-01	6.52637E-01	6.60566E-01	6.52303E-01	6.47468E-01	6.50187E-01	6.57822E-01
17	3.87946E-01	4.11995E-01	4.03561E-01	4.05324E-01	4.26616E-01	4.65790E-01	4.38280E-01	4.23491E-01
18	7.14241E-01	6.94287E-01	6.81577E-01	6.88288E-01	6.81322E-01	6.68974E-01	6.67514E-01	6.79965E-01
19	4.49163E-01	4.52509E-01	4.47682E-01	4.51686E-01	4.53610E-01	4.63348E-01	4.52327E-01	4.52106E-01
20	2.84516E-01	2.84923E-01	2.81743E-01	2.85201E-01	2.80134E-01	2.90654E-01	2.84271E-01	2.85214E-01
21	2.23579E-01	2.23375E-01	2.20525E-01	2.23501E-01	2.23489E-01	2.26264E-01	2.21203E-01	2.22557E-01
22	1.42445E-01	1.43860E-01	1.42059E-01	1.44369E-01	1.45428E-01	1.49259E-01	1.44814E-01	1.44998E-01
23	9.63002E-02	9.56924E-02	9.41112E-02	9.54960E-02	9.59886E-02	9.73320E-02	9.47158E-02	9.53334E-02
24	7.77689E-02	7.69501E-02	7.49942E-02	7.54654E-02	7.55568E-02	7.65208E-02	7.40929E-02	7.44481E-02
25	4.67206E-02	4.64563E-02	4.46953E-02	4.43056E-02	4.54294E-02	4.69103E-02	4.45513E-02	4.38745E-02
26	1.48545E-02	1.47327E-02	1.32686E-02	1.16235E-02	1.39212E-02	1.52309E-02	1.33273E-02	1.13973E-02
27	1.49081E-02	1.49434E-02	1.55325E-02	1.75965E-02	1.60643E-02	1.55422E-02	1.59893E-02	1.76605E-02
28	3.38568E-02	3.36951E-02	3.43109E-02	3.69510E-02	3.46634E-02	3.39019E-02	3.44570E-02	3.68557E-02
29	2.63348E-02	2.62449E-02	2.59422E-02	2.71399E-02	2.63616E-02	2.66626E-02	2.60447E-02	2.69558E-02
30	1.56672E-02	1.56946E-02	1.53043E-02	1.59450E-02	1.57852E-02	1.62869E-02	1.55020E-02	1.58446E-02
31	8.36753E-03	8.33747E-03	8.05916E-03	8.29193E-03	8.17699E-03	8.55638E-03	8.12847E-03	8.27525E-03
32	4.25980E-03	4.24236E-03	4.08345E-03	4.20540E-03	4.17147E-03	4.35979E-03	4.11032E-03	4.17839E-03
33	1.94505E-03	1.93289E-03	1.83851E-03	1.90131E-03	1.86106E-03	1.99336E-03	1.85123E-03	1.86769E-03
34	8.58753E-04	8.53420E-04	8.11998E-04	8.42636E-04	8.40359E-04	8.84684E-04	8.17649E-04	8.32434E-04
35	3.71037E-04	3.66557E-04	3.49235E-04	3.60744E-04	3.56982E-04	3.80945E-04	3.52166E-04	3.58755E-04
36	1.46084E-04	1.45067E-04	1.36077E-04	1.39055E-04	1.35003E-04	1.49065E-04	1.37895E-04	1.40721E-04
37	5.37913E-05	5.33293E-05	4.96117E-05	5.20450E-05	5.16320E-05	5.57092E-05	4.99578E-05	5.11565E-05
38	2.07135E-05	2.05770E-05	1.93246E-05	2.00926E-05	1.99895E-05	2.14744E-05	1.94951E-05	1.98681E-05
39	8.19821E-06	8.09909E-06	7.55151E-06	8.15801E-06	8.35733E-06	8.64225E-06	7.55663E-06	7.73377E-06
40	3.02111E-06	2.98169E-06	2.76864E-06	2.88396E-06	2.85577E-06	3.09565E-06	2.79317E-06	2.86468E-06
41	1.41117E-06	1.39244E-06	1.33797E-06	1.47857E-06	1.60248E-06	1.52573E-06	1.33833E-06	1.35924E-06
42	9.28807E-07	8.99821E-07	8.40628E-07	9.64663E-07	1.01263E-06	9.83763E-07	8.23454E-07	8.54275E-07
43	3.12803E-07	3.04025E-07	2.69087E-07	2.94139E-07	2.95265E-07	3.15087E-07	2.63509E-07	2.73412E-07
44	1.86445E-07	1.60859E-07	1.68997E-07	1.88866E-07	1.99869E-07	1.67540E-07	1.62432E-07	1.68514E-07
45	1.11157E-07	1.05909E-07	9.06995E-08	1.00919E-07	9.57170E-08	9.91414E-08	9.09764E-08	9.54555E-08
46	6.16035E-08	5.73610E-08	4.97125E-08	5.69934E-08	5.73867E-08	5.52420E-08	4.59157E-08	4.94566E-08
47	4.84578E-08	4.57114E-08	4.22277E-08	4.20271E-08	3.71670E-08	3.90517E-08	3.84227E-08	4.03536E-08
48	4.23103E-08	3.98037E-08	3.46175E-08	3.58093E-08	3.19568E-08	3.45053E-08	3.13108E-08	3.36346E-08

COLLAPSED FLUX*VOLUME (GROUP/REGION)

	1	2	3	4	5	6	7	8
1	2.51120E-01	1.51923E-01	3.09067E-01	6.03728E-01	1.46017E-01	5.90243E-01	3.06137E-01	2.94882E-01
2	2.30770E-01	1.39297E-01	2.63279E-01	5.50552E-01	1.35646E-01	5.34229E-01	2.79346E-01	2.69479E-01
3	3.46464E-01	2.10655E-01	4.27157E-01	8.23168E-01	1.96739E-01	8.07442E-01	4.23119E-01	4.06703E-01
4	3.84109E-01	2.31853E-01	4.64591E-01	8.91472E-01	2.14192E-01	8.92816E-01	4.63094E-01	4.44530E-01
5	4.15818E-01	2.50854E-01	5.06352E-01	9.91323E-01	2.33422E-01	9.60496E-01	5.05227E-01	4.93152E-01
6	2.60539E-01	1.57008E-01	3.22016E-01	6.19669E-01	1.46123E-01	5.91613E-01	3.16932E-01	3.08592E-01
7	4.97001E-01	3.00465E-01	5.97794E-01	1.15607E+00	2.75794E-01	1.16743E+00	5.98344E-01	5.77824E-01
8	4.45699E-01	2.69421E-01	5.37414E-01	1.04053E+00	2.47361E-01	1.04590E+00	5.37935E-01	5.20416E-01
9	3.75965E-01	2.27295E-01	4.54662E-01	8.77597E-01	2.08559E-01	8.80786E-01	4.55391E-01	4.40033E-01

Table 1 continued

10	4.35806E-01	2.62802E-01	5.27073E-01	1.02651E+00	2.42415E-01	1.01531E+00	5.27131E-01	5.13972E-01
11	3.67300E-01	2.21811E-01	4.38976E-01	8.49085E-01	2.02689E-01	8.64625E-01	4.40942E-01	4.26052E-01
12	2.49681E-01	1.51862E-01	3.02519E-01	5.89343E-01	1.40078E-01	5.97831E-01	3.04882E-01	2.95345E-01
13	2.64342E-01	1.56760E-01	3.15406E-01	6.11187E-01	1.44653E-01	6.11346E-01	3.15164E-01	3.05730E-01
14	3.29511E-01	1.99435E-01	3.95475E-01	7.65557E-01	1.82570E-01	7.79462E-01	3.97927E-01	3.84478E-01
15	2.28928E-01	1.38459E-01	2.75368E-01	5.35412E-01	1.27118E-01	5.40522E-01	2.76511E-01	2.68010E-01
16	1.71754E-01	1.03352E-01	2.07212E-01	4.05248E-01	9.52363E-02	3.98193E-01	2.06434E-01	2.02280E-01
17	1.01913E-01	6.54042E-02	1.28131E-01	2.49274E-01	6.22860E-02	2.86461E-01	1.39154E-01	1.30224E-01
18	1.87631E-01	1.10218E-01	2.15401E-01	4.23297E-01	9.94731E-02	4.11419E-01	2.11936E-01	2.09089E-01
19	1.17995E-01	7.18358E-02	1.42139E-01	2.77767E-01	6.62270E-02	2.64959E-01	1.43614E-01	1.39022E-01
20	7.47424E-02	4.52315E-02	8.94534E-02	1.75399E-01	4.17755E-02	1.78752E-01	9.02560E-02	8.77033E-02
21	5.87341E-02	3.54608E-02	7.00168E-02	1.37453E-01	3.26293E-02	1.39152E-01	7.02319E-02	6.84362E-02
22	3.74203E-02	2.26377E-02	4.51036E-02	8.87871E-02	2.12524E-02	9.17944E-02	4.59764E-02	4.45870E-02
23	2.52981E-02	1.51912E-02	2.98803E-02	5.87300E-02	1.40143E-02	5.98592E-02	3.00723E-02	2.93150E-02
24	2.04299E-02	1.22158E-02	2.38106E-02	4.64112E-02	1.10513E-02	4.70603E-02	2.35245E-02	2.28928E-02
25	1.22735E-02	7.37494E-03	1.41908E-02	2.72479E-02	6.63270E-03	2.68498E-02	1.41450E-02	1.34914E-02
26	3.90229E-03	2.33882E-03	4.21924E-03	7.14843E-03	2.03250E-03	9.36701E-03	4.23142E-03	3.50468E-03
27	3.91637E-03	2.37227E-03	4.93156E-03	1.08219E-02	2.34538E-03	9.55845E-03	5.07661E-03	5.43062E-03
28	8.89418E-03	5.34910E-03	1.08937E-02	2.27248E-02	5.06086E-03	2.08497E-02	1.09401E-02	1.13331E-02
29	6.91815E-03	4.16638E-03	8.23665E-03	1.65911E-02	3.84579E-03	1.63975E-02	8.26921E-03	8.28891E-03
30	4.11576E-03	2.47152E-03	4.85913E-03	9.80615E-03	2.30464E-03	1.00164E-02	4.92188E-03	4.87222E-03
31	2.19815E-03	1.32357E-03	2.55878E-03	5.09954E-03	1.19384E-03	5.26217E-03	2.58079E-03	2.54464E-03
32	1.11905E-03	6.73475E-04	1.29650E-03	2.58632E-03	6.09035E-04	2.68127E-03	1.30503E-03	1.28486E-03
33	5.10965E-04	3.06847E-04	5.63727E-04	1.16930E-03	2.74635E-04	1.22592E-03	5.87764E-04	5.80464E-04
34	2.25594E-04	1.35480E-04	2.57810E-04	5.18221E-04	1.22692E-04	5.44060E-04	2.59603E-04	2.55973E-04
35	9.74714E-05	5.65085E-05	1.10862E-04	2.21858E-04	5.21194E-05	2.34281E-04	1.11819E-04	1.10317E-04
36	3.83762E-05	2.30294E-05	4.32045E-05	8.55185E-05	1.97104E-05	9.16750E-05	4.37817E-05	4.32718E-05
37	1.41310E-05	8.46603E-06	1.57517E-05	3.20077E-05	7.56747E-06	3.42612E-05	1.58616E-05	1.57306E-05
38	5.44143E-06	3.26660E-06	6.13556E-06	1.23570E-05	2.91646E-06	1.32067E-05	6.18971E-06	6.10945E-06
39	2.15367E-06	1.28573E-06	2.39754E-06	5.01718E-06	1.21725E-06	5.31498E-06	2.39923E-06	2.37814E-06
40	7.93645E-07	4.73344E-07	8.79106E-07	1.77364E-06	4.14022E-07	1.90395E-06	8.86831E-07	8.80889E-07
41	3.70715E-07	2.21050E-07	4.24807E-07	9.09319E-07	2.33962E-07	9.38326E-07	4.24919E-07	4.17965E-07
42	2.43998E-07	1.42647E-07	2.66963E-07	5.93268E-07	1.47644E-07	6.05014E-07	2.61447E-07	2.62689E-07
43	8.21733E-08	4.62640E-08	8.54350E-08	1.80896E-07	4.31087E-08	1.93778E-07	8.36640E-08	8.40741E-08
44	4.95044E-08	2.87114E-08	5.36568E-08	1.16155E-07	2.91638E-08	1.15337E-07	5.15722E-08	5.18181E-08
45	2.92010E-08	1.66131E-08	3.07019E-08	6.20650E-08	1.39747E-08	6.09719E-08	2.88857E-08	2.93526E-08
46	1.61832E-08	9.10606E-09	1.57637E-08	3.50509E-08	8.37646E-09	3.39736E-08	1.45782E-08	1.52079E-08
47	1.27286E-08	7.25669E-09	1.34073E-08	2.58466E-08	5.42639E-09	2.40168E-08	1.21992E-08	1.24087E-08
48	1.11149E-08	6.31884E-09	1.09911E-08	2.20227E-08	4.66570E-09	2.12207E-08	9.94119E-09	1.03426E-08

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

FISSION SPECTRUM (RENORMALIZED) 5.91954E-01

UPPER GROUPS FISSION SPECTRUM

	1
1	4.89164E-03
2	1.52514E-02
3	3.30423E-02
4	5.78162E-02
5	8.69800E-02
6	8.92901E-02
7	1.23059E-01

LOWER GROUPS FISSION SPECTRUM

	1
1	1.39866E-01
2	9.89807E-02
3	1.02822E-01
4	6.20224E-02
5	4.71096E-02
6	3.52258E-02
7	3.02113E-02
8	1.89006E-02
9	1.46912E-02
10	1.33968E-02
11	7.06930E-03
12	4.53930E-03
13	4.62742E-03
14	3.28191E-03
15	2.12303E-03
16	1.51563E-03
17	1.03960E-03
18	7.11954E-04
19	4.99406E-04
20	3.20342E-04
21	2.27234E-04
22	1.55076E-04
23	1.05788E-04
24	7.21395E-05
25	4.91809E-05
26	3.35221E-05
27	2.28454E-05
28	1.59640E-05
29	1.02100E-05
30	7.22643E-06
31	4.92311E-06
32	3.35379E-06
33	2.28464E-06
34	1.55628E-06
35	1.06011E-06
36	7.22110E-07
37	4.91873E-07
38	3.35041E-07
39	2.28213E-07
40	1.55446E-07
41	1.05881E-07
42	7.02598E-08
43	4.97164E-08
44	3.47265E-08
45	2.27906E-08
46	1.55235E-08
47	1.05736E-08
48	7.01628E-09

Table 1 continued

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

MACROSCOPIC CROSS SECTION FOR REGION 1

GRP	TOTAL	ABSORPTION	ELASTIC S.	CAPTURE	FISSION	NU*FIS.	INELA. S.	TRANSPORT
1	1.56889E-01	1.61617E-04	1.26003E-01	1.61617E-04	0.0	0.0	3.07236E-02	1.26153E-01
2	1.42792E-01	1.91348E-04	1.25420E-01	1.91348E-04	0.0	0.0	1.71802E-02	1.19650E-01
3	1.43716E-01	2.40586E-04	1.36762E-01	2.40586E-04	0.0	0.0	6.71466E-03	1.09658E-01
4	1.63366E-01	2.65451E-04	1.62916E-01	2.65451E-04	0.0	0.0	1.82553E-04	1.28732E-01
5	1.46580E-01	2.76599E-04	1.46255E-01	2.76599E-04	0.0	0.0	4.86130E-05	1.13352E-01
6	1.95515E-01	2.83620E-04	1.95231E-01	2.83620E-04	0.0	0.0	0.0	1.61966E-01
7	1.66322E-01	2.91493E-04	1.66030E-01	2.91493E-04	0.0	0.0	0.0	1.27115E-01
8	1.38007E-01	3.09093E-04	1.37698E-01	3.09093E-04	0.0	0.0	0.0	1.07200E-01
9	1.85438E-01	3.39318E-04	1.85099E-01	3.39318E-04	0.0	0.0	0.0	1.53567E-01
10	2.21077E-01	4.17605E-04	2.20660E-01	4.17605E-04	0.0	0.0	0.0	1.40682E-01
11	2.21750E-01	4.38038E-04	2.21312E-01	4.38038E-04	0.0	0.0	0.0	1.26953E-01
12	2.13066E-01	4.66778E-04	2.12599E-01	4.66778E-04	0.0	0.0	0.0	1.73684E-01
13	2.84000E-01	9.62246E-04	2.83037E-01	9.62246E-04	0.0	0.0	0.0	1.71125E-01
14	2.31684E-01	7.44813E-04	2.30939E-01	7.44813E-04	0.0	0.0	0.0	1.58997E-01
15	2.62995E-01	1.06473E-03	2.61930E-01	1.06473E-03	0.0	0.0	0.0	2.13223E-01
16	2.54907E-01	8.01756E-04	2.54105E-01	8.01756E-04	0.0	0.0	0.0	2.42682E-01
17	8.81951E-01	1.09000E-03	8.80861E-01	1.09000E-03	0.0	0.0	0.0	5.81236E-01
18	2.84087E-01	1.67664E-03	2.82411E-01	1.67664E-03	0.0	0.0	0.0	1.27544E-01
19	2.44483E-01	7.14343E-04	2.43769E-01	7.14343E-04	0.0	0.0	0.0	2.24119E-01
20	4.46486E-01	1.09310E-03	4.45393E-01	1.09310E-03	0.0	0.0	0.0	3.93984E-01
21	4.21348E-01	1.09068E-03	4.20257E-01	1.09068E-03	0.0	0.0	0.0	3.73636E-01
22	6.02876E-01	1.69317E-03	6.01183E-01	1.69317E-03	0.0	0.0	0.0	5.54014E-01
23	9.82102E-01	3.47799E-03	9.78624E-01	3.47799E-03	0.0	0.0	0.0	8.95584E-01
24	6.59811E-01	1.72387E-03	6.58087E-01	1.72387E-03	0.0	0.0	0.0	6.10282E-01
25	5.33824E-01	1.23585E-03	5.32588E-01	1.23585E-03	0.0	0.0	0.0	5.18813E-01
26	3.92437E-01	8.10537E-04	3.91626E-01	8.10537E-04	0.0	0.0	0.0	3.83207E-01
27	3.59926E-01	7.84148E-04	3.59142E-01	7.84148E-04	0.0	0.0	0.0	3.54912E-01
28	3.80274E-01	1.29484E-03	3.78979E-01	1.29484E-03	0.0	0.0	0.0	3.75353E-01
29	4.06602E-01	1.14928E-03	4.05452E-01	1.14928E-03	0.0	0.0	0.0	4.01563E-01
30	4.55870E-01	2.11678E-02	4.34703E-01	2.11678E-02	0.0	0.0	0.0	4.46173E-01
31	4.71663E-01	9.01355E-04	4.70762E-01	9.01355E-04	0.0	0.0	0.0	4.65852E-01
32	4.98439E-01	9.66583E-04	4.97472E-01	9.66583E-04	0.0	0.0	0.0	4.92416E-01
33	5.18520E-01	1.04643E-03	5.17474E-01	1.04643E-03	0.0	0.0	0.0	5.12301E-01
34	5.33721E-01	1.18875E-03	5.32532E-01	1.18875E-03	0.0	0.0	0.0	5.27347E-01
35	5.44792E-01	1.34919E-03	5.43443E-01	1.34919E-03	0.0	0.0	0.0	5.38303E-01
36	5.52831E-01	1.53173E-03	5.51300E-01	1.53173E-03	0.0	0.0	0.0	5.46254E-01
37	5.58355E-01	1.74053E-03	5.56614E-01	1.74053E-03	0.0	0.0	0.0	5.51719E-01
38	5.61628E-01	1.97691E-03	5.59651E-01	1.97691E-03	0.0	0.0	0.0	5.54958E-01
39	5.63380E-01	2.24612E-03	5.61134E-01	2.24612E-03	0.0	0.0	0.0	5.56694E-01
40	5.64241E-01	2.55478E-03	5.61686E-01	2.55478E-03	0.0	0.0	0.0	5.57549E-01
41	5.64676E-01	2.94076E-03	5.61735E-01	2.94076E-03	0.0	0.0	0.0	5.57984E-01
42	5.65066E-01	3.27892E-03	5.61769E-01	3.27892E-03	0.0	0.0	0.0	5.58374E-01
43	5.65622E-01	3.74629E-03	5.61875E-01	3.74629E-03	0.0	0.0	0.0	5.58928E-01
44	5.66190E-01	4.28567E-03	5.61904E-01	4.28567E-03	0.0	0.0	0.0	5.59497E-01
45	5.66813E-01	4.87834E-03	5.61935E-01	4.87834E-03	0.0	0.0	0.0	5.60118E-01
46	5.67461E-01	5.53304E-03	5.61928E-01	5.53304E-03	0.0	0.0	0.0	5.60764E-01
47	5.68112E-01	6.31348E-03	5.61798E-01	6.31348E-03	0.0	0.0	0.0	5.61418E-01
48	4.27451E-01	5.37487E-03	4.22076E-01	5.37487E-03	0.0	0.0	0.0	7.48034E-01

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

MACROSCOPIC CROSS SECTION FOR REGION 1

ELASTIC MATRIX

	0	1	2
1	1.11206E-01	1.47971E-02	0.0
2	1.08345E-01	1.70757E-02	0.0
3	1.15187E-01	2.15757E-02	0.0
4	1.41377E-01	2.15412E-02	0.0
5	1.24314E-01	2.19406E-02	0.0
6	1.61953E-01	3.32780E-02	0.0
7	1.47006E-01	1.90243E-02	0.0
8	1.14925E-01	2.27731E-02	0.0
9	1.57262E-01	2.78363E-02	0.0
10	1.97212E-01	2.34473E-02	0.0
11	1.98935E-01	2.23764E-02	0.0
12	1.65016E-01	4.76051E-02	0.0
13	2.54672E-01	2.83653E-02	0.0
14	2.09455E-01	2.14844E-02	0.0
15	2.34521E-01	2.74089E-02	0.0
16	2.29212E-01	2.48930E-02	0.0
17	6.97284E-01	1.83576E-01	0.0
18	2.67552E-01	1.48585E-02	0.0
19	2.09100E-01	3.46688E-02	0.0
20	3.97987E-01	4.74050E-02	0.0
21	3.74962E-01	4.52951E-02	0.0
22	5.15026E-01	8.61567E-02	0.0
23	8.86403E-01	9.22206E-02	0.0
24	5.98528E-01	5.95588E-02	0.0
25	4.87668E-01	4.49206E-02	0.0
26	3.75268E-01	1.63581E-02	0.0
27	2.79526E-01	7.96157E-02	0.0
28	3.32283E-01	4.66955E-02	0.0
29	3.60512E-01	4.49404E-02	0.0
30	3.91481E-01	4.32212E-02	0.0
31	4.26313E-01	4.44491E-02	0.0
32	4.51493E-01	4.59788E-02	0.0
33	4.72965E-01	4.45082E-02	0.0
34	4.86497E-01	4.60347E-02	0.0
35	4.97615E-01	4.58272E-02	0.0
36	5.07469E-01	4.38107E-02	0.0
37	5.14745E-01	4.18689E-02	0.0
38	5.13275E-01	4.63757E-02	0.0
39	5.18063E-01	4.30712E-02	0.0
40	5.17165E-01	4.45209E-02	0.0
41	4.83669E-01	7.60667E-02	0.0
42	5.24100E-01	3.76889E-02	0.0
43	5.15486E-01	4.63891E-02	0.0
44	5.07212E-01	5.46921E-02	0.0
45	5.04351E-01	5.75841E-02	0.0
46	5.09436E-01	5.24920E-02	0.0
47	4.99744E-01	6.20547E-02	0.0
48	3.87426E-01	3.46494E-02	0.0

Table 1 continued

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

MACROSCOPIC CROSS SECTION FOR REGION 1

INELASTIC MATRIX

	0	1	2	3	4	5	6	7	8	9
1	0.0	9.64491E-05	9.33804E-03	9.64391E-03	6.66999E-03	6.74712E-04	9.74753E-04	6.30584E-04	5.00503E-04	4.50727E-04
2	0.0	7.75051E-06	1.32011E-04	1.56932E-03	5.34657E-03	4.74787E-03	3.45360E-03	1.74892E-03	6.74981E-05	3.95919E-05
3	0.0	0.0	5.36514E-06	6.53313E-05	7.76426E-05	1.01729E-04	1.04737E-03	1.95651E-03	9.53448E-04	5.84896E-04
4	0.0	0.0	0.0	0.0	0.0	1.76675E-05	5.54477E-05	3.41031E-05	2.33690E-05	2.45236E-05
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	10	11	12	13	14	15	16	17	18	19
1	2.56532E-04	1.64228E-04	1.60701E-04	1.25454E-04	9.04120E-05	6.52479E-05	4.25869E-05	3.92338E-05	2.08743E-05	1.29748E-05
2	2.67395E-05	2.91850E-05	8.89915E-06	0.0	1.76820E-07	3.96353E-07	4.40655E-07	2.62135E-07	1.68542E-07	1.88042E-07
3	5.42476E-04	4.65995E-04	2.72235E-04	1.79566E-04	1.22912E-04	7.56691E-05	4.69269E-05	3.54967E-05	2.00243E-05	1.06099E-05
4	1.94435E-05	8.57880E-06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	5.28425E-06	1.07723E-05	8.60032E-06	6.18212E-06	4.88965E-06	3.45313E-06	2.05912E-06	2.48296E-06	1.39876E-06	9.31373E-07
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	20	21	22	23	24	25	26	27	28	29
1	1.49495E-05	1.24479E-05	9.63641E-06	7.45995E-06	1.14634E-06	0.0	0.0	0.0	0.0	0.0
2	1.45571E-07	6.69158E-08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1.04179E-05	7.70910E-06	5.86566E-06	3.29531E-06	3.36937E-07	2.67961E-07	1.94801E-07	1.56318E-07	1.21013E-07	9.36810E-08
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	5.70286E-07	7.04089E-07	5.45065E-07	4.33482E-07	3.06138E-07	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1 continued

26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	30	31	32	33	34	35	36	37	38	39
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2.02745E-07	2.35308E-07	1.72316E-07	1.07373E-07	8.31218E-08	6.43481E-08	2.01869E-08	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	40	41	42	43	44	45	46	47
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1 continued

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

MACROSCOPIC CROSS SECTION FOR REGION 3

GRP	TOTAL	ABSORPTION	ELASTIC S.	CAPTURE	FISSION	NU*FIS.	INELA. S.	TRANSPORT
1	3.09011E-01	2.63136E-02	1.80174E-01	2.67936E-03	2.36344E-02	6.11773E-02	1.02524E-01	2.22633E-01
2	2.99244E-01	1.65031E-02	1.83971E-01	4.11298E-03	1.23901E-02	3.16233E-02	9.87705E-02	2.26603E-01
3	3.09319E-01	1.69691E-02	2.01465E-01	6.44250E-03	1.05266E-02	2.65665E-02	9.08846E-02	2.42542E-01
4	3.32598E-01	1.61255E-02	2.36106E-01	6.34261E-03	9.76370E-03	2.44845E-02	8.03652E-02	2.61361E-01
5	3.55649E-01	1.55779E-02	2.66909E-01	5.76668E-03	9.81124E-03	2.44089E-02	7.31619E-02	2.80050E-01
6	3.64913E-01	1.53929E-02	3.03062E-01	5.71523E-03	1.01777E-02	2.52051E-02	6.59364E-02	3.08477E-01
7	4.10415E-01	1.66231E-02	3.35015E-01	5.90514E-03	1.07180E-02	2.64316E-02	5.67766E-02	3.34960E-01
8	4.31578E-01	1.74740E-02	3.60444E-01	5.61831E-03	1.12556E-02	2.76733E-02	5.32601E-02	3.60973E-01
9	4.54371E-01	1.94359E-02	3.86953E-01	7.42838E-03	1.20075E-02	2.94549E-02	4.79817E-02	3.88207E-01
10	4.78123E-01	2.12916E-02	4.15846E-01	6.30527E-03	1.29363E-02	3.17906E-02	4.09851E-02	4.13784E-01
11	5.00013E-01	2.36820E-02	4.43923E-01	9.85470E-03	1.38273E-02	3.37905E-02	3.24074E-02	4.41477E-01
12	5.14430E-01	2.55899E-02	4.61740E-01	1.11637E-02	1.44262E-02	3.52196E-02	2.70999E-02	4.67589E-01
13	5.37153E-01	2.78035E-02	4.91000E-01	1.26133E-02	1.51902E-02	3.70486E-02	1.63494E-02	4.92985E-01
14	5.51214E-01	3.04195E-02	5.14366E-01	1.42735E-02	1.61460E-02	3.93479E-02	6.42851E-03	5.14328E-01
15	5.65602E-01	3.39690E-02	5.30910E-01	1.67711E-02	1.72979E-02	4.18843E-02	7.22906E-04	5.31615E-01
16	5.81358E-01	3.97565E-02	5.41332E-01	2.12439E-02	1.85126E-02	4.50649E-02	2.69197E-04	5.51541E-01
17	6.46041E-01	4.35325E-02	6.02329E-01	2.35342E-02	1.99982E-02	4.86615E-02	1.79611E-04	5.94404E-01
18	6.24773E-01	4.51714E-02	5.79558E-01	2.46850E-02	2.04865E-02	4.98342E-02	4.33475E-05	5.65789E-01
19	6.18477E-01	4.47932E-02	5.73550E-01	2.34837E-02	2.13094E-02	5.18239E-02	3.61266E-06	5.92526E-01
20	6.35498E-01	4.96520E-02	5.85846E-01	2.55069E-02	2.40452E-02	5.84660E-02	0.0	6.09249E-01
21	6.36250E-01	5.46057E-02	5.81645E-01	2.84469E-02	2.61588E-02	6.35967E-02	0.0	6.12473E-01
22	6.38303E-01	5.95207E-02	5.78752E-01	3.30906E-02	2.64301E-02	6.42496E-02	0.0	6.16933E-01
23	6.79074E-01	6.62926E-02	6.12781E-01	3.70921E-02	2.92005E-02	7.09777E-02	0.0	6.52830E-01
24	6.63650E-01	7.40004E-02	5.89649E-01	4.15476E-02	3.24528E-02	7.88722E-02	0.0	6.59873E-01
25	6.38303E-01	7.77864E-02	5.60516E-01	4.26519E-02	3.51345E-02	8.53919E-02	0.0	6.37167E-01
26	6.17244E-01	8.78003E-02	5.29444E-01	4.84762E-02	3.93220E-02	9.55659E-02	0.0	6.16525E-01
27	6.53888E-01	1.02272E-01	5.51616E-01	5.37300E-02	4.85421E-02	1.17969E-01	0.0	6.53255E-01
28	6.38808E-01	1.00960E-01	5.37848E-01	4.77542E-02	5.32061E-02	1.29301E-01	0.0	6.38366E-01
29	6.26177E-01	1.13465E-01	5.12712E-01	5.31277E-02	6.03376E-02	1.46630E-01	0.0	6.25790E-01
30	6.90340E-01	1.39991E-01	5.50349E-01	6.63888E-02	7.16027E-02	1.74003E-01	0.0	6.89405E-01
31	6.73763E-01	1.37519E-01	5.36244E-01	6.39921E-02	7.35267E-02	1.78677E-01	0.0	6.73032E-01
32	6.79367E-01	1.53903E-01	5.25464E-01	7.35394E-02	8.03634E-02	1.95289E-01	0.0	6.78844E-01
33	6.94466E-01	1.91011E-01	5.03454E-01	8.10718E-02	1.09940E-01	2.67160E-01	0.0	6.93986E-01
34	6.93611E-01	1.96496E-01	4.97114E-01	9.03997E-02	1.06097E-01	2.57820E-01	0.0	6.93117E-01
35	7.17738E-01	1.98854E-01	5.18883E-01	8.60503E-02	1.12804E-01	2.74117E-01	0.0	7.17219E-01
36	7.20920E-01	2.11422E-01	5.09498E-01	9.22355E-02	1.19187E-01	2.89626E-01	0.0	7.19172E-01
37	8.75680E-01	2.65530E-01	6.10150E-01	1.14565E-01	1.50965E-01	3.66847E-01	0.0	8.61714E-01
38	7.82220E-01	2.75385E-01	5.06834E-01	1.32605E-01	1.42781E-01	3.46960E-01	0.0	7.81681E-01
39	1.08046E+00	3.52111E-01	7.28368E-01	2.37139E-01	1.14972E-01	2.79363E-01	0.0	1.07979E+00
40	7.43391E-01	3.32184E-01	4.11206E-01	1.81026E-01	1.51159E-01	3.67317E-01	0.0	7.42860E-01
41	9.89724E-01	3.68106E-01	6.21616E-01	2.11140E-01	1.56968E-01	3.81434E-01	0.0	9.77217E-01
42	1.07638E+00	5.77999E-01	4.98377E-01	1.73608E-01	4.04390E-01	9.82671E-01	0.0	1.06048E+00
43	1.64076E+00	6.07474E-01	1.03329E+00	3.63431E-01	2.44043E-01	5.93026E-01	0.0	1.60029E+00
44	9.39111E-01	6.16866E-01	3.22245E-01	2.99309E-01	3.17558E-01	7.71666E-01	0.0	9.36978E-01
45	1.06972E+00	5.35359E-01	5.34357E-01	1.88999E-01	3.46360E-01	8.41657E-01	0.0	1.06883E+00
46	1.40136E+00	9.24665E-01	4.76694E-01	6.11185E-01	3.13480E-01	7.61757E-01	0.0	1.36951E+00
47	8.24442E-01	4.28972E-01	3.95469E-01	1.63044E-01	2.65328E-01	6.44748E-01	0.0	8.23575E-01
48	7.62634E-01	4.36376E-01	3.26259E-01	2.59453E-01	1.76923E-01	4.29922E-01	0.0	1.34155E+00

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

MACROSCOPIC CROSS SECTION FOR REGION 3

ELASTIC MATRIX

	0	1	2
1	1.75334E-01	4.63947E-03	0.0
2	1.77914E-01	6.05640E-03	0.0
3	1.95391E-01	9.07375E-03	0.0
4	2.27802E-01	8.30437E-03	0.0
5	2.58595E-01	8.31427E-03	0.0
6	2.90983E-01	1.20991E-02	0.0
7	3.24341E-01	1.06736E-02	0.0
8	3.49380E-01	1.10646E-02	0.0
9	3.75485E-01	1.14685E-02	0.0
10	4.07027E-01	8.81980E-03	0.0
11	4.33449E-01	1.04742E-02	0.0
12	4.46728E-01	1.50129E-02	0.0
13	4.72619E-01	1.83807E-02	0.0
14	5.01746E-01	1.26202E-02	0.0
15	5.16163E-01	1.47473E-02	0.0
16	5.32950E-01	6.38189E-03	0.0
17	5.80418E-01	2.19108E-02	0.0
18	5.67931E-01	1.16268E-02	0.0
19	5.61562E-01	1.21180E-02	0.0
20	5.71576E-01	1.42701E-02	0.0
21	5.67614E-01	1.40308E-02	0.0
22	5.63238E-01	1.55438E-02	0.0
23	5.94815E-01	1.79664E-02	0.0
24	5.74791E-01	1.46581E-02	0.0
25	5.49287E-01	1.12291E-02	0.0
26	5.24214E-01	5.23005E-03	0.0
27	5.23879E-01	2.77363E-02	0.0
28	5.23667E-01	1.41810E-02	0.0
29	4.99872E-01	1.28401E-02	0.0
30	5.38818E-01	1.15306E-02	0.0
31	5.23566E-01	1.26782E-02	0.0
32	5.14391E-01	1.10730E-02	0.0
33	4.92925E-01	1.05295E-02	0.0
34	4.86667E-01	1.04474E-02	0.0
35	5.08096E-01	1.07877E-02	0.0
36	5.01206E-01	8.29220E-03	0.0
37	5.90028E-01	2.01226E-02	0.0
38	4.96624E-01	1.02103E-02	0.0
39	7.16128E-01	1.22399E-02	0.0
40	4.02600E-01	8.60658E-03	0.0
41	5.93502E-01	2.81147E-02	0.0
42	4.93425E-01	4.95246E-03	0.0
43	1.00810E+00	2.51939E-02	0.0
44	3.10932E-01	1.13131E-02	0.0
45	5.24033E-01	1.03240E-02	0.0
46	4.61829E-01	1.48655E-02	0.0
47	3.83455E-01	1.20144E-02	0.0
48	3.23632E-01	2.62632E-03	0.0

Table 1 continued

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

MACROSCOPIC CROSS SECTION FOR REGION 5

GRP	TOTAL	ABSORPTION	ELASTIC S.	CAPTURE	FISSION	NU*FIS.	INELA. S.	TRANSPORT
1	1.07297E-01	6.01738E-05	3.78741E-02	6.01738E-05	0.0	0.0	1.93630E-02	6.17303E-02
2	1.13415E-01	7.13508E-05	9.69091E-02	7.13508E-05	0.0	0.0	1.64341E-02	8.78510E-02
3	1.30234E-01	9.14453E-05	1.20144E-01	9.14453E-05	0.0	0.0	9.99875E-03	9.30384E-02
4	1.74064E-01	1.01868E-04	1.68074E-01	1.01868E-04	0.0	0.0	5.86775E-03	1.39383E-01
5	1.16343E-01	1.07082E-04	1.15001E-01	1.07082E-04	0.0	0.0	1.23466E-03	9.63691E-02
6	1.30426E-01	1.11086E-04	1.30255E-01	1.11086E-04	0.0	0.0	5.96766E-05	1.10759E-01
7	1.21460E-01	1.15829E-04	1.21345E-01	1.15829E-04	0.0	0.0	0.0	1.05349E-01
8	1.12265E-01	1.23228E-04	1.12142E-01	1.23228E-04	0.0	0.0	0.0	9.45190E-02
9	1.60757E-01	1.34423E-04	1.60622E-01	1.34423E-04	0.0	0.0	0.0	1.39013E-01
10	1.46297E-01	1.62854E-04	1.46134E-01	1.62854E-04	0.0	0.0	0.0	1.14253E-01
11	1.40066E-01	1.72415E-04	1.39893E-01	1.72415E-04	0.0	0.0	0.0	1.03154E-01
12	1.35652E-01	1.84425E-04	1.35468E-01	1.84425E-04	0.0	0.0	0.0	1.19816E-01
13	1.69004E-01	3.55791E-04	1.68648E-01	3.55791E-04	0.0	0.0	0.0	1.25813E-01
14	1.64414E-01	2.83913E-04	1.64130E-01	2.83913E-04	0.0	0.0	0.0	1.30790E-01
15	2.02963E-01	3.98226E-04	2.02565E-01	3.98226E-04	0.0	0.0	0.0	1.73090E-01
16	1.61148E-01	3.11078E-04	1.60837E-01	3.11078E-04	0.0	0.0	0.0	1.54915E-01
17	4.07307E-01	4.30365E-04	4.06877E-01	4.30365E-04	0.0	0.0	0.0	2.85267E-01
18	1.86621E-01	6.24958E-04	1.85996E-01	6.24958E-04	0.0	0.0	0.0	1.26259E-01
19	1.84263E-01	2.99777E-04	1.83964E-01	2.99777E-04	0.0	0.0	0.0	1.71871E-01
20	2.86526E-01	4.52344E-04	2.86074E-01	4.52344E-04	0.0	0.0	0.0	2.56620E-01
21	2.62950E-01	4.46446E-04	2.62504E-01	4.46446E-04	0.0	0.0	0.0	2.36430E-01
22	3.24961E-01	6.53770E-04	3.24307E-01	6.53770E-04	0.0	0.0	0.0	3.04590E-01
23	4.88888E-01	1.24970E-03	4.87638E-01	1.24970E-03	0.0	0.0	0.0	4.53675E-01
24	4.53721E-01	6.56639E-04	4.53064E-01	6.56639E-04	0.0	0.0	0.0	4.24698E-01
25	7.02158E-01	5.72368E-04	7.01585E-01	5.72368E-04	0.0	0.0	0.0	6.24083E-01
26	3.09957E+00	1.59657E-03	3.09798E+00	1.59657E-03	0.0	0.0	0.0	1.98052E+00
27	1.84593E+00	1.41155E-03	1.84452E+00	1.41155E-03	0.0	0.0	0.0	1.23538E+00
28	4.90995E-01	7.57516E-04	4.90238E-01	7.57516E-04	0.0	0.0	0.0	4.49092E-01
29	3.08082E-01	5.71794E-04	3.07510E-01	5.71794E-04	0.0	0.0	0.0	2.97944E-01
30	2.68352E-01	7.63285E-03	2.60719E-01	7.63285E-03	0.0	0.0	0.0	2.60916E-01
31	2.49297E-01	4.32381E-04	2.48865E-01	4.32381E-04	0.0	0.0	0.0	2.44745E-01
32	2.47537E-01	4.50845E-04	2.47086E-01	4.50845E-04	0.0	0.0	0.0	2.43390E-01
33	2.48658E-01	4.79795E-04	2.48178E-01	4.79795E-04	0.0	0.0	0.0	2.44676E-01
34	2.52197E-01	5.33893E-04	2.51663E-01	5.33893E-04	0.0	0.0	0.0	2.48237E-01
35	2.55776E-01	5.97568E-04	2.55178E-01	5.97568E-04	0.0	0.0	0.0	2.51787E-01
36	2.58620E-01	6.72796E-04	2.57947E-01	6.72796E-04	0.0	0.0	0.0	2.54600E-01
37	2.60608E-01	7.59413E-04	2.59848E-01	7.59413E-04	0.0	0.0	0.0	2.56567E-01
38	2.61917E-01	8.58451E-04	2.61058E-01	8.58451E-04	0.0	0.0	0.0	2.57861E-01
39	2.62581E-01	9.71649E-04	2.61609E-01	9.71649E-04	0.0	0.0	0.0	2.58518E-01
40	2.62913E-01	1.10106E-03	2.61812E-01	1.10106E-03	0.0	0.0	0.0	2.58848E-01
41	2.63095E-01	1.26590E-03	2.61829E-01	1.26590E-03	0.0	0.0	0.0	2.59031E-01
42	2.63246E-01	1.40750E-03	2.61839E-01	1.40750E-03	0.0	0.0	0.0	2.59182E-01
43	2.63477E-01	1.60602E-03	2.61871E-01	1.60602E-03	0.0	0.0	0.0	2.59413E-01
44	2.63947E-01	1.83495E-03	2.62112E-01	1.83495E-03	0.0	0.0	0.0	2.59877E-01
45	2.64349E-01	2.08950E-03	2.62260E-01	2.08950E-03	0.0	0.0	0.0	2.60274E-01
46	2.64704E-01	2.36866E-03	2.62335E-01	2.36866E-03	0.0	0.0	0.0	2.60626E-01
47	2.65109E-01	2.70263E-03	2.62406E-01	2.70263E-03	0.0	0.0	0.0	2.61029E-01
48	1.96970E-01	2.27090E-03	1.94699E-01	2.27090E-03	0.0	0.0	0.0	3.52193E-01

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

MACROSCOPIC CROSS SECTION FOR REGION 6

ELASTIC MATRIX

	0	1	2
1	6.87577E-02	1.91163E-02	0.0
2	7.08909E-02	2.60182E-02	0.0
3	8.97616E-02	3.03821E-02	0.0
4	1.22677E-01	4.54172E-02	0.0
5	9.09966E-02	2.40042E-02	0.0
6	9.47414E-02	3.55137E-02	0.0
7	9.44897E-02	2.68748E-02	0.0
8	7.96030E-02	3.25392E-02	0.0
9	1.17580E-01	4.30423E-02	0.0
10	1.23719E-01	2.24149E-02	0.0
11	1.08696E-01	3.11971E-02	0.0
12	9.37993E-02	4.16688E-02	0.0
13	1.32862E-01	3.57864E-02	0.0
14	1.34190E-01	2.99401E-02	0.0
15	1.63963E-01	3.86014E-02	0.0
16	1.35170E-01	2.56671E-02	0.0
17	3.09400E-01	9.74766E-02	0.0
18	1.60735E-01	2.72605E-02	0.0
19	1.47427E-01	3.65362E-02	0.0
20	2.36723E-01	4.73513E-02	0.0
21	2.16866E-01	4.56376E-02	0.0
22	2.62167E-01	6.21400E-02	0.0
23	4.07266E-01	8.03700E-02	0.0
24	3.57126E-01	9.59374E-02	0.0
25	5.04816E-01	1.96769E-01	0.0
26	2.08069E+00	1.01729E+00	0.0
27	1.36480E+00	4.79725E-01	0.0
28	3.97389E-01	9.28489E-02	0.0
29	2.52495E-01	5.50153E-02	0.0
30	2.21791E-01	3.69279E-02	0.0
31	2.14155E-01	3.47098E-02	0.0
32	2.14292E-01	3.27943E-02	0.0
33	2.17822E-01	3.03562E-02	0.0
34	2.20929E-01	3.07345E-02	0.0
35	2.24741E-01	3.04374E-02	0.0
36	2.28737E-01	2.92092E-02	0.0
37	2.32047E-01	2.78015E-02	0.0
38	2.30663E-01	3.03952E-02	0.0
39	2.33100E-01	2.85092E-02	0.0
40	2.32519E-01	2.92921E-02	0.0
41	2.13210E-01	4.66188E-02	0.0
42	2.36989E-01	2.48496E-02	0.0
43	2.32163E-01	2.91077E-02	0.0
44	2.27434E-01	3.46776E-02	0.0
45	2.25602E-01	3.06579E-02	0.0
46	2.29313E-01	3.50219E-02	0.0
47	2.23384E-01	3.90223E-02	0.0
48	1.71241E-01	2.34580E-02	0.0

Table 1 continued

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

MACROSCOPIC CROSS SECTION FOR REGION 8

INELASTIC MATRIX

	0	1	2	3	4	5	6	7	8	9
1	1.67366E-04	4.59951E-03	7.39508E-03	3.42721E-03	2.29396E-03	2.48622E-04	3.38764E-04	2.16630E-04	1.74135E-04	1.56478E-04
2	0.0	1.70070E-03	6.52145E-03	2.90533E-03	1.84666E-03	1.62315E-03	1.18059E-03	5.99700E-04	2.16662E-05	1.27935E-05
3	0.0	6.20745E-05	2.30191E-03	2.51327E-03	2.56201E-03	3.45105E-04	3.56764E-04	6.74345E-04	3.27810E-04	2.02640E-04
4	0.0	0.0	0.0	4.22311E-04	1.95545E-03	1.96258E-03	1.36979E-03	1.32690E-04	7.47742E-06	8.05514E-06
5	0.0	0.0	0.0	0.0	0.0	1.96436E-04	4.11501E-04	2.36622E-04	1.82440E-04	1.00512E-04
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	10	11	12	13	14	15	16	17	18	19
1	[illegible]	[illegible]	[illegible]	4.14153E-05	[illegible]	2.12025E-05	1.37743E-05	1.27055E-05	6.77120E-06	4.20876E-06
2	[illegible]	[illegible]	[illegible]	0.0	9.45722E-06	2.11990E-07	2.36436E-07	1.40855E-07	9.06326E-08	1.01149E-07
3	[illegible]	[illegible]	[illegible]	6.13566E-05	4.21993E-05	2.59792E-05	[illegible]	1.22557E-05	6.92402E-06	3.65934E-06
4	6.50670E-06	7.68092E-06	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	5.58541E-05	3.13296E-05	1.14463E-05	2.77605E-06	1.56601E-06	1.11296E-06	6.65747E-07	8.05771E-07	4.54706E-07	3.02766E-07
6	7.43722E-06	1.55333E-05	1.57363E-05	1.03259E-05	5.26070E-06	2.96036E-06	1.45902E-06	6.93579E-07	1.63335E-07	9.25157E-08
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	20	21	22	23	24	25	26	27	28	29
1	4.68124E-06	4.06441E-06	3.14643E-06	2.43579E-06	3.91277E-07	0.0	0.0	0.0	0.0	0.0
2	7.83034E-08	3.59943E-08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	3.59613E-06	2.66887E-06	2.03272E-06	1.14034E-06	1.06877E-07	8.65682E-08	6.29476E-08	5.05124E-08	3.91038E-08	3.02719E-08
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	1.65900E-07	2.29517E-07	1.77678E-07	1.41305E-07	9.97939E-08	0.0	0.0	0.0	0.0	0.0
6	1.24338E-08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1 continued

26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	30	31	32	33	34	35	36	37	38	39
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	6.59260E-08	7.66024E-08	5.61200E-08	3.50355E-08	2.71225E-08	2.09966E-08	6.58759E-09	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	40	41	42	43	44	45	46	47
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1 continued

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

MACROSCOPIC CROSS SECTION

GRP	TOTAL	ABSORPTION	ELASTIC S.	CAPTURE	FISSION	NU*FIS.	INELA. S.	TRANSPORT
1	2.07123E-01	6.49287E-03	1.59307E-01	6.98660E-04	7.79421E-03	2.12943E-02	3.93228E-02	1.56849E-01
2	2.30434E-01	6.08287E-03	1.89193E-01	1.06570E-03	5.01717E-03	1.38112E-02	3.51560E-02	1.60940E-01
3	2.53155E-01	6.08652E-03	2.20152E-01	1.66127E-03	4.42525E-03	1.20768E-02	2.69164E-02	1.93620E-01
4	2.55187E-01	5.77143E-03	2.27465E-01	1.66547E-03	4.10597E-03	1.11079E-02	2.19503E-02	2.00476E-01
5	2.52292E-01	5.62681E-03	2.27995E-01	1.55425E-03	4.07256E-03	1.09409E-02	1.86695E-02	1.91610E-01
6	3.66423E-01	5.75535E-03	3.45968E-01	1.58904E-03	4.16631E-03	1.11135E-02	1.66802E-02	2.83956E-01
7	2.78513E-01	5.86334E-03	2.56051E-01	1.64682E-03	4.21653E-03	1.11748E-02	1.45991E-02	2.52588E-01
8	2.69129E-01	6.17090E-03	2.49733E-01	1.84373E-03	4.32716E-03	1.14056E-02	1.32251E-02	2.38091E-01
9	3.10768E-01	6.56447E-03	2.92233E-01	2.06675E-03	4.49773E-03	1.17934E-02	1.19500E-02	2.76603E-01
10	3.36991E-01	7.05647E-03	3.19725E-01	2.31703E-03	4.73944E-03	1.23705E-02	1.02095E-02	2.80756E-01
11	3.07711E-01	7.70851E-03	2.91899E-01	2.72267E-03	4.98584E-03	1.29786E-02	8.10400E-03	2.51550E-01
12	3.09164E-01	8.21532E-03	2.94135E-01	3.05519E-03	5.16013E-03	1.34070E-02	6.81415E-03	2.79263E-01
13	3.95466E-01	8.85979E-03	3.81865E-01	3.51258E-03	5.34720E-03	1.38521E-02	4.72157E-03	3.20846E-01
14	3.10001E-01	9.39309E-03	2.98699E-01	3.83693E-03	5.55616E-03	1.43468E-02	1.90907E-03	2.75994E-01
15	3.41014E-01	1.03922E-02	3.30069E-01	4.56953E-03	5.82271E-03	1.49979E-02	5.52964E-04	3.10417E-01
16	3.82334E-01	1.19280E-02	3.69962E-01	5.74540E-03	6.18262E-03	1.56909E-02	4.43988E-04	3.48567E-01
17	5.66398E-01	1.29227E-02	5.53062E-01	6.40937E-03	6.51336E-03	1.66926E-02	4.13261E-04	4.09631E-01
18	3.32308E-01	1.33352E-02	3.18611E-01	6.78063E-03	6.55459E-03	1.67642E-02	3.62489E-04	2.74955E-01
19	3.26410E-01	1.32827E-02	3.12799E-01	6.40494E-03	6.87775E-03	1.75990E-02	3.28778E-04	3.10064E-01
20	3.96843E-01	1.47025E-02	3.81854E-01	7.14060E-03	7.56190E-03	1.92881E-02	2.86391E-04	3.69607E-01
21	3.87227E-01	1.60884E-02	3.70922E-01	6.02035E-03	8.06809E-03	2.05266E-02	2.16707E-04	3.62335E-01
22	4.35334E-01	1.77610E-02	4.17515E-01	9.55832E-03	8.20266E-03	2.08870E-02	5.72951E-05	4.13113E-01
23	5.60102E-01	2.00397E-02	5.40062E-01	1.10413E-02	8.99839E-03	2.28969E-02	0.0	5.25557E-01
24	4.99839E-01	2.19966E-02	4.77843E-01	1.20722E-02	9.92442E-03	2.52305E-02	0.0	4.77850E-01
25	5.53118E-01	2.30936E-02	5.30025E-01	1.24246E-02	1.06690E-02	2.70979E-02	0.0	5.21945E-01
26	1.20990E+00	2.66647E-02	1.18304E+00	1.47362E-02	1.21285E-02	3.08294E-02	0.0	8.80865E-01
27	9.67790E-01	3.09146E-02	9.36875E-01	1.64768E-02	1.44357E-02	3.66190E-02	0.0	7.39870E-01
28	4.68020E-01	3.10640E-02	4.36956E-01	1.53439E-02	1.57200E-02	3.97979E-02	0.0	4.49578E-01
29	4.05349E-01	3.46866E-02	3.70663E-01	1.65177E-02	1.81689E-02	4.61333E-02	0.0	3.98162E-01
30	4.11334E-01	4.59662E-02	3.65368E-01	2.48004E-02	2.11658E-02	5.36506E-02	0.0	4.04222E-01
31	4.09976E-01	4.43328E-02	3.65643E-01	2.01990E-02	2.41338E-02	6.19747E-02	0.0	4.04469E-01
32	4.12690E-01	4.68316E-02	3.65858E-01	2.29137E-02	2.39179E-02	6.06994E-02	0.0	4.07334E-01
33	4.23043E-01	5.89165E-02	3.64126E-01	2.49457E-02	3.39708E-02	8.66935E-02	0.0	4.17686E-01
34	4.22428E-01	5.73231E-02	3.65105E-01	2.56338E-02	3.16893E-02	8.05630E-02	0.0	4.17031E-01
35	4.38908E-01	6.28184E-02	3.76090E-01	2.85334E-02	3.42850E-02	8.73519E-02	0.0	4.33474E-01
36	4.55839E-01	7.83799E-02	3.77459E-01	2.89629E-02	4.94169E-02	1.30128E-01	0.0	4.50110E-01
37	4.76778E-01	8.20249E-02	3.94753E-01	3.21989E-02	4.98260E-02	1.28488E-01	0.0	4.68407E-01
38	4.62041E-01	8.44920E-02	3.77549E-01	4.19860E-02	4.25060E-02	1.08108E-01	0.0	4.56556E-01
39	5.25057E-01	1.02180E-01	4.22877E-01	6.28009E-02	3.93793E-02	1.02102E-01	0.0	5.19476E-01
40	4.60731E-01	1.05019E-01	3.55712E-01	4.63329E-02	5.86664E-02	1.53851E-01	0.0	4.55204E-01
41	5.50947E-01	1.41418E-01	4.09529E-01	6.54636E-02	7.59546E-02	2.03202E-01	0.0	5.42277E-01
42	5.83858E-01	2.09231E-01	3.74627E-01	6.24381E-02	1.46793E-01	3.84318E-01	0.0	5.74667E-01
43	6.56235E-01	1.65338E-01	4.90897E-01	1.09300E-01	5.60382E-02	1.38235E-01	0.0	6.42509E-01
44	4.72361E-01	1.38945E-01	3.33416E-01	6.85198E-02	7.04251E-02	1.72822E-01	0.0	4.65998E-01
45	5.57853E-01	1.75196E-01	3.82657E-01	7.36342E-02	1.01562E-01	2.58144E-01	0.0	5.51924E-01
46	5.91966E-01	2.24352E-01	3.67614E-01	1.42125E-01	8.22263E-02	2.08074E-01	0.0	5.80209E-01
47	5.32911E-01	1.80156E-01	3.52755E-01	6.37581E-02	1.16398E-01	3.07791E-01	0.0	5.27447E-01
48	4.27356E-01	1.62791E-01	2.64565E-01	8.23411E-02	8.04496E-02	2.14343E-01	0.0	7.88427E-01

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

MACROSCOPIC CROSS SECTION

ELASTIC MATRIX

	0	1	2
1	1.26768E-01	3.25387E-02	0.0
2	1.38456E-01	5.07369E-02	0.0
3	1.68183E-01	5.19696E-02	0.0
4	1.70785E-01	5.66026E-02	7.75793E-05
5	1.70569E-01	5.71348E-02	2.91682E-04
6	2.33476E-01	1.12512E-01	0.0
7	2.00699E-01	5.68966E-02	4.55403E-04
8	1.89667E-01	5.96243E-02	2.41414E-04
9	2.21705E-01	7.05482E-02	0.0
10	2.61975E-01	5.74532E-02	2.97210E-04
11	2.31756E-01	5.83446E-02	1.79795E-03
12	2.18354E-01	7.57805E-02	0.0
13	3.10813E-01	7.10722E-02	0.0
14	2.50875E-01	4.78236E-02	0.0
15	2.70708E-01	5.93611E-02	0.0
16	3.01303E-01	6.86595E-02	0.0
17	4.57767E-01	9.52951E-02	0.0
18	2.76264E-01	4.23468E-02	0.0
19	2.65472E-01	4.73264E-02	0.0
20	3.23719E-01	5.81353E-02	0.0
21	3.15287E-01	5.56351E-02	0.0
22	3.51580E-01	6.59346E-02	0.0
23	4.61508E-01	7.85540E-02	0.0
24	4.02160E-01	7.56825E-02	0.0
25	4.27630E-01	1.02394E-01	0.0
26	8.60445E-01	3.22594E-01	0.0
27	7.03666E-01	2.33210E-01	0.0
28	3.63293E-01	7.36634E-02	0.0
29	3.11372E-01	5.92901E-02	0.0
30	3.14615E-01	5.07551E-02	0.0
31	3.15849E-01	4.97939E-02	0.0
32	3.17007E-01	4.88514E-02	0.0
33	3.17068E-01	4.70582E-02	0.0
34	3.17565E-01	4.75397E-02	0.0
35	3.28822E-01	4.72676E-02	0.0
36	3.32075E-01	4.53842E-02	0.0
37	3.47523E-01	4.72308E-02	0.0
38	3.30439E-01	4.71101E-02	0.0
39	3.77484E-01	4.53931E-02	0.0
40	3.10209E-01	4.55029E-02	0.0
41	3.37353E-01	7.21756E-02	0.0
42	3.34921E-01	2.97054E-02	0.0
43	4.40004E-01	5.08926E-02	0.0
44	2.82154E-01	5.12612E-02	0.0
45	3.29468E-01	5.31891E-02	0.0
46	3.15395E-01	5.22190E-02	0.0
47	2.97240E-01	5.55149E-02	0.0
48	2.30427E-01	3.41389E-02	0.0

Table 1 continued

ESELEM 4 SAMPLE PROBLEM *FCA V-1 CORE CELL* 75/12/15

MACROSCOPIC CROSS SECTION

INELASTIC MATRIX

	0	1	2	3	4	5	6	7	8	9
1	2.22190E-03	4.30282E-03	7.25035E-03	7.50014E-03	6.29323E-03	4.09464E-03	2.94940E-03	1.22916E-03	9.77256E-04	9.04956E-04
2	4.40837E-03	5.46559E-03	3.21547E-03	3.12704E-03	3.88558E-03	4.13718E-03	3.55670E-03	2.58990E-03	1.93151E-03	1.04088E-03
3	9.65107E-03	6.30199E-03	1.56863E-03	1.15178E-03	2.06767E-03	1.08021E-03	1.16180E-03	1.38051E-03	7.12211E-04	4.55965E-04
4	9.88334E-03	7.47295E-03	1.11669E-03	7.04938E-04	8.19752E-04	7.98460E-04	6.05257E-04	1.26962E-04	5.66949E-05	1.66447E-04
5	8.93925E-03	7.04233E-03	1.26615E-03	3.73867E-04	3.06076E-04	1.89399E-04	1.96524E-04	1.17301E-04	9.67922E-05	5.85102E-05
6	7.86646E-03	7.02061E-03	9.65741E-04	1.94497E-04	2.88691E-04	1.28825E-04	8.37473E-05	4.98107E-05	2.71390E-05	1.36943E-05
7	5.70537E-03	7.35650E-03	7.19487E-04	5.44600E-04	7.60203E-05	2.51378E-05	5.64354E-05	4.64005E-05	2.98020E-05	1.85343E-05
8	3.00493E-03	9.12014E-03	4.83255E-04	2.86793E-04	2.26252E-04	7.33082E-05	1.68572E-05	4.73405E-06	3.28280E-06	2.13863E-06
9	1.25214E-03	9.93986E-03	3.07207E-04	9.06941E-05	1.64902E-04	1.29322E-04	6.01954E-05	4.60653E-06	8.00180E-07	2.33269E-07
10	1.26051E-03	5.86440E-03	2.67247E-03	2.14955E-04	8.76656E-05	2.91288E-05	3.86897E-05	2.15841E-05	9.73736E-06	4.66195E-06
11	3.33113E-04	5.18232E-04	6.04171E-03	6.42397E-04	8.70706E-05	6.23604E-05	1.32453E-05	3.70155E-06	1.83537E-06	3.28939E-07
12	2.83492E-04	2.35380E-04	4.87343E-03	1.30023E-03	1.94860E-05	4.20803E-05	3.16292E-05	1.93061E-05	6.70695E-06	7.91062E-07
13	2.44599E-04	2.60503E-04	1.57817E-03	1.70468E-03	8.55946E-04	5.84547E-05	7.12025E-06	3.75632E-06	4.13349E-06	1.83038E-06
14	2.29636E-04	2.54760E-04	1.87835E-06	5.01483E-04	5.41378E-04	2.33037E-04	7.86029E-05	4.32217E-05	2.10605E-05	1.81356E-06
15	1.36912E-04	3.09509E-04	1.85372E-05	0.0	0.0	2.80069E-05	2.00978E-05	1.45673E-05	1.36196E-05	5.84688E-06
16	9.27300E-05	3.24378E-04	2.65999E-05	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	2.19169E-06	3.13973E-04	9.19337E-05	5.16233E-06	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	1.90334E-04	1.65957E-04	5.19815E-06	1.01943E-06	0.0	0.0	0.0	0.0	0.0
19	0.0	3.67526E-05	1.99479E-04	9.21149E-05	4.31778E-07	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	5.35928E-05	1.42813E-04	8.99844E-05	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	1.27607E-05	6.89869E-05	6.45181E-05	4.07980E-05	9.63499E-06	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	7.26711E-06	1.01564E-05	8.15680E-06	5.96847E-06
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	10	11	12	13	14	15	16	17	18	19
1	4.78676E-04	2.99462E-04	2.91654E-04	1.97648E-04	1.22016E-04	8.12241E-05	5.09406E-05	3.49144E-05	2.08675E-05	1.22085E-05
2	6.64075E-04	4.29707E-04	3.09777E-04	1.80669E-04	1.30327E-04	6.19219E-05	2.90303E-05	6.15561E-06	3.53192E-06	2.26364E-06
3	5.06066E-04	3.02679E-04	1.98362E-04	1.29680E-04	9.64046E-05	6.91982E-05	2.65263E-05	4.06476E-05	8.37263E-06	5.88481E-06
4	1.11887E-04	4.40990E-05	2.04932E-05	1.30678E-05	7.20764E-06	4.20297E-06	2.27849E-06	1.83428E-06	7.99839E-07	5.15877E-07
5	3.49797E-05	2.25478E-05	1.17292E-05	5.98650E-06	3.89798E-06	2.42647E-06	1.50818E-06	1.25612E-06	7.33027E-07	4.66908E-07
6	1.17067E-05	1.11568E-05	9.05357E-06	5.90805E-06	3.16694E-06	1.90166E-06	1.04209E-06	5.66156E-07	2.56349E-07	1.56403E-07
7	1.04954E-05	6.11861E-06	2.76767E-06	1.47668E-06	1.02231E-06	5.79262E-07	3.18072E-07	1.32890E-07	8.04109E-08	4.85504E-08
8	1.36727E-06	1.30124E-06	6.83099E-07	4.93628E-07	2.71280E-07	1.62981E-07	1.27905E-07	4.56672E-08	5.23738E-08	1.77256E-08
9	1.99842E-08	1.17106E-08	7.54040E-09	4.63237E-09	2.82996E-09	1.72138E-09	1.04355E-09	6.30992E-10	3.80768E-10	2.34874E-10
10	2.33266E-06	1.19176E-06	8.82689E-07	5.11654E-07	3.86031E-07	1.56892E-07	1.83750E-07	5.75186E-08	1.14295E-09	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	5.34038E-07	3.25913E-07	1.75741E-07	1.82614E-07	9.34977E-08	4.59435E-08	1.04492E-07	0.0	9.67869E-08	0.0
13	8.93319E-07	5.12988E-07	2.69413E-07	2.44970E-07	1.51403E-07	1.05275E-07	6.37422E-08	4.72427E-08	0.0	1.45925E-08
14	1.16559E-06	5.83615E-07	2.67660E-07	1.22517E-07	5.61707E-08	0.0	0.0	0.0	0.0	0.0
15	2.79643E-06	1.43698E-06	7.92659E-07	3.56047E-07	1.66567E-07	1.52082E-07	0.0	1.11952E-07	0.0	0.0
16	0.0	0.0	2.80408E-07	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	4.43208E-06	3.38322E-06	2.65071E-06	1.61674E-06	1.56060E-06	1.54350E-06	5.26535E-07	9.80196E-07	0.0	8.61608E-07
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	20	21	22	23	24	25	26	27	28	29
1	9.57205E-06	6.72463E-06	4.64161E-06	3.25077E-06	1.05404E-06	4.36251E-07	2.62143E-07	1.61167E-07	9.07554E-08	5.67014E-08
2	1.38261E-06	8.28453E-07	4.85600E-07	2.92517E-07	1.76003E-07	1.05803E-07	6.50692E-08	3.66503E-08	2.29023E-08	1.37404E-08
3	7.06300E-06	2.54193E-06	1.67752E-06	1.06324E-06	1.71253E-07	1.21976E-07	8.07301E-08	1.17599E-07	9.14355E-08	4.32541E-08
4	4.99616E-07	1.76841E-07	1.06538E-07	6.41077E-08	3.94567E-08	2.22372E-08	1.39020E-08	8.34355E-09	5.00591E-09	3.00264E-09
5	2.64407E-07	2.70476E-07	1.96193E-07	1.47069E-07	1.00224E-07	1.00569E-08	6.03694E-09	3.62250E-09	2.17309E-09	1.30331E-09
6	7.33137E-08	4.16076E-08	2.56292E-08	1.44532E-08	9.03986E-09	5.42747E-09	3.25727E-09	1.95421E-09	1.17215E-09	7.02924E-10
7	2.92644E-08	1.80356E-08	1.01750E-08	6.36602E-09	3.82304E-09	2.29481E-09	1.37698E-09	8.26013E-10	4.95395E-10	2.97059E-10
8	1.02648E-08	5.79341E-09	3.62560E-09	2.17798E-09	1.30760E-09	7.84732E-10	4.70794E-10	2.82380E-10	1.69339E-10	1.01535E-10
9	1.32597E-10	8.30017E-11	4.98659E-11	2.99418E-11	1.79706E-11	1.07821E-11	6.46743E-12	3.87656E-12	2.32565E-12	1.39433E-12
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	2.06351E-08	3.71518E-08	0.0	0.0	0.0	0.0	0.0
13	4.58947E-08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	3.95832E-09	5.08154E-08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	6.12432E-07	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 1 continued

26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	30	31	32	33	34	35	36	37	38	39
1	3.40135E-08	2.03995E-08	1.22343E-08	7.33401E-09	4.39676E-09	2.63566E-09	1.57967E-09	9.46959E-10	5.67579E-10	3.40180E-10
2	6.24164E-09	4.94246E-09	2.96351E-09	1.77673E-09	1.06511E-09	6.38470E-10	3.82763E-10	2.29385E-10	1.37485E-10	8.24010E-11
3	5.92223E-08	6.66605E-08	4.85211E-08	3.02016E-08	2.32413E-08	1.79087E-08	5.70046E-09	1.02760E-10	6.15898E-11	3.60229E-11
4	1.80069E-09	1.07971E-09	6.47330E-10	3.88064E-10	2.32622E-10	1.39435E-10	8.35752E-11	5.00919E-11	2.92983E-11	1.82838E-11
5	7.81529E-10	4.68581E-10	2.80918E-10	1.68399E-10	1.00942E-10	6.05040E-11	3.62644E-11	2.12109E-11	1.32369E-11	8.12163E-12
6	4.21474E-10	2.52667E-10	1.51480E-10	9.08030E-11	5.44278E-11	3.26230E-11	1.90813E-11	1.19080E-11	7.30631E-12	4.20943E-12
7	1.78106E-10	1.06775E-10	6.40068E-11	3.83670E-11	2.29969E-11	1.34511E-11	8.39449E-12	5.15060E-12	2.96747E-12	1.77847E-12
8	6.08728E-11	3.64916E-11	2.18744E-11	1.31116E-11	7.66924E-12	4.78623E-12	2.93671E-12	1.69197E-12	1.01404E-12	6.07734E-13
9	8.35883E-13	5.01065E-13	3.00344E-13	1.75679E-13	1.09638E-13	6.72718E-14	3.87525E-14	2.32290E-14	1.39216E-14	8.34344E-15
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	40	41	42	43	44	45	46	47
1	2.03884E-10	1.19246E-10	7.44145E-11	4.56566E-11	2.63038E-11	1.57641E-11	9.44751E-12	5.66192E-12
2	4.81945E-11	3.00756E-11	1.84528E-11	1.06311E-11	6.37134E-12	3.81839E-12	2.28856E-12	0.0
3	2.24801E-11	1.37927E-11	7.94435E-12	4.76235E-12	2.85412E-12	1.71049E-12	0.0	0.0
4	1.12181E-11	6.46310E-12	3.87343E-12	2.32139E-12	1.39122E-12	0.0	0.0	0.0
5	4.67915E-12	2.60429E-12	1.68065E-12	1.00723E-12	0.0	0.0	0.0	0.0
6	2.52279E-12	1.51195E-12	9.06125E-13	0.0	0.0	0.0	0.0	0.0
7	1.06587E-12	6.36787E-13	0.0	0.0	0.0	0.0	0.0	0.0
8	3.64223E-13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

```
        AAAA            1  1523    1    0    0
   NEUTRON ENERGY(EV)
   NEUTRON FLUX
   CORE SPECTRUM OF FCA V-1 *PU REGION*
        AAAA            1  1523    1    0    0

CPU TIME IS 28 MIN.  17.31 SEC.
```