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DTF-BURN: A Multigroup Transport Theory
Burnup Program Written in FORTRAN-IV

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Burnup Program Written in FORTRAN-IV

by

Joseph J. Prabulos, Jr.

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ABSTRACT

The report describes the one-dimensional, multigroup transport burnup code, DTF-BURN. Instructions for the use of the program are included, together with flow diagrams of the code, listings of certain subroutines, and the results of a test problem. The code computes the neutron flux distribution as a discrete-ordinates solution of the Boltzmann transport equation at the beginning of each specified time step. This calculated flux distribution is then used to determine the change in nuclide concentrations during the time interval. Nuclides considered in the burnup routine are ^{235}U , ^{236}U , ^{238}U , ^{239}Np , ^{239}Pu , ^{240}Pu , ^{241}Pu , ^{242}Pu , and FP, a pseudo fission product pair. The burnup differential equations may be applied to each region or to each point, at the option of the user.

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1. INTRODUCTION

The DTF-IV code^(1,2) is designed to solve numerically (by the method of discrete ordinates) the multigroup form of the neutron transport equation in one-dimensional plane, cylindrical, or spherical geometry. The code DTF-BURN, described in this report, is a multigroup transport burnup program which uses revised subroutines from DTF-IV for the flux solution. The program was designed especially for survey life history analyses of plutonium-fueled fast reactor systems. Like DTF-IV, DTF-BURN is written in FORTRAN-IV and employs variable dimensioning so that a problem with any number of neutron energy groups and spatial intervals may be run provided the available core storage is not exceeded.

The burnup differential equations may be solved either for each region or for each point at the option of the user. A separate subroutine is used for each type of calculation, and both subroutines employ the solution method of the SIZZLE diffusion burnup program.⁽³⁾

The basic features of DTF-BURN are listed below:

- a. A different type of eigenvalue calculation (multiplication [k], period, element concentration, zone thickness, or system dimension) can be performed at the beginning of each time step as specified in the input. This feature permits the simulation, in a single problem run, of a system in which various control methods are used as a function of time (e.g., control rod movement part of the time and reflector control at other times).
- b. The nuclide concentration search can be executed directly on the atom densities of a specified number of materials, and an option exists for keeping the total number of heavy atoms per region constant.
- c. The number of time intervals for burnup and the length of each interval are specified by the user, so that a different width can be used for each time step, if required.

- d. Burnup calculations are performed only in the regions specified.
- e. Changes in the concentrations of ^{235}U , ^{236}U , ^{238}U , ^{239}Np , ^{239}Pu , ^{240}Pu , ^{241}Pu , ^{242}Pu , and FP, a pseudo fission product pair, can be computed.
- f. Microscopic cross sections can be entered as a function of region.

This report includes a detailed description of the program along with instructions for its use. Familiarity with the DTF-IV code is assumed, and the reader is referred to the DTF-IV manual⁽¹⁾ for pertinent background material.

2. CODE DESCRIPTION

2.1 General Discussion

A diagram of the general calculational flow is presented in Fig. 1. Program execution commences with the reading of input data. Problem storage requirements are computed next from the input data in accord with the variable dimensioning. Following this, various constants and initial functions are evaluated. Calculational flow continues by setting the time-step indicator ISTEP equal to one.

Each burnup time step begins with the calculation and printing of macroscopic cross sections. Following this, a multigroup flux calculation is performed. The time step indicator is then compared with the input integer value, NTS, which specifies the number of burnup time intervals. A value of ISTEP greater than NTS indicates the end of the problem and summons a "CALL EXIT" statement; otherwise, the burnup calculation trigger, IPT, is tested. A value of unity for IPT summons subroutine POBURN, which solves the burnup equations for each space point. A value other than unity calls subroutine BURN, which solves the burnup equations for each region.

Fig. 1. Flow diagram of DTF-BURN.

After each burnup calculation, iteration triggers for the solution of the neutron flux distribution are set for the subsequent calculation, and the time-step indicator is increased. A flux computation is normally executed after the last burnup time interval with the final set of atom densities. Hence, for an N time-step problem, $(N + 1)$ flux calculations are performed.

At the beginning of each time step, calculation of the macroscopic cross sections from the microscopic cross sections and number densities of the nuclides takes place as prescribed by a table of input data. The microscopic cross sections of the various nuclides are present in core storage in a certain order denoted by consecutive material numbers. Higher material numbers are used to specify the storage of the computed macroscopic values. Entries in the table of input data specifying the calculation of the macroscopic cross sections are called mixture specifications. In general, each mixture specification refers to one of the nuclides in each region. It is identified by a mixture specification number and consists of: (1) the material number of the appropriate macroscopic cross section; (2) a mix component number (the material number of the microscopic cross section for the nuclide); and (3) the number density of the nuclide in the region.

Use of the table of mixture specifications is illustrated in Table I, which shows the proper arrangement of data for a three-zone modular reactor consisting of a core, blanket, and reflector. Part A of the table lists the order of cross section values in the common storage array. The microscopic values for the 12 components are followed by the macroscopic values for the 3 regions. Part B of the table illustrates the proper arrangement of the mixture specifications. It should be noted that the first entry for each mixture (macroscopic cross section) consists of a material number followed by a zero mix component number and a zero number density. The two values of zero initiate the calculation of the macroscopic cross section having the designated material number.

TABLE I

Sample Data Arrangement for Calculation of Macroscopic Cross Sections

A. Arrangement of Cross Sections in Core Storage

<u>Material Number</u>	<u>Description</u>	<u>Cross-Section Type</u>
1	Tantalum	<div style="text-align: center;"> Microscopic ↓ Macroscopic ↓ </div>
2	^{238}U	
3	^{239}Np	
4	^{239}Pu	
5	^{240}Pu	
6	^{241}Pu	
7	^{242}Pu	
8	FP (fission product)	
9	SS (stainless steel)	
10	Sodium	
11	Carbon	
12	Oxygen	
13	Core (Region 1)	
14	Blanket (Region 2)	
15	Reflector (Region 3)	

B. Table of Mixture Specifications

<u>Mixture Specification Number</u>	<u>Material Number</u>	<u>Mix Component Number</u>	<u>Number Density</u>	<u>Comments</u>
1	13	0	0.0	Clear material 13
2		1	0.006	Tantalum poison
3		2	0.007265	^{238}U
4		3	0.0	^{239}Np
5		4	0.0014105	^{239}Pu
6		5	0.0006207	^{240}Pu
7		6	0.0000877	^{241}Pu
8		7	0.0000214	^{242}Pu
9		8	0.0	Fission product
10		9	0.012963	Stainless steel
11		10	0.01184	Sodium
12		11	0.0094053	Carbon
13	14	0	0.0	Clear material 14
14		2	0.0119398	^{238}U
15		3	0.0	^{239}Np
16		4	0.0	^{239}Pu
17		5	0.0	^{240}Pu
18		6	0.0	^{241}Pu
19		7	0.0	^{242}Pu
20		8	0.0	Fission product
21		12	0.0238796	Oxygen
22		9	0.016730	Stainless steel
23		10	0.005372	Sodium
24	15	0	0.0	Clear material 15
25		9	0.0041813	Stainless steel
26		10	0.00108	Sodium
27		11	0.072	Carbon

2.2 Modifications to DTF-IV Subroutines

Several subroutines from DTF-IV have been modified for use in the DTF-BURN code. The most important changes are discussed briefly below.

The subroutine controlling the calculational flow was rewritten to correspond to Fig. 1. Statements were modified and added to read and print the additional input required for the new features incorporated in the program and to store additional variables. Because additional storage was required by the modifications, the size of the common block was reduced, and the adjoint and distributed source options were removed.

Inasmuch as the program permits a different type of eigenvalue search at each time step, the eigenvalue-type trigger, IEVT, used in DTF-IV was replaced by a dimensioned input variable, IEVT(J). This new variable specifies the type of eigenvalue search at the beginning of each time step, so that a reactor in which various control methods are used as a function of time may be simulated in a single problem run.

Subroutine MIXCX was changed in several ways to be compatible with the region and point burnup subroutines. The concentration option sections of MIXCX were modified to search directly on atom densities in lieu of a search on the product of atom densities and microscopic cross-section values. These changes were necessary to: (1) permit the use of final search atom densities in the solution of the burnup equations for those problems where search materials are nuclides in the burnup chains; and (2) to permit the entry of zero atom densities for nuclides in the burnup chains which are not present initially. The modified concentration option can be used to search directly on the atom densities of one or more principal nuclides. The atom density of a single secondary nuclide can also be adjusted, so that the total number of heavy atoms (principal plus secondary search nuclides) remains constant. Although microscopic and macroscopic cross sections are printed out at the beginning of the first time step, subroutine MIXCX was modified to print only the macroscopic values after the first flux calculation.

2.3 Region Burnup Subroutine

The new subroutine BURN solves the burnup differential equations for each region and can be used to calculate concentration changes during input-specified time intervals. Provision exists for nine burnup nuclides which are identified by the numerical designators below:

1. ^{235}U	6. ^{240}Pu (or ^{234}U)
2. ^{236}U	7. ^{241}Pu (or ^{235}U)
3. ^{238}U (or ^{232}Th)	8. ^{242}Pu (or ^{236}U)
4. ^{239}Np (or ^{233}Pa)	9. FP
5. ^{239}Pu (or ^{233}U)	

For an analysis of the thorium chain, the atomic weights for burnup nuclides 3-8 and the decay constant for burnup nuclide 4, which are built into the program, must be changed to the proper values in subroutines BURN and POBURN.

The differential equations are written in terms of reaction coefficients, RC_k^x , which are computed from the expression

$$\text{RC}_k^x = \frac{\left[\sum_{j=1}^{\text{IGM}} \sigma_k^{xj} \int_{\text{region}} \phi^j dV \right] \left[(3.1 \times 10^{-8}) \bar{v} (\text{POWER}) \right]}{H \cdot V_{\text{region}}} \quad (1)$$

where

σ_k^{xj} represents σ_k^{aj} , σ_k^{fj} , or σ_k^{cj} for burnup nuclide k ,

IGM is the number of neutron energy groups,

(POWER) is the total reactor power in megawatts, and

H is the height or cross-sectional area.

The quantity $[(3.1 \times 10^{-8}) \bar{v} (\text{POWER})]$ consists of a factor (10^{-24} cm^2) , since the σ_k are given in barns, and a power normalization factor for the flux. The neutron fluxes are normalized such that the total integrated fission source,

$$\int_{\text{reactor}} \int v \Sigma_f \phi dE dV,$$

has a value of unity. If the reactor power is given in megawatts, then the number of fissions per second is $(3.1 \times 10^{16})(\text{POWER})$, which should be identical to

$$\int_{\text{reactor}} \int \Sigma_f \phi \, dE \, dV.$$

However, due to the source normalization,

$$\int_{\text{reactor}} \int \Sigma_f \phi \, dE \, dV = \frac{1}{\bar{v}}, \quad (2)$$

with $\bar{v}$ given by

$$\bar{v} = \frac{\int_{\text{reactor}} \sum_{j=1}^{\text{IGM}} \phi^j (\bar{v} \Sigma_f^j)^j \, dV}{\int_{\text{reactor}} \sum_{j=1}^{\text{IGM}} \phi^j (\Sigma_f^j)^j \, dV}, \quad (3)$$

where the ϕ^j are the multigroup neutron fluxes for energy group j . The differential equations and their solutions are given in Appendix I. Mathematical solutions to the equations are the same as are used in the SIZZLE diffusion burnup program. ⁽³⁾

A function SERIES(X,Y) is used in the solution of each of the burnup equations containing term(s) with differences of exponentials. For example, the value of a term like $C \cdot [e^{-X} - e^{-Y}]$ is given by $C \cdot \text{SERIES}(X,Y)$ where the value of SERIES is computed in one of two ways depending upon the absolute values of its arguments. Where $|X|$ or $|Y| \geq 0.1$, then

$$\text{SERIES}(X,Y) = e^{-X} - e^{-Y}. \quad (4)$$

However, if both $|X|$ and $|Y| < 0.1$, then the value of SERIES is computed from the lower order terms of a power series expansion,

$$\text{SERIES}(X,Y) = -(X - Y) + 1/2(X^2 - Y^2) - 1/6(X^3 - Y^3) + 1/24(X^4 - Y^4). \quad (5)$$

Atom densities computed for the burnup nuclides are stored in the same density array used in the calculation of the macroscopic cross sections. Since this density array is indexed by mixture specification numbers, region-dependent microscopic cross sections can be used in the burnup equations.

In the two-dimensional input array MSEZ(K,I), the mixture specification numbers denoting each of the nine burnup nuclides are entered for each burnup control region. The first subscript, K, is the numerical designator identifying a particular nuclide, while the second subscript, I, is the burnup control region number. Microscopic cross sections used in calculating the reaction coefficients are selected from the mix component numbers corresponding to the mixture specification numbers entered in the MSEZ array.

The calculational flow for subroutine BURN is given in Fig. 2. During the first time step, geometric parameters denoting the first and last space cells in each zone are computed. These parameters are used throughout the subroutine as limits in the spatial integration of quantities over each zone. Zone volumes are also calculated during the first time step and for all subsequent time steps in which zone thicknesses or system dimensions have been modified. Calculational flow continues with computation of the regional integrated fluxes followed by a determination of $\bar{v}$ from the expression of Eq. (3). The integrated fluxes and $\bar{v}$ are both used in the calculation of the reaction coefficients.

The differential equations are solved for each specified burnup control region. At the beginning of each repetition of the calculational cycle, the control region index, I, increases in value and the zone number, IR, of burnup control region I is determined from the input variable LBBS. This arrangement ensures that the burnup calculations are performed only in those burnup control regions specified by the user. The differential equations for each burnup region are solved in the following order:

Fig. 2. Flow diagram of subroutine BURN.

- (1) ^{235}U chain,
- (2) Fission product pairs from fissions in ^{235}U chain nuclides,
- (3) ^{238}U chain,
- (4) Fission product pairs from fissions in ^{238}U chain nuclides.

Equations for a chain are bypassed in a region, if the location in the MSEZ array for the lead nuclide in the chain for that region is given a value of zero. Chain lead nuclides and numerical designators are, respectively, ^{235}U , ^{238}U , and FP; 1, 3, and 9.

2.4 Point Burnup Subroutine

A second new subroutine, POBURN, has been included in the DTF-BURN program to solve the burnup equations at each space point, if specified. The differential equations and solutions are identical to those in subroutine BURN, but the reaction coefficients are computed for each spatial interval in every burnup region from the expression

$$RC_k^x(r) = \left[\sum_{j=1}^{IGM} \sigma_k^{x^j} \phi^j(r) \right] \left[(3.1 \times 10^{-8}) \bar{v} (\text{POWER}) \right] \cdot \left[\frac{1}{H} \right]. \quad (6)$$

The microscopic cross sections appearing in expression (6) are region-dependent, as in the other subroutine. With the point reaction coefficients, the change in atom density values as a result of burnup is computed for each nuclide as a function of position.

Some of the essential differences between BURN and POBURN may be seen by a comparison of Figs. 2 and 3. When the burnup calculation loop in subroutine POBURN is entered during the first time step, the input guess trigger, IFN, is tested to determine whether point atom densities have been read in as input data. If not, the input regional average atom density for each nuclide is read into the locations of the point atom density array representing all spatial intervals in the region. When the burnup calculation loop is entered during subsequent time steps, the input variable IEVT(J) is tested to determine whether or not a

Fig. 3. Flow diagram of subroutine POBURN.

concentration search was executed during the previous eigenvalue calculation. If so, and if the search nuclides are nuclides in the burnup chain, new point atom density values are computed for these nuclides; the new values are calculated by multiplying the point atom density values obtained during the last burnup calculation by the ratio of the average atom densities immediately before and after the concentration search.

The burnup differential equations are next solved to yield atom densities for each point in every burnup control region. The method of solution is identical to that in subroutine BURN. Average atom densities are then calculated for the burnup nuclides for use in the computation of macroscopic cross sections at the beginning of the next time step. Point atom densities, as well as the average atom densities and nuclide masses, are written on the output tape.

If concentration search nuclides are present in the burnup control region, the eigenvalue-type variable IEVT(ISTP + 1) is tested to determine whether or not a concentration search has been specified for the next time step. If so, the average atom densities of the search nuclides are transferred to a temporary array. These values will be used during the next time step to calculate new point atom densities for the search nuclides as described above.

2.5 Sense Switch Option

As in DTF-IV, a sense switch option has been included in the DTF-BURN program. The user may instruct the operator to depress binary key 4 to initiate an orderly exit from the problem in the event of an over-time job. Fluxes in core storage will be punched on cards in a format for input to the code. If a point burnup calculation is being run, point atom densities for the burnup nuclides will also be punched on cards in the proper input format. Data on the punched cards can then be used to continue the calculations by starting a new problem in the restart dump mode. Fluxes and point atom densities will also be punched when a problem is run to termination as specified in the input data.

3. USE OF THE DTF-BURN CODE

3.1 Input

Input to DTF-BURN is largely the same as that for the DTF-IV code except for certain modified and additional values. Table II lists all data required for execution of the program and may be used as a guide for preparation of problem input.

The ID card is first read and printed. After the ID card, 35 control integers are read; the last 5 of these are not used in DTF-IV. MACS, MSEC, and MSDC specify the density concentration search option present in DTF-BURN. MACS is the number of the zone in which the search nuclide(s) are present. MSEC is the mixture specification number of the first principal search nuclide, which must be located in zone MACS. If this search option is not used, MSEC must be given a value of zero. The integer MSDC may be given a value of minus N, zero, or plus N. A zero value implies a one-nuclide search, while a nonzero value indicates an $(N + 1)$ nuclide search on those nuclides possessing mixture specification numbers MSEC through $MSEC + |N|$. If N is positive, the N additional search nuclides are principal nuclides. If N is negative, $(|N| - 1)$ of the additional nuclides are principal nuclides, and the $|N|$ th additional nuclide is a secondary nuclide, usually a fertile material, whose density is adjusted to keep the sum of the densities of all search nuclides constant. The integer NB8 is the total number of regions in which burnup calculations are desired. NTS is the number of time steps or intervals for burnup.

The 13 floating-point control numbers defined in Section C of Table II are next read, followed by two additional control numbers (Section D) on a new card.

TABLE II
Input Data for DTF-BURN Code

A. IC Card (12A6)

B. Integer Control Parameters

1. (12I6)

Location in Storage Array	Parameter Name	Description
IA		
1	ID	Problem identification number
2	ITH	0
3	ISCT	Scattering (0/N = Isotropic/Nth order anisotropic)
4	ISN	Quadrature order - 2, 4, 6, etc.
5	IGE	Geometry (1/2/3 = plane/cylinder/sphere)
6	IBL	Left boundary condition (0/1/2 = vacuum/reflective/periodic)
7	IBR	Right boundary condition (0/1/2 = vacuum/reflective/periodic)
8	IZM	Number of zones
9	IM	Number of intervals
10	IFN	Input guess (0/1/2 = fission/flux/flux and point densities)
11	IPT	Type of burnup calculation (0/1 = region/point)
12	IGM	Number of groups
13	IHT	Position of total cross sections in table
14	IHS	Position of self-scatter cross sections in table
15	IHM	Cross-section table length
16	MS	Number of cross-section mixture specifications
17	MCR	Number of microscopic cross section sets to be read from cards
18	MTP	Number of microscopic cross-section sets to be read from disk
19	MT	Total number of materials (including mixtures)
20	IPVT	Parametric eigenvalue type (0/1/2 = none/K/alpha)
21	IQM	0
22	IIM	Inner iteration maximum (per group)
23	ID1	Print angular flux (0/1 = no/yes)
24	ID2	Print balance tables by group and zone (0/1 = no/yes)
25	ID3	Print activities by zone (0/N = no/yes - number of activities)
26	ID4	Print activities by space point (0/1 = no/yes)
27	ICM	Outer iteration maximum
28	NFF	Detailed print if negative flux fixup used (0/1 = yes/no)
29	IC	Iteration count (nonzero only for problem starting from flux dump)
30	IIL	Inner iteration limit used until $(1 - \lambda) < 10 * EPS$

TABLE II (continued)

B. Integer Control Parameters (continued)2. (5I6)

Location in Storage Array	Parameter Name	Description
IA		
74	MACS	Zone for nuclide density concentration search
80	MSEC	Mixture specification of first principal nuclide varied in concentration search
96	MSDC	Search specifier (if $N < 0$, $ N $ additional nuclides including one secondary nuclide; if $N > 0$, N additional principal nuclides.)
192	NB8	Number of burnup control regions
193	NTS	Number of time intervals

C. Floating-Point Control Parameters (6E12.5)

Location in Storage Array	Parameter Name	Description
A		
1	EV	Eigenvalue guess for first time step (normal values are 0, 0, 1.0, 0 and R_{max} for IEVT(1) = 1, 2, 3, 4, 5)
2	EVM	Eigenvalue modifier
3	EPS	Overall convergence precision
4	EPSA	Pointwise convergence criterion (not used if zero)
5	BF	Buckling factor (normally $\pi/\sqrt{3}$ - used in the calculation of buckling absorption corrections to the total cross section for each space dimension not considered in one-dimensional flux calculation)
6	DY	Buckling total height, cm (slabs, cylinders)
7	DZ	Buckling total depth, cm (slabs only)
8	XNF	1.0 (normalization factor)
9	PV	Parametric eigenvalue
10	XEPS	Precision used in eigenvalue searches after first lambda obtained
11	XLAL	Parameters used in eigenvalue searches ⁽¹⁾
12	XLAM	
13	XNPM	

D. Additional Floating-Point Control Parameters (2E12.5)

19	POW	Total reactor power in thermal megawatts (includes contribution of any blanket in the space dimension considered)
20	CRA	Height (cylindrical geometry) or cross-sectional area (plane geometry)

TABLE II (continued)

E. Sequential Listing of Input Data Read by Subroutines REAI, REAG, RECS, and FINPR

<u>Sequence Number</u>	<u>Parameter Name</u>	<u>Number of Pieces of Data</u>	<u>Conditional?</u>	<u>Subroutine</u>	<u>Description</u>
1	IEVT	(NTS + 1)	Unconditional	REAI	Eigenvalue type (for NTS time steps and final flux calculation) (1/2/3/4/5 = K/alpha/concentration/delta/radius)
2	R	(IM + 1)	Unconditional	REAG	Radii
3	MA	IM	Unconditional	REAI	Zone numbers for each space cell
4	MZ	IZM	Unconditional	REAI	Material numbers for each zone
5	XEI	IGM	If MTP = 0	REAG	Group fission spectrum values (χ 's)
6	VE	IGM	If MTP = 0	↓	Group velocity values
7	W	(ISN + 1)	Unconditional		Quadrature weights
8	D	(ISN + 1)	Unconditional		Quadrature directions
9	F	IM	If IFN = 0		Input fission guess
10	XN	(IM)(IGM)	If IFN $\neq$ 0		Input flux guess or restart dump
11	PYMD	(IM)(MS)	If IFN = 2	↓	Restart dump point atom density values
12	MB	MS	If MS > 0	REAI	Integers numbering material mixtures
13	MC	MS	If MS > 0	REAI	Integers specifying mixture operations
14	XMD	MS	If MS > 0	REAG	Material densities
15	RM	IZM	If any IEVT(J) = 4	REAG	Radial modifiers
16	MIT	MTP	If MTP > 0	REAI	Numbers identifying microscopic cross sections on a disk or tape file
17	C	(IHM)(IGM) *(MT)	If MCR $\neq$ 0	RECS	Microscopic cross sections from cards
18	LBBS	NB8	Unconditional	REAI	Burnup region numbers (in ascending order)
19	MSEZ	(NB8)(9)	Unconditional	REAI	Mixture specifications for burnup isotopes in each burnup control region
20	DAYS	NTS	Unconditional	REAG	Burnup time step widths in days
21	KM3	ID3	If ID3 $\neq$ 0	REAI	Integers specifying materials for calculating activities
22	KM4	ID3	If ID3 $\neq$ 0	REAI	Integers specifying cross section positions for activity calculations

The remaining input data are read in the sequence listed in Section E. (Control integers for activity prints are read in subroutine FINPR, during the first time step.) These data are read by the subroutines REAI (integers), REAG (floating point), and RECS (cross sections). The subroutines use 6(I1,I2,I9), 6(I1,I2,E9.4), and 6E12.5 formats, respectively. In REAI and REAG, if I1 = 0, only the word in the nine-digit format is read; if I1 = 1, the nine-digit word is repeated I2 times; if I1 = 2, I2 linear interpolants are placed between the nine-digit word and the next such word; and if I1 = 3, reading of that data set is terminated. Thus, each data set read by REAG and REAI must be followed by a three in the first column after the last word.

Item 1 in Section E of Table II is the eigenvalue-type variable used for specifying the type of flux calculation at the beginning of each burnup time interval and after all nuclide concentration calculations have been completed. For example, in a problem with two burnup time intervals, three IEVT values would be required. The values 3, 5, 1 would cause the execution of a concentration search at the beginning of the first time step, a system dimension search at the beginning of the second time step, and a k calculation for the final pass.

Item 11 is a restart option for point burnup calculations and can read in point atom density values punched as output in subroutine FINPR. In order to use this option, the input guess trigger, IFN, must be given a value of two, and a flux dump must precede the point densities in the input data.

Item 15, the radial modifiers, must be included if any one of the (NTS + 1) IEVT values is four, signifying a zone thickness computation somewhere in the calculational sequence.

Item 18 consists of the NB8 burnup region numbers specifying those regions in which burnup calculations are desired. For a three-zone problem, for example, with burnup in the first and third zones, LBBS values of 1,3 would be required together with an NB8 value of 2.

Item 19 is the two-dimensional input array, MSEZ, discussed in Section 2.3. This gives the mixture specifications of each of the nine burnup nuclides for each of the NB8 control regions. The proper use of the MSEZ array in conjunction with related input data is illustrated in Table III. These data are for a core and blanket problem with ^{235}U and ^{238}U initially in zone 1 and ^{238}U initially in zone 2. The data have been set up so that different sets of microscopic cross sections for the ^{238}U chain nuclides are used for core and blanket burnup calculations. In this illustration, the effects of fission product poisoning are calculated only in the blanket.

Item 20 in Section E of Table II consists of the widths of the NTS burnup time intervals, in full-power days.

In DTF-BURN, unlike DTF-IV, the microscopic cross-section table must include capture and fission cross-section values which are used in the solution of the burnup equations. The cross sections are read into a three-dimensional array C_{ijk} , where k designates the material, j the energy group, and i the position in the group column of the table. The arrays are read for the j th group for material k , then for the $j+1$ th group for k until all groups are read, then for the $k+1$ th material, and so on. The length of the column indicated by i is IHM. Cross sections are located in the following rows of the column:

$\sigma(\text{total})$ is in the IHT row

$v\sigma_f$ is in the IHT-1 row

σ_a is in the IHT-2 row

σ_f is in the IHT-3 row

σ_c is in the IHT-4 row

σ_s^{g+g} is in the IHS row.

TABLE III

Data Values Illustrating Proper Use of MSEZ Array
in Conjunction with Other Input Data

A. Cross-Section Material Numbers

1. Input Microscopic Cross Sections

<u>Core</u>	<u>Blanket</u>
^{235}U - 1	^{238}U - 9
^{236}U - 2	^{239}Np - 10
^{238}U - 3	^{239}Pu - 11
^{239}Np - 4	^{240}Pu - 12
^{239}Pu - 5	^{241}Pu - 13
^{240}Pu - 6	^{242}Pu - 14
^{241}Pu - 7	Fission Product - 15
^{242}Pu - 8	

2. Macroscopic Cross Sections

Core - 16 Blanket - 17

B. Data Pertaining to Cross-Section Mixes

Mixture Specifications	Mixture Numbers	Mixture Commands
<u>MS</u>	<u>MB</u>	<u>MC</u>
1	16	0
2		1
3		2
4		3
5		4
6		5
7		6
8		7
9		8
10	17	0
11		9
12		10
13		11
14		12
15		13
16		14
17		15

C. MSEZ Values for NB8 = 2

MSEZ(1,1) = 2 ^{235}U	MSEZ(1,2) = 0 ^{235}U
MSEZ(2,1) = 3 ^{236}U	MSEZ(2,2) = 0 ^{236}U
MSEZ(3,1) = 4 ^{238}U	MSEZ(3,2) = 11 ^{238}U
MSEZ(4,1) = 5 ^{239}Np	MSEZ(4,2) = 12 ^{239}Np
MSEZ(5,1) = 6 ^{239}Pu	MSEZ(5,2) = 13 ^{239}Pu
MSEZ(6,1) = 7 ^{240}Pu	MSEZ(6,2) = 14 ^{240}Pu
MSEZ(7,1) = 8 ^{241}Pu	MSEZ(7,2) = 15 ^{241}Pu
MSEZ(8,1) = 9 ^{242}Pu	MSEZ(8,2) = 16 ^{242}Pu
MSEZ(9,1) = 0 FP	MSEZ(9,2) = 17 FP

The arrangement of column 1 is:

IHM	.	.	
	.	.	
	.	.	
IHT-4	σ_c		
IHT-3	σ_f		
IHT-2	σ_a		
IHT-1	$\nu\sigma_f$		
IHT	σ		
IHT+1	σ^{up} (if IHT+1 $\neq$ IHS)		
.			
.			
.			
IHS-2	σ_s^{g+g+2}	}	up scatter
IHS-1	σ_s^{g+g+1}		
IHS	σ_s^{g+g}		
IHS+1	σ_s^{g+g-1}	}	down scatter
IHS+2	σ_s^{g+g-2}		
.			
.			
.			

The cross-section table may contain values not needed in the calculation. These extra nuclides can be used in the calculation of activities, if desired.

3.2 General

The DTF-BURN code consists of 15 subroutines. The machine storage requirements are shown in parentheses.

1. OUTER (1933)	6. RMAVGF (380)	11. MIXCX (368)
2. INNER (801)	7. NEWPAR (243)	12. FINPR (1193)
3. SNCN (666)	8. REAI (185)	13. DTFBUR (1927)
4. FISSN (397)	9. REAC (242)	14. BURN (1204)
5. IFUNC (190)	10. RECS (395)	15. POBURN (1921)

Like DTF-IV, the DTF-BURN program makes use of the variable dimensioning permitted with the FORTRAN-IV language. Computation of the storage requirements for each problem run is performed in the control flow subroutine, DTFBUR, which is depicted schematically in Fig. 1. All program variables are stored in either a floating common vector, A, or an integer common vector, IA. In subroutine DTFBUR, the first-word location in the A or IA vector of each separate variable storage array is computed from the control integers read in as input data. Dimensioned variable arrays in the other subroutines are located in the proper portions of the floating common or integer common vectors when their first-word locations and dimensions are transferred to the other subroutines through the call statements in subroutine DTFBUR. The location and identification of most of the first-word addresses and other integers utilized in the DTF-BURN code are the same as those employed in DTF-IV.⁽¹⁾ The location and identification of other integers and addresses is given in Table IV.

Even though written for the IBM 7030, the DTF-BURN code may be modified for the IBM 7090/IBM 7094 or for any other computer which is compatible with the FORTRAN-IV language. As coded for the IBM 7030, the floating common vector, A, contains 65K words, while the integer common vector, IA, contains 4K words. In order to make the program operable on other computers, the common dimensions of the A (floating point) and IA (integer) vector variables must be adjusted to fit the available core storage. In addition, a clear-common statement at the beginning of subroutine DTFBUR must be changed to correspond to the adjusted dimensions.

TABLE IV

Definition and Location of Integers Stored in Common Array IA
Which Differ from Those in the DTF-IV Code

Location	Parameter Name	Type	
11	IPT	Input	Type of burnup calculation (0/1 = region/point)
74	MACS		Zone number for concentration search
80	MSEC		Mixture specification of first principal nuclide varied in concentration search
96	MSDC		Search specifier (if $N < 0$, $ N $ additional nuclides including one secondary nuclide; if $N > 0$, N additional principal nuclides)
192	NB8	Computed	Number of burnup control regions
193	NTS		Number of burnup time intervals
194	MTB		9
195	ISTP		Time step indicator
196	KM5		First word address for ISC(IZM) array - integers defining first space cell in each zone
197	KM6		First word address for LSC(IZM) array - integers defining last space cell in each zone
198	KM7		First word address for LBBS(NB8) array - zone numbers of NB8 burnup control regions
199	KM8		First word address for MSEZ(MTB,NB8) array - mixture specification numbers of nine burnup nuclides for each burnup control region
200	KM9		First word address for IEVT(NTSS) array - eigenvalue-type values for flux calculations
201	JAA		First word address for DAYS(NTS) array - burnup time widths
202	JAB		First word address for VOL(IZM) array - zone volumes
203	JAC		If IPT = 0, first word address for RINT(NB8,IGM) array - group-integrated fluxes for burnup control regions
			If IPT = 1, first word address for PXMD(IM,MS) array - point atom densities
204	JAD		If IPT = 0, first word address for TMD(MS) array - temporary storage for regional atom densities
			If IPT = 1, first word address for PTMD(IM,MS) array - temporary storage for point atom densities.
205	JAE		If IPT = 1, first word address for TMD(MS) array - storage of average atom densities obtained from integration of point atom density values
206	NTSS		NTE + 1
207	JAH		First word address for XXMD(MS) array - temporary atom density storage array used in concentration search

The 15 subroutines comprising the DTF-BURN program require about 12K words and the library and FORTRAN monitor system require about 5K additional words. All the remaining available core storage may be used for the floating common and integer common vectors.

The code uses these library routines:

1. CLOCK	5. EXIT
2. SSWTCH	6. POWER
3. ATAN	7. EXP
4. COS	8. ALOG

3.3 Typical Running Time

The computing time required for the calculation of nuclide concentration changes in a depletion problem with the DTF-BURN code is small in comparison with the time required for the flux calculations at the beginning of each time step. Estimates may, therefore, be made of total running times for different problems from the execution times for analogous flux problems with DTF-IV.

The following depletion problem ran 28.32 minutes on the IBM 7030: 15-group, S_4 , 50 spatial intervals, cylindrical critical poison search with vacuum boundary condition at outer boundary, point five time step burnup.

More typical depletion problems with five neutron energy groups would, therefore, require about 10 minutes of computing time.

REFERENCES

1. K. D. Lathrop, "DTF-IV, A FORTRAN-IV Program for Solving the Multi-group Transport Equation with Anisotropic Scattering," Los Alamos Scientific Laboratory Report, LA-3373 (1965).
2. K. D. Lathrop, Nucl. Sci. Eng. 25, 306 (1966).
3. D. P. Satkus and H. P. Flatt, "SIZZLE, A Fast or Intermediate Reactor Burnup Code," NAA Program Description, AI-64-MEMO-183 (1964).

APPENDIX I

BURNUP DIFFERENTIAL EQUATIONS AND SOLUTIONS

In the lists of equations and solutions given in this appendix, the following notations are used:

- N - atom density (atoms/cc)
- $\dot{N} - \frac{dN}{dt}$
- RC_k^x - reaction coefficient for nuclide k and process x (absorption, capture, or fission) as defined in Section 2.3.
- λ_k - decay constant for nuclide k for process of beta emission.

EQUATIONS

^{235}U Chain

1. $\dot{N}_{\text{U235}} + \text{RC}_{\text{U235}}^a N_{\text{U235}} = 0$
2. $\dot{N}_{\text{U236}} + \text{RC}_{\text{U236}}^a N_{\text{U236}} = \text{RC}_{\text{U235}}^c N_{\text{U235}}$

^{238}U Chain

3. $\dot{N}_{\text{U238}} + \text{RC}_{\text{U238}}^a N_{\text{U238}} = 0$
4. $\dot{N}_{\text{Np239}} + (\lambda_{\text{Np239}} + \text{RC}_{\text{Np239}}^a) N_{\text{Np239}} = \text{RC}_{\text{U238}}^c N_{\text{U238}}$
5. $\dot{N}_{\text{Pu239}} + \text{RC}_{\text{Pu239}}^a N_{\text{Pu239}} = \lambda_{\text{Np239}} N_{\text{Np239}}$
6. $\dot{N}_{\text{Pu240}} + \text{RC}_{\text{Pu240}}^a N_{\text{Pu240}} = \text{RC}_{\text{Np239}}^c N_{\text{Np239}} + \text{RC}_{\text{Pu239}}^c N_{\text{Pu239}}$
7. $\dot{N}_{\text{Pu241}} + \text{RC}_{\text{Pu241}}^a N_{\text{Pu241}} = \text{RC}_{\text{Pu240}}^c N_{\text{Pu240}}$
8. $\dot{N}_{\text{Pu242}} + \text{RC}_{\text{Pu242}}^a N_{\text{Pu242}} = \text{RC}_{\text{Pu241}}^c N_{\text{Pu241}}$

Fission Product Pair Chain

9. $\dot{N}_{\text{FP}} = \text{RC}_{\text{U235}}^f N_{\text{U235}} + \text{RC}_{\text{U236}}^f N_{\text{U236}} + \text{RC}_{\text{U238}}^f N_{\text{U238}} + \text{RC}_{\text{Np239}}^f N_{\text{Np239}}$
 $+ \text{RC}_{\text{Pu239}}^f N_{\text{Pu239}} + \text{RC}_{\text{Pu240}}^f N_{\text{Pu240}} + \text{RC}_{\text{Pu241}}^f N_{\text{Pu241}}$

SOLUTIONS

²³⁵U Chain

1. $N_{U235}(t + h) = N_{U235}(t) e^{-RC_{U235}^a h}$
2. $N_{U236}(t + h) = N_{U236}(t) e^{-RC_{U236}^a h} + C_0 \left[e^{-RC_{U236}^a h} - e^{-RC_{U235}^a h} \right]$

where

$$C_0 = \frac{RC_{U235}^c N_{U235}(t)}{RC_{U235}^a - RC_{U236}^a}$$

²³⁸U Chain

3. $N_{U238}(t + h) = N_{U238}(t) e^{-RC_{U238}^a h}$
4. $N_{Np239}(t + h) = N_{Np239}(t) e^{-A_1 h} + C_1 \left[e^{-A_1 h} - e^{-RC_{U238}^a h} \right]$

where

$$A_1 = \lambda_{Np239} + RC_{Np239}^a$$

$$C_1 = \frac{RC_{U238}^c N_{U238}(t)}{RC_{U238}^a - A_1}$$

$$5. \quad N_{\text{Pu239}}(t+h) = N_{\text{Pu239}}(t) e^{-RC_{\text{Pu239}}^a h} + C_2 \left[e^{-RC_{\text{Pu239}}^a h} - e^{-A_1 h} \right] - C_3 \left[e^{-RC_{\text{Pu239}}^a h} - e^{-RC_{\text{U238}}^a h} \right]$$

where

$$C_2 = \frac{\lambda_{\text{Np239}}}{A_1 - RC_{\text{Pu239}}^a} \left[N_{\text{Np239}}(t) + C_1 \right]$$

$$C_3 = \frac{\lambda_{\text{Np239}} C_1}{RC_{\text{U238}}^a - RC_{\text{Pu239}}^a}$$

$$6. \quad N_{\text{Pu240}}(t+h) = N_{\text{Pu240}}(t) e^{-RC_{\text{Pu240}}^a h} + C_4 \left[e^{-RC_{\text{Pu240}}^a h} - e^{-A_1 h} \right] + C_5 \left[e^{-RC_{\text{Pu240}}^a h} - e^{-RC_{\text{U238}}^a h} \right] + C_6 \left[e^{-RC_{\text{Pu240}}^a h} - e^{-RC_{\text{Pu239}}^a h} \right]$$

where

$$C_4 = \frac{RC_{\text{Np239}}^c N_{\text{Np239}}(t) + RC_{\text{Np239}}^c C_1 - RC_{\text{Pu239}}^c C_2}{A_1 - RC_{\text{Pu240}}^a}$$

$$C_5 = \frac{RC_{\text{Pu239}}^c C_3 - RC_{\text{Np239}}^c C_1}{RC_{\text{U238}}^a - RC_{\text{Pu240}}^a}$$

$$C_6 = \frac{RC_{\text{Pu239}}^c}{RC_{\text{Pu239}}^a - RC_{\text{Pu240}}^a} \left[N_{\text{Pu239}}(t) + C_2 - C_3 \right]$$

$$\begin{aligned}
7. \quad N_{\text{Pu241}}(t + h) = & N_{\text{Pu241}}(t) e^{-\text{RC}_{\text{Pu241}}^a h} + c_7 \left[e^{-\text{RC}_{\text{Pu241}}^a h} - e^{-\text{RC}_{\text{Pu240}}^a h} \right] \\
& - c_8 \left[e^{-\text{RC}_{\text{Pu241}}^a h} - e^{-A_1 h} \right] - c_9 \left[e^{-\text{RC}_{\text{Pu241}}^a h} - e^{-\text{RC}_{\text{U238}}^a h} \right] \\
& - c_{10} \left[e^{-\text{RC}_{\text{Pu241}}^a h} - e^{-\text{RC}_{\text{Pu239}}^a h} \right]
\end{aligned}$$

where

$$c_7 = \frac{\text{RC}_{\text{Pu240}}^c}{\text{RC}_{\text{Pu240}}^a - \text{RC}_{\text{Pu241}}^a} \left[N_{\text{Pu240}}(t) + c_4 + c_5 + c_6 \right]$$

$$c_8 = \frac{\text{RC}_{\text{Pu240}}^c c_4}{A_1 - \text{RC}_{\text{Pu241}}^a}$$

$$c_9 = \frac{\text{RC}_{\text{Pu240}}^c c_5}{\text{RC}_{\text{U238}}^a - \text{RC}_{\text{Pu241}}^a}$$

$$c_{10} = \frac{\text{RC}_{\text{Pu240}}^c c_6}{\text{RC}_{\text{Pu239}}^a - \text{RC}_{\text{Pu241}}^a}$$

$$\begin{aligned}
8. \quad N_{\text{Pu242}}(t + h) = & N_{\text{Pu242}}(t) e^{-\text{RC}_{\text{Pu242}}^a h} + C_{11} \left[e^{-\text{RC}_{\text{Pu242}}^a h} - e^{-\text{RC}_{\text{Pu241}}^a h} \right] \\
& - C_{12} \left[e^{-\text{RC}_{\text{Pu242}}^a h} - e^{-\text{RC}_{\text{Pu240}}^a h} \right] \\
& + C_{13} \left[e^{-\text{RC}_{\text{Pu242}}^a h} - e^{-A_1 h} \right] \\
& + C_{14} \left[e^{-\text{RC}_{\text{Pu242}}^a h} - e^{-\text{RC}_{\text{U238}}^a h} \right] \\
& + C_{15} \left[e^{-\text{RC}_{\text{Pu242}}^a h} - e^{-\text{RC}_{\text{Pu239}}^a h} \right]
\end{aligned}$$

where

$$C_{11} = \frac{\text{RC}_{\text{Pu241}}^c}{\text{RC}_{\text{Pu241}}^a - \text{RC}_{\text{Pu242}}^a} \left[N_{\text{Pu241}}(t) + C_7 - C_8 - C_9 - C_{10} \right]$$

$$C_{12} = \frac{\text{RC}_{\text{Pu241}}^c C_7}{\text{RC}_{\text{Pu240}}^a - \text{RC}_{\text{Pu242}}^a}$$

$$C_{13} = \frac{\text{RC}_{\text{Pu241}}^c C_8}{A_1 - \text{RC}_{\text{Pu242}}^a}$$

$$C_{14} = \frac{\text{RC}_{\text{Pu241}}^c C_9}{\text{RC}_{\text{U238}}^a - \text{RC}_{\text{Pu242}}^a}$$

$$C_{15} = \frac{\text{RC}_{\text{Pu241}}^c C_{10}}{\text{RC}_{\text{Pu239}}^a - \text{RC}_{\text{Pu242}}^a}$$

Fission Product Pair Chain

$$\begin{aligned} 9. \quad N_{FP}(t + h) = N_{FP}(t) + \frac{h}{2} \bigg\{ & RC_{U235}^f \left[N_{U235}(t + h) + N_{U235}(t) \right] \\ & + RC_{U236}^f \left[N_{U236}(t + h) + N_{U236}(t) \right] \\ & + RC_{U238}^f \left[N_{U238}(t + h) + N_{U238}(t) \right] \\ & + RC_{Np239}^f \left[N_{Np239}(t + h) + N_{Np239}(t) \right] \\ & + RC_{Pu239}^f \left[N_{Pu239}(t + h) + N_{Pu239}(t) \right] \\ & + RC_{Pu240}^f \left[N_{Pu240}(t + h) + N_{Pu240}(t) \right] \\ & + RC_{Pu241}^f \left[N_{Pu241}(t + h) + N_{Pu241}(t) \right] \bigg\} \end{aligned}$$

APPENDIX II

FLOW DIAGRAMS OF DTF-BURN SUBROUTINES

In this appendix, flow diagrams of several of the subroutines listed in Section 3.2 are given. For those subroutines nearly identical to ones in the DTF-IV program, flow diagrams are not given; instead, a list of the modifications is presented. In the flow charts, subscripted variables are written with true subscripts [W_m instead of $W(M)$]; arguments for functions are written in parentheses [$\text{EXP}(UU)$]; and the asterisks (*) indicate multiplication.

A. Subroutine DTF-BUR

B. Subroutine REAI

(Identical with that in DTF-IV program.)

C. Subroutine REAG

(Identical with that in DTF-IV program.)

D. Subroutine RECS

1. Dimension of variable A in COMMON statement changed from A(66000) to A(65000).

E. Subroutine SNCN

(Identical with that in DTF-IV program.)

F. Subroutine IFUNC

1. Subroutine argument changed from
(XKI, XKE, VE, IGP, IQM, PV, IPVT, IEVT) to
(XKI, XKE, VE, IGP, IQM, PV, IPVT, ISTP, NTS, IEVT).
2. IEVT(NTS) added to DIMENSION statement.
3. Second statement changed from
[IF (IQM•EQ•0•AND•IEVT•LE•0) GO TO 23] to
[IF ((IQM•EQ•0)•AND•(IEVT(ISTP)•LE•0)) GO TO 23].

G. Subroutine MIXCX^a

^aRange of subscripts: m = 1 to MS = number of mixture specifications
 i = 1 to lhm = length of cross section table
 j = 1 to IGM = number of groups
 n = 1 to MT = total number of materials

H. Subroutine RMAVGF

1. Argument of subroutine changed from
(RA, AA, R, V, RM, RAV, MA, W, D, DA, DB, DC, DS, IP, IM, IZM,
MM) to
(RA, AA, R, V, RM, RAV, MA, W, D, DA, DB, DC, DS, IP, IM, IZM,
MM, NTSS, IEVT).
2. IEVT(NTSS) added to DIMENSION statement.
3. Dimension of variable A in COMMON statement changed from
A(66000) to A(65000).
4. (IEVT, IA(11)) deleted from EQUIVALENCE statement and
(ISTP, IA(195)) added to EQUIVALENCE statement.
5. Statement number 8 changed from
[IF (IEVT-4) 201, 10, 20] to
[IF (IEVT(ISTP)-4) 201, 10, 20].
6. Statement number 201 changed from
[IF (ICC·NE·0·AND·IEVT·LE·3) GO TO 500] to
[IF ((ICC·NE·0)·AND·(IEVT(ISTP)·LE·3)) GO TO 500]..

I. Subroutine FISSN

1. Argument of subroutine changed from
(XN, C, XJ, B, IGM, IM, IHM, MT, NM, MM, FG, IGP, F, XKE, MA,
MZ, IZM, V, QG) to
(XN, C, XJ, B, IGM, IM, IHM, MT, NM, MM, FG, ICP, F, XKE, MA,
MZ, IZM, V, QG, NTSS, IEVT).
2. IEVT(NTSS) added to DIMENSION statement.
3. Dimension of variable A in COMMON statement changed from
A(66000) to A(65000).
4. (IEVT, IA(11)) deleted from EQUIVALENCE statement and
(ISTP, IA(195)) added to EQUIVALENCE statement.
5. Sixth statement after statement number 224 changed from
[IF (IEVT·EQ·0) GO TO 248] to
[IF (IEVT(ISTP)·EQ·0) GO TO 248].

6. Eighth statement after statement number 224 changed from

[IF (IEVT·NE·1) GO TO 248] to

[IF (IEVT(ISTP)·NE·1) GO TO 248].

7. Statement following statement number 248 changed from

[IF (IEVT·NE·0) GO TO 308] to

[IF (IEVT(ISTP)·NE·0) GO TO 308].

J. Subroutine OUTER

1. Argument of subroutine changed from

(C, SA, CL, XN, XJ, CH, Q, B, XND, XJJ, T, SUMT, SUMZ, IHM,
IGM, MT, IM, MM, NM, ISCT, IT, IP, IZ, MA, MZ, IZM, F, CS,
V, SR, CT, CA, XNN, XNO, ST, XNR, W, RA, D, AV, WD, SNG, SCG,
XNL, AG, SDG, RL, XNB, IGP, FNG, XNG, XNDG, QG, FG, XKE, XKI)

to

(C, SA, CL, XN, XJ, CH, Q, B, XND, XJJ, T, SUMT, SUMZ, IHM,
IGM, MT, IM, MM, NM, ISCT, IT, IP, IZ, MA, MZ, IZM, F, CS,
V, SR, CT, CA, XNN, XNO, ST, XNR, W, RA, D, AV, WD, SNG, SCG,
XNL, AG, SDG, RL, XNB, IGP, FNG, XNG, XNDG, QG, FG, XKE, XKI,
NTSS, IEVT).

2. IEVT(NTSS) added to DIMENSION statement.

3. Dimension of variable A in COMMON statement changed from
A(66000) to A(65000).

4. (IEVT, IA(11)) deleted from EQUIVALENCE statement and
(ISTP, IA(195)) added to EQUIVALENCE statement.

5. Fourth line after statement number 79 changed from
[1 QG] to [1 QG, NTSS, IEVT].

6. Statement number 85 changed from
[IF (IEVT·EQ·1) EV = XKI(IGP)/XKE(IGP)] to

[IF (IEVT(ISTP)·EQ·1) EV = XKI(IGP)/XKE(IGP)].

7. Third statement after statement number 83 changed from

[IF (IEVT·EQ·0) GO TO 114] to

[IF (IEVT(ISTP)·EQ·0) GO TO 114].

8. Fourth statement after statement number 83 changed from

[IF (IEVT·GT·1) GO TO 113] to

[IF (IEVT(ISTP)·GT·1) GO TO 113].

K. Subroutine INNER

1. Dimension of variable A in COMMON statement changed from A(66000) to A(65000).

L. Subroutine FINPR

M. Function Series (X,Y)

N. Subroutine BURN

N. Subroutine BURN (continued)

2. Computation of Geometrical Parameters

N. Subroutine BURN (continued)

3. Calculation of Integrated Flux for Burnup Control Regions and Average Value of Nu

N. Subroutine BURN (continued)

4. Calculation of Reaction Coefficients

for ^{235}U Chain

N. Subroutine BURN (continued)

5. Solution of Burnup Equations for ^{235}U Chain

N. Subroutine BURN (continued)

6. Calculation of Reaction Coefficients for ^{238}U Chain

$A3 = (A3 * VBARP)/VREGN$
 $C3 = (C3 * VBARP)/VREGN$
 $F3 = (F3 * VBARP)/VREGN$
 $A4 = (A4 * VBARP)/VREGN$
 $C4 = (C4 * VBARP)/VREGN$
 $F4 = (F4 * VBARP)/VREGN$
 $A5 = (A5 * VBARP)/VREGN$
 $C5 = (C5 * VBARP)/VREGN$
 $F5 = (F5 * VBARP)/VREGN$
 $A6 = (A6 * VBARP)/VREGN$
 $C6 = (C6 * VBARP)/VREGN$
 $F6 = (F6 * VBARP)/VREGN$
 $A7 = (A7 * VBARP)/VREGN$
 $C7 = (C7 * VBARP)/VREGN$
 $F7 = (F7 * VBARP)/VREGN$
 $A8 = (A8 * VBARP)/VREGN$

RETURN

N. Subroutine BURN (continued)

7. Solution of Burnup Equations for ^{238}U Chain

ENTER

$YY = -A3 * SECS$
 $TMD_{K3} = XMD_{K3} * EXP(YY)$

$AA1 = AML4 + A4$
 $CC1 = (C3 * XMD_{K3}) / (A3 - AA1)$
 $XX = -AA1 * SECS$
 $TMD_{K4} = XMD_{K4} * EXP(XX) + CC1 * SERIES(-XX, -YY)$

$ZZ = -A5 * SECS$
 $CC2 = \{ (XMD_{K4} + CC1) * AML4 \} / (AA1 - A5)$
 $CC3 = (AML4 * CC1) / (A3 - A5)$
 $TMD_{K5} = XMD_{K5} * EXP(ZZ) + CC2 * SERIES(-ZZ, -XX) - CC3 * SERIES(-ZZ, -YY)$

$WW = -A6 * SECS$
 $CC4 = (C4 * XMD_{K4} + C4 * CC1 - C5 * CC2) / (AA1 - A6)$
 $CC5 = (C5 * CC3 - C4 * CC1) / (A3 - A6)$
 $CC6 = \{ (XMD_{K5} + CC2 - CC3) * C5 \} / (A5 - A6)$
 $TMD_{K6} = XMD_{K6} * EXP(WW) + CC4 * SERIES(-WW, -XX)$
 $+ CC5 * SERIES(-WW, -YY) + CC6 * SERIES(-WW, -ZZ)$

next page

↓

$$VV = -A7 * SECS$$

$$CC7 = \left\{ C6 * \left(XMD_{K6} + CC4 + CC5 + CC6 \right) \right\} / (A6 - A7)$$

$$CC8 = (C6 * CC4) / (AA1 - A7)$$

$$CC9 = (C6 * CC5) / (A3 - A7)$$

$$CC10 = (C6 * CC6) / (A5 - A7)$$

$$TMD_{K7} = XMD_{K7} * EXP(VV) + CC7 * SERIES(-VV, -WW)$$

$$- CC8 * SERIES(-VV, -XX) - CC9 * SERIES(-VV, -YY)$$

$$- CC10 * SERIES(-VV, -ZZ)$$

↓

$$UU = -A8 * SECS$$

$$CC11 = \left\{ C7 * \left(XMD_{K7} + CC7 - CC8 - CC9 - CC10 \right) \right\} / (A7 - A8)$$

$$CC12 = (C7 * CC7) / (A6 - A8)$$

$$CC13 = (C7 * CC8) / (AA1 - A8)$$

$$CC14 = (C7 * CC9) / (A3 - A8)$$

$$CC15 = (C7 * CC10) / (A5 - A8)$$

$$TMD_{K8} = XMD_{K8} * EXP(UU) + CC11 * SERIES(-UU, -VV)$$

$$- CC12 * SERIES(-UU, -WW) + CC13 * SERIES(-UU, -XX)$$

$$+ CC14 * SERIES(-UU, -YY) + CC15 * SERIES(-UU, -ZZ)$$

↓

$$VMASS3 = \left(VOL_{IR} * TMD_{K3} * AW3 * CRA \right) / 602.252$$

$$PRINT \quad TMD_{K3}, \quad VMASS3$$

↓

next page

0. Subroutine POBURN

1. Control Flow

0. Subroutine POBURN (continued)

2. Computation of Geometrical Parameters

0. Subroutine POBURN (continued)

3. Calculation of Average Value of Nu

0. Subroutine POBURN (continued)

4. Transfer of Average Densities to Point Density Array

0. Subroutine POBURN (continued)

5. Compute New Point Densities for Search Elements

0. Subroutine POBURN (continued)

6. Transfer Point Densities into Temporary Point Density Array

0. Subroutine POBURN (continued)

7. Solve Burnup Equations for ²³⁵U Chain

0. Subroutine POBURN (continued)

8. Solve Burnup Equations for ^{238}U Chain

$A3 = (A3 * VBARP)/CRA$
 $C3 = (C3 * VBARP)/CRA$
 $F3 = (F3 * VBARP)/CRA$
 $A4 = (A4 * VBARP)/CRA$
 $C4 = (C4 * VBARP)/CRA$
 $F4 = (F4 * VBARP)/CRA$
 $A5 = (A5 * VBARP)/CRA$
 $C5 = (C5 * VBARP)/CRA$
 $F5 = (F5 * VBARP)/CRA$
 $A6 = (A6 * VBARP)/CRA$
 $C6 = (C6 * VBARP)/CRA$
 $F6 = (F6 * VBARP)/CRA$
 $A7 = (A7 * VBARP)/CRA$
 $C7 = (C7 * VBARP)/CRA$
 $F7 = (F7 * VBARP)/CRA$
 $A8 = (A8 * VBARP)/CRA$

$YY = -A3 * SECS$
 $PTMD_{ii, K3} = PXMD_{ii, K3} * EXP(YY)$

$AA1 = AML4 + A4$
 $CC1 = (C3 * PXMD_{ii, K3}) / (A3 - AA1)$
 $XX = -AA1 * SECS$
 $PTMD_{ii, K4} = PXMD_{ii, K4} * EXP(XX) + CC1 * SERIES(-XX, -YY)$

next column

$ZZ = -A5 * SECS$
 $CC2 = (PXMD_{ii, K4} + CC1) * AML4 / (AA1 - A5)$
 $CC3 = (AML4 * CC1) / (A3 - A5)$
 $PTMD_{ii, K5} = PXMD_{ii, K5} * EXP(ZZ) + CC2 * SERIES(-ZZ, -XX) - CC3 * SERIES(-ZZ, -YY)$

$WW = -A6 * SECS$
 $CC4 = (C4 * PXMD_{ii, K4} + C4 * CC1 - C5 * CC2) / (AA1 - A6)$
 $CC5 = (C5 * CC3 - C4 * CC1) / (A3 - A6)$
 $CC6 = \left\{ (PXMD_{ii, K5} + CC2 - CC3) * C5 \right\} / (A5 - A6)$
 $PTMD_{ii, K6} = PXMD_{ii, K6} * EXP(WW) + CC4 * SERIES(-WW, -XX)$
 $+ CC5 * SERIES(-WW, -YY) + CC6 * SERIES(-WW, -ZZ)$

$VV = -A7 * SECS$
 $CC7 = \left\{ C6 * (PXMD_{ii, K6} + CC4 + CC5 + CC6) \right\} / (A6 - A7)$
 $CC8 = (C6 * CC4) / (AA1 - A7)$
 $CC9 = (C6 * CC5) / (A3 - A7)$
 $CC10 = (C6 * CC6) / (A5 - A7)$
 $PTMD_{ii, K7} = PXMD_{ii, K7} * EXP(VV) + CC7 * SERIES(-VV, -WW)$
 $- CC8 * SERIES(-VV, -XX) - CC9 * SERIES(-VV, -YY)$
 $- CC10 * SERIES(-VV, -ZZ)$

next page

0. Subroutine POBURN (continued)

9. Transfer Point Densities from Temporary into Regular Array

0. Subroutine POBURN (continued)

10. Compute Regional Average Densities

O. Subroutine POBURN (continued)

11. Compute Regional Isotope Masses

P. Subroutine NEWPAR

1. Arguments added: (NTS, IEVT)
2. Dimensions of variable A in COMMON statement changed from A(66000) to A(65000).
3. (IA(11), IEVT) deleted from EQUIVALENCE statement and replaced by (IA(195), ISTEP).
4. DIMENSION statement added: IEVT(NTS).
5. Statement number 13 changed from [IF (IEVT.EQ.2) GO TO 14] to [IF (IEVT(ISTEP).EQ.2) GO TO 14].

APPENDIX III

LISTINGS OF CODE SUBROUTINES

In this appendix, listings of all subroutines diagrammed in Appendix II are given.

[illegible][illegible]

```

00045 NI=NM+IP
00046 IZP=IZM+I
00047 IGP=IGM+I
00048 ML=MC+MTP
00049 NTSS=NTS+I
00050 IILP=IIL
00051 MTB=9
00052 NMNM=NM+NS
00053 IF(IISCT.LT.1)GOTO52
00054 NM=ISCT
00055 IF(IGE.EQ.2)NM=(NM+NM+4)/4
C COMPUTE STORAGE REQUIREMENTS AND STORAGE INDICES
52 JR=51
00056 JKI=JR+IP
00057 JVE=JKI+IGP
00058 JM=JVE+IGP
00059 JD=JM+NM
00060 JWD=JD+NM
00061 JF=JWD+NM
00062 JN=JF+IP
00063 JMD=JN+IG
00064 JRM=JMD+MS
00065 JQ=JRM+IZM
00066 JC=JQ
00067 IF(IQM.EQ.0)GOTO51
00068 JC=JQ+IG
00069 51 JL=JC+IM+IG+MT
00070 JQG=JL+NM+NM
00071 JKE=JQG+IGP
00072 JRA=JKE+IGP
00073 JA=JRA+IP
00074 JV=JA+IP
00075 JAV=JV+IP
00076 JDA=JAV+IP
00077 JDB=JDA+MI
00078 JDC=JDB+MI
00079 JDS=JDC+MI
00080 JX=JDS+MI
00081 JB=JX+IG+NM
00082 JFG=JB
00083 IF(IIBR.GE.1)JFG=JB+MG
00084 JTB=JFG+IGP
00085 JSR=JTB+IGM
00086 JSN=JSR+IM
00087 JCT=JSN+IGP
00088 JCS=JCT+IM
00089 JCH=JCS+IM
00090 JSA=JCH+IM+ISCT
00091 JNN=JSA+IM+NM
00092 JJJ=JNN+IM
00093 JND=JJJ+IM+NM
00094 JNL=JND+IM
00095 JRL=JNL+IGP
00096 JAF=JRL+IGP
00097 JST=JAF+MI
00098 JNA=JST+IM
00099 JAT=JNA+IM
00100 JNI=JAT+IM+NM
00101 JNE=JNI+NM
00102 JNR=JNE+IM
00103 JOR=JNR+IM
00104 JSC=JOR+NM
00105 JAG=JSC+IGP
00106 JNG=JAG+IGP
00107 JFN=JNG+IGP
00108 JDG=JFN+IGP
00109 JSD=JDG+IGP
00110 JNB=JSD+IGP
00111 JCA=JNB+IGP
00112 KMA=208
00113 KMZ=KMA+IM
00114 KMB=KMZ+IZM
00115 KMC=KMB+MS
00116 KMT=KMC+MS
00117 KMR=KMT+MTP
00118 KMS=KMR+NM
00119 KM4=KMS+I03
00120 KM5=KM4+I03
00121 KM6=KM5+IZM
00122 KMT=KM6+IZM
00123 KMB=KMT+NB8
00124 MIA=9+NB8
00125 KMO=KMB+MIA
00126 JTOTI=KM9+NTS+1
00127 JT=JCA+IM
00128 IT=NM+IS
00129 JSM=JT+IZP+IT
00130 JSZ=JSM+IT+IZP
00131 JTS=JSZ+IT
00132 JTS=JTS+I03+IZP
00133 JJJR=JTS+I03+IM
00134 JAA=JJJR+MI
00135 JAB=JAA+NTS
00136 JAC=JAB+IZM
00137 IF(IPT.EQ.1)GO TO 400
00138 JAD=JAC+NB8+IGM
00139 JAH=JAD+MS
00140 JFIN=JAH+MS
00141 GO TO 500
00142 400 JAD=JAC+IM+MS
00143 JAE=JAD+IM+MS
00144 JAH=JAE+MS
00145 JFIN=JAH+MS
00146 500 JNRG=JNB+IGM
00147 C STARTING INDICES
00148 D054=1.70
00149 KA=1+50
00150 KB=1+120
00151 54 IAKB)=IAKA)-1
00152 JTOTI=JFIN+JTOTI
00153 WRITE(9,55)JTOTI,JFIN,JTOTI
00154 55 FORMAT(17HINTEGER STORAGE=15/24H FLOATING POINT STORAGE=15/
IZOM TOTAL DATA STORAGE=16,6H WORCS,/)
00155 IF(IJTOTI.GT.4000).OR.(JFIN.GT.65000)WRITE(9,53)
00156 53 FORMAT(29H***STORAGE EXCEEDS COMMON***,/)
C READ RADII
00157 CALL RCAI (IA(KM9),NTSS,6HIEVT V,6HALUES )
00158 CALL REAG (IA(JR),IP,6HRAII ,6H )
C READ ZONE NUMBERS
00159 CALL REAI (IA(KMA),IM,6HZONE N,6HNUMBERS)
C READ MATERIAL NUMBERS
00160 CALL REAI (IA(KMZ),IZM,6HMATERI,6HAL NO.)

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00161 IF (MTP.NE.0)GOTO899
00162 C READ FISSION FRACTIONS AND VELOCITIES
00163 CALL REAG (AIJKI),IGM,6HFSSIO,6-N FRAC)
00164 CALL REAG (AIJVE),IGM,6HVELOCI,6-TIES )
00165 C READ QUADRATURE COEFFICIENTS
00166 899 CALL REAG (AIJWI),MM,6M WEIGH,6MNTS )
00167 CALL REAG (AIJDI),MM,6M DIREC,6MNTONS )
00168 C TEST FOR FISSION OR FLUX INPUT
00169 IF (IFN.NE.0)GOTO901
00170 C READ FISSION GUESS
00171 CALL REAG (AIJFI),IM,6HFSSIO,6MNS )
00172 GOTO902
00173 C READ FLUXES (GUESS OR RESTART DUMP)
00174 901 CALL REAG (AIJNI),IG,6HINITIA,6HL FLUX)
00175 C TEST FOR POINT DENSITY INPUT
00176 IF (IFN.NE.2) GO TO 902
00177 C READ POINT DENSITIES (RESTART DUMP)
00178 CALL REAG (AIJAC),MM,6MPT DEN,6HSITIES)
00179 C TEST FOR MIXTURE COMMANDS
00180 902 IF (MS.LE.0)GOTO903
00181 CALL REAI (IAKMB),MS,6MMIX NU,6NUMBER )
00182 CALL REAI (IAKMC),MS,6MMIX CO,6PMAND )
00183 CALL REAG (AIJND),MS,6MMIX DE,6HASITY, )
00184 IF (IFN.NE.2) GO TO 903
00185 DO 9030 J=1,MS
00186 J1=JAE+J-1
00187 J1=JND+J-1
00188 AIJ1=AIJKI
00189 9030 CONTINUE
00190 C TEST FOR DELTA CALCULATION
00191 903 DO 550 J=1,NTSS
00192 JJ1=KM9 + J - 1
00193 IF (IAJJ1.NE.4) GO TO 550
00194 GO TO 551
00195 550 CONTINUE
00196 GO TO 907
00197 C READ RADIAL MODIFIERS
00198 551 CALL REAG (AIJRM),IZM,6HRADIAL,6- MODS )
00199 C TEST FOR NUCLIDES TO BE READ FROM DISK AND CARDS
00200 907 IF (MTP.LE.0)GOTO908
00201 CALL RFAT (IAKMT),MTP,6MDISK M,6HAT NO,)
00202 908 CALL RECS (AIJCI),IMM,IGM,MT)
00203 CALL REAI (IAKMT),N8,6MBURNUP,6M R.NOS)
00204 CALL REAI (IAKMB),MIA,6MSEZ N,6NUMBERS)
00205 CALL REAG (AIJAA),NTS,6MTIME M,6-IDHS )
00206 C====DONE WITH INPUT====
00207 C COMPUTE AND PRINT SN CONSTANTS
00208 C TEMPORARY STORAGE
00209 909 J1=JKE
00210 J2=J1+MM
00211 J3=J2+MM
00212 J4=J3+MM
00213 KA=ISCT+1
00214 KB=KA+ISCT
00215 JS=J4+KB
00216 J6=JS+MM+KA+KA
00217 CALL SNEY (AIJWI),AIJDI),AIJND),AIJLI),IAKMR),AIJLI),AIJ2),AIJ3),
00218 IA(JN),AIJS),MM,NM,KA,KB)
00219 C ZERO TEMPORARY STORAGE
00220 DO 9090 K=J1,J6
00221 9090 A(K)=0.0
00222 C COMPUTE INITIAL FUNCTIONS
00223 910 CALL IFUNC (AIJKI),AIJKE),AIJVE),IGP,IQM,PV,IPVT,ISTP,NTS,
00224 IA(KM9))
00225 C MIX AND PRINT CROSS SECTIONS
00226 ISTP = 1
00227 3000 FORMAT(1H1,18HEDIT FOR TIME STEP,13)
00228 11 WRITE(9,3000) ISTP
00229 IF (ICC.EQ.0) GO TO 911
00230 J=KM9+ISTP-1
00231 IF (IA(JI).NE.3)GO TO 911
00232 911 CALL MIXCX (AIJCI),IAKMB),IAKMC),AIJND),IMM,IGM,MT,
00233 IM,SE,NTSS,ICC,IA(KM9),MSCE,MSDC,ISTP,MCA,MIP,AIJAHI)
00234 9111 NFN=1
00235 C MODIFY RADII AND COSINE OF ARCS, VOLUMES, AND GEOMETRIC FUNCTIONS
00236 CALL RMVGEF (AIJRA),AIJAI),AIJRI),AIJVI),AIJRI),AIJVI),IA(KMA),
00237 IA(JN),AIJDI),AIJDA),AIJDB),AIJDC),AIJDS),IP,IM,IZM,MM,NTSS,IA(KM9))
00238 C FISSION CALCULATIONS AND NORMALIZATIONS
00239 914 CALL FISSN (AIJN),AIJCI),AIJX),AIJBE),IGM,IM,IMM,MT,NM,MM,AIJFG),IGP
00240 1,AIJFI),AIJKE),IA(KMA),IA(KMZ),IZP,AIJVI),AIJQC),NTSS,IA(KM9))
00241 C MONITOR PRINT
00242 8300 IF (ICC.GT.0)GOTO915
00243 WRITE(9,321)EPS,EPSA,IO
00244 321 FORMAT(1H0//10H ITERATION MONITOR,5X,4HEPS=E16.8,5X,5HEPSA=E16.8,
00245 1X,11H PROBLEM ID,10//,8H TIME IN,4X,
00246 1X,5HMINUTE,7X,7HMINUTE,7X,7HMINUTE,7X,10HEIGENVALUE,5A
00247 2,10HEIGENVALUE,7X,6HLAMBD0A/10H MINUTES ITERATIONS, 2X,10HITERATIO
00248 3NS,5X,7HDBALANCE,24X,5HSLOPE/)
00249 915 CALL CLOCK(TI)
00250 WRITE(9,331)TI,ICC,LC,AIJNBG),EV,EQ,XLA
00251 331 FORMAT(1X,F6.3,1X,18,4X,18,4X,4E15.8)
00252 IF (ICC.LE.1)GOTO937
00253 C FLUX DUMP
00254 332 WRITE(9,333)
00255 333 FORMAT(1H0//100 MANY OUTER ITERATIONS-FLUXES DUMPED)
00256 GO TO 917
00257 C ALPHA OPTION
00258 337 C1=0.0
00259 J=KM9+ISTP-1
00260 IF (IA(JI).EQ.2)E1=EV
00261 IF (IPVT.EQ.2)E1=E1+PV
00262 DO 916 I=1,IGM
00263 JTB=JTB+1-1
00264 JVE=JVE+1-1
00265 916 AIJTB)=E1/AIJVEI)
00266 C BEGIN GROUP LOOP
00267 CALL OUTER(AIJCI),AIJSA),AIJLI),AIJNI),AIJXI),AIJCH),AIJQ),
00268 IA(JB),AIJAF),AIJJI),AIJTI),AIJSM),AIJSE),IMM,IGM,MT,IM,
00269 2NM,MM,ISCT,IT,IP,IZP, IA(KMA),IA(KMZ),IZM,AIJFI),AIJCS),AIJVI),
00270 3A(JSR),AIJCT),AIJCA),AIJNN),AIJND),AIJST),AIJNR),AIJMI),
00271 4 AIJRA),AIJDI),AIJJA),AIJND),
00272 5 AIJSM),AIJSC),AIJNL),AIJAG),AIJSD),AIJRL),AIJNB),IGP,
00273 6AIJFN),AIJNG),AIJOG),AIJOG),AIJFG),AIJKE),AIJKI),NTSS,IA(KM9))
00274 GOTO917,8300,852),K501
00275 917 CALL CLOCK(TI)
00276 WRITE(9,321)EPS,EPSA,IO
00277 WRITE(9,331)TI,ICC,LC,AIJNBG),EV,EQ,XLA
00278 TI=TI-TIME
00279 WRITE(9,330)TI
00280 330 FORMAT(1H0//EXECUTION TIME=F7.3,8H MINUTES)
00281 C FINAL PRINT
00282 J=KM9+ISTP-1

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00244	IF(IA(J).NE.3) GO TO 200	003121
00245	IF(IA(80).EQ.0) GO TO 200	003131
00246	100 FORMAT(43H0SEARCH DENSITY OF FIRST PRINCIPAL ELEMENT=E16.8)	003137
00247	101 FORMAT(39H SEARCH DENSITY OF PRINCIPAL ELEMENT NO,13,1H=E16.8)	003137
00248	102 FORMAT(37H SEARCH DENSITY OF SECONDARY ELEMENT=E16.8)	003137
00249	JARG=JMD+MSEC-1	003137
00250	WRITE(9,100) A(JARG)	003145
00251	IF(IA(96).EQ.0) GO TO 200	003162
00252	IF(IA(96).GT.0) GO TO 7000	003170
00253	L=IABS(IA(96))	003176
00254	LPR=L-1	003200
00255	IF(LPR.EQ.0) GO TO 7010	003203
00256	DO 7020 I=1,LPR	003211
00257	NE=JMD+MSEC+I-1	003212
00258	NAE=I+1	003217
00259	WRITE(9,101) NAE,A(NE)	003222
00260	7020 CONTINUE	003246
00261	7010 NE=JMD+MSEC+L-1	003247
00262	WRITE(9,102) A(NE)	003254
00263	GO TO 200	003273
00264	7000 DO 7030 I=1,MSDC	003274
00265	NE=JMD+MSEC+I-1	003275
00266	NAE=I+1	003302
00267	WRITE(9,101) NAE,A(NE)	003305
00268	7030 CONTINUE	003331
00269	200 CALL FINPR (A(JN),A(JX),A(JT3),A(JT5),A(JC),IGM,IM,NM,ID3, 11ZP,IMH,MT,A(JNB),ICP,IA(KMA),A(JHA),A(JAV),A(JV),A(JF),IP,IA(KM3) 2,IA(KM4), IA(KMZ),IZM,A(JPC),MS,IA(KMC),IA(KMB),AID) CALL SSWTCH(4,K000FX) IF(K000FX.EQ.1) GO TO 40 IF(ISTP.GT.NTS) GO TO 40 IF(IPT.EQ.1) GO TO 560 CALL BURN (IA(KM6),IA(KMA),A(JAB),A(JV),A(JAA),IA(KMZ),A(JC),IA(KM 17),A(JN),A(JMD),IA(KMB),IA(KMC),IZM,IM,IP,NTS,IMH,IGM,MT,NBB,MS,A 2JAC),A(JAD),MTB,IA(KM5),IA(KM9)) 603 ICC=0 EVM = EV IC=0 IIL=IILP LC=0 ICVT=0 XLA=0.0 EQ=0.0 FTP=0.0 IA(49)=0 A(27)=0.0 A(30)=0.0 A(31)=0.0 A(33)=0.0 A(34)=0.0 A(35)=0.0 A(JNDC)=0.0 ISTP=ISTP+1 J=KM9+ISTP-1 610 IF(IA(J).GE.31G) GO TO 600 EV=0.0 GO TO 11 600 IF(IA(J).GT.31G) GO TO 601 EV=1.0 GO TO 11 601 IF(IA(J).GT.41G) GO TO 602 EV=0.0 GO TO 11 602 IZT=JR+IP-1 EV=A(IZT) GO TO 11 560 CALL PBURN(IA(KM6),IA(KMA),A(JAB),A(JV),A(JAA),IA(KMZ),A(JC),IA(K 1M7),A(JN),A(JMD),IA(KMB),IA(KMC),IZM,IM,IP,NTS,IMH,IGM,NT,NBB,MS,A 2JAC),A(JAD),MTB,IA(KM5),IA(KM9),A(JAE)) GO TO 603 40 RETURN C NEW PARAMETERS FOR IMPLICIT EIGENVALUE SEARCH 852 CALL NEWPAR(NTSS,IA(KM9)) GOTO(917,8300,9100),KS852 END	003332 003332 003332 003332 003426 003434 003442 003450 003456 003456 003456 003544 003546 003550 003552 003554 003556 003560 003562 003564 003566 003570 003572 003574 003576 003600 003602 003604 003606 003611 003615 003625 003627 003630 003636 003640 003641 003647 003651 003652 003656 003660 003661 003661 003661 003751 003752 003752 003753 003761 003771
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SUBTYPE,FORTAN

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C MIX CROSS SECTIONS AND PRINT
SUBROUTINE MIXCX (C,MB,MC,XMD,IHM,IGM,MT,MS,EV,NTSS,ICC,IEVT,MSEC,
1MSDC,ISTP,MCR,MTP,XXMD)
DIMENSION C(IHM,IGM,MT),MB(MS),MC(MS),XMD(MS),IEVT(NTSS),XXMD(MS)
IF(MS.EQ.0)GOTO20
DO18M=1,MS
IF(IEVT(ISTP).NE.3) GO TO 302
IF(M.NE.MSEC) GO TO 302
IF(ICC.EQ.0) XXMC(M)=XMC(M)
DENS0=XMD(M)
XMD(M)=XXMD(M)+EV
DENSE=XMD(M)
IF(MSDC.EQ.0)GO TO 302
IF(MSDC.GT.0) GO TO 270
L=IABS(MSDC)
LPR=L-1
IF(LPH.EQ.0) GO TO 220
DO 210 I=1,LPR
NE=M+I
IF(ICC.EQ.0) XXMD(NE)=XMD(NE)
DENSE=DENSE+XMD(NE)
XMD(NE)=XXMD(NE)+EV
DENSE=DENSE+XMD(NE)
210 CONTINUE
220 NE=M+L
XMD(NE)=XMD(NE)+(DENS0-DENSE)
GO TO 302
270 DO 303 I=1,L
NE=M+I
IF(ICC.EQ.0) XXMC(NE)=XMC(NE)
DENSE=DENSE+XMD(NE)
XMD(NE)=XXMD(NE)+EV
DENSE=DENSE+XMD(NE)
303 CONTINUE
302 K=MB(M)
L=MC(M)
A=XMD(M)
DO18I=1,IHM
DO18J=1,IGM
IF(L)16,15,16
15 C(I,J,K)=C(I,J,K)+A
GOTO18
16 C(I,J,K)=C(I,J,K)+A+C(I,J,L)
18 CONTINUE
IF(IEVT(ISTP).EQ.3.AND. ICC.NE.0)GO TO 53
WRITE(9,201)(MB(I),MC(I),XMD(I),I=1,MS)
20 IF(ISTP.EQ.1) GO TO 25
MTI=MCR+MTP+1
GO TO 30
25 MTI=1
30 DO 52 I=MTI,MT
WRITE(9,101)I
KA=1
KB=0
51 KC=MIND(KB,IGM)
WRITE(9,102)(K,K+KA,KC)
WRITE(9,103)
DO 510 J=1,IHM
510 WRITE(9,104) J,(C(J,K,I),K=KA,KC)
KA=KA+8
KB=KB+8
IF(KA.LE.IGM)GOTO51
52 CONTINUE
53 RETURN
101 FORMAT(1H0//26H CROSS SECTION OF MATERIAL,13/)
102 FORMAT(1H0,5X,8(2X,5HGROUP,13,3X))
103 FORMAT(1H )
104 FORMAT(14,1P8E13.5)
201 FORMAT(1H0/16H MIXTURE NUMBER ,16H MIX COMMAND ,
124H MATERIAL ATOMIC DENSITY/(4X,18,8X,18,8X,E16.8,8X,18))
END

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C FINAL PRINT

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[illegible]

00104	716	FORMAT(1P5E12.3,1M3)	001411
	C	PLOT FISSIONS	001411
00105	607	CALL ADV(2)	001411
00106		CALL SPLOT(1,1M,RAV,F,44,1)	001415
00107		CALLTSP(120,950,12,BCD2)	001433
00108		CALL TSP (120,20,72,AID)	001445
00109		CALLTSPV(50,90,8,BCD1)	001457
00110		CALL ADV(2)	001471
00111		DO 62 IG=1,1GM	001475
00112		DO 63 I=1,1M	001476
00113		IF (XN(I,IG).GT.0.01G0 TO 64	001477
00114		F(I)=0.0	001505
00115		GO TO 63	001507
00116	64	F(I)=ALOG10(XN(I,IG))	001510
00117	63	CONTINUE	001515
00118		CALL SPLOT(2,1M,RAV,F,44,1)	001516
00119		ITEM5=IG/10	001534
00120		ITEM6=IG-(ITEM5*10)	001544
00121		CALLTSP(120,950,12,BCD2)	001552
00122		CALL TSP (120,20,72,AID)	001564
00123		CALLTSPV(50,90,33,BCD3)	001576
00124		CALL TSP(300,950,12,BCD5)	001610
00125		CALL TSP(380,950,1,BCD4(ITEM5+1))	001622
00126		CALL TSP (395,950,1,BCD4(ITEM6+1))	001634
00127		CALL ADV(1)	001646
00128	62	CONTINUE	001652
00129		CALL ADV(5)	001653
00130		IF(1D3.EQ.0)GOTO500	001657
00131		IF(1STP.NE.1) GO TO 720	001665
00132		CALL REAI (KM3,1D3,6HACT MA,6HT NO.5)	001675
00133		CALL REAI (KM4,1D3,6HACT CX,6H POS. 1)	001707
00134	720	DO 305I=1,1D3	001721
00135		DO304J=1,1ZP	001722
00136	304	T3(I,J)=0.0	001723
00137		DO305J=1,1M	001725
00138	305	T5(I,J)=0.0	001726
00139		DO317IG=1,1GM	001730
00140		DO317JJ=1,1D3	001731
00141		IF(1JJ.EQ.1)GOTO307	001732
00142		IF(KM3(JJ).EQ.KM3(JJ-1))GO TO 309	001740
00143	307	IE=KM3(JJ)	001746
00144		DO410I=1,1M	001750
00145		IE1=IE(I)	001751
00146		IE1=IABS(MZ(IE1))	001753
00147		E2=0.0	001755
00148		IF(IE.NE.IE1)GOTO412	001757
00149		E2=1.0	001767
00150	405	RA(I)=E2*XN(I,IG)	001771
00151		RAV(I)=RA(I)+V(I)	001774
00152		GOTO410	001777
00153	412	DO422J=1,1M	002000
00154		IF(IE1.NE.MG(J))GOTO422	002001
00155		IF(XMD(J).EQ.0.0)GOTO415	002011
00156		IF(MF(J).EQ.0)GOTO419	002017
00157		IF(MF(J)-IE1)422,420,422	002025
00158	415	IF(MF(J).NE.0)GOTO418	002031
00159		E2=0.0	002041
00160		GOTO422	002043
00161	418	E2=E2+1.0	002044
00162		GOTO422	002047
00163	419	E2=E2+XMD(J)	002050
00164		GO TO 422	002053
00165	420	E2=E2+XMD(J)	002054
00166	422	CONTINUE	002057
00167		GOTO405	002060
00168	410	CONTINUE	002061
00169	309	N=KM4(JJ)	002062
00170		DO315I=1,1M	002064
00171		J=ME(I)	002065
00172		T3(JJ,J)=T3(JJ,J)+RAV(I)*C(N,IG,IE)	002067
00173		IF(1D4.NE.0)T5(JJ,I)=T5(JJ,I)+RA(I)*C(N,IG,IE)	002073
00174	315	CONTINUE	002106
00175	317	CONTINUE	002107
00176		DO320L=1,1D3	002110
00177		T3(L,I2P)=0.0	002111
00178		DO320I=1,1ZM	002113
00179	320	T3(L,I2P)=T3(L,I2P)+T3(L,I)	002114
00180		MA=1	002117
00181		MB=8	002121
00182	321	MC=MINO(MB,1D3)	002123
00183		WRITE(9,391)(I,I=MA,MC)	002130
00184		WRITE(9,5)	002150
00185		DO322J=1,1ZP	002162
00186	322	WRITE(9,393)J,(T3(I,J),I=MA,MC)	002163
00187		IF(1D4.EQ.0)GOTO325	002210
00188		WRITE(9,394)(I,I=MA,MC)	002216
00189		WRITE(9,5)	002236
00190		DO323J=1,1M	002250
00191	323	WRITE(9,393)J,(T5(I,J),I=MA,MC)	002251
00192	325	MA=MA+8	002276
00193		MB=MB+8	002301
00194		IF(MA.LE.1D3)GOTO321	002304
00195	391	FORMAT(7H0 2ONE,5X,8(10H MATERIAL,13))	002314
00196	393	FORMAT(3X,16,3X,1P8E13.5)	002314
00197	394	FORMAT(12HOSPACE POINT,8(10H MATERIAL,13))	002314
00198	500	IG=1M+1GM	002314
00199		RETURN	002321
00200		END	002372
SUBTYPE,FORTAN			
00000		FUNCTION SERIES (X,Y)	2600
	C		000002
00001		IF (ABS(X).LT.0.1) GO TO 110	2610
00002	100	ANS = EXP(-X)-EXP(-Y)	2620
00003		GO TO 130	2630
00004	110	IF (ABS(Y).LT.0.1) GO TO 120	2640
00005		GO TO 100	2650
00006	120	ANS = -(X-Y)+(X**2-Y**2)/2.0-(X**3-Y**3)/6.0+(X**4-Y**4)/24.0	2660
00007	130	SERIES=ANS	2670
00008		RETURN	2680
00009		END	2690
			2700

SUBTYPE,FORTAN

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C
C
C PERFORMS BURNUP CALCULATIONS
10
20
30
00000 SUBROUTINE BURN (LSC,MA,VOL,V,DAYS,MZ,C,LBBS,XN,XMD,MSEZ,MC,I2M,IM
40 00000 1,IP,NTS,IMM,IGM,MT,NBB,PS,RINT,TMD,MTB,ISC,IEVT) 000002
00001 DIMENSION LSC(I2M),MA(IM),VOL(I2M),V(IP),DAYS(NTS),MZ(I2
60 00001 1M),C(IMM,IGM,MT),LBBS(NBB),XN(IM,IGM),RINT(NBB,IGM),TMD(NTS),XMD(MS
70 00001 2),MSEZ(MTB,NBB),MC(MS),ISC(I2M),IEVT(NTS) 000002
00002 COMMON A(65000),IA(4000) 000002
00003 EQUIVALENCE (IMT,IA(13)),(ISTP,IA(195)),(PDW,A(19)),(CRA,A(20)) 000002
C
00004 AW1 =235.43915 110 000002
00005 AW2 =236.45637 120 000002
00006 AW3 =236.50770 121 000002
00007 AW4 =239.52924 122 000006
00008 AW5 =239.52146 123 000010
00009 AW6 =240.53882 124 000012
00010 AW7 =241.56737 125 000014
00011 AW8 =242.58725 126 000016
00012 AW9 =230.0000 127 000020
00013 AML4 = 0.34370E-05 128 000022
00014 IF (ISTP.NE.1) GO TO 40 129 000024
C
C COMPUTATION OF GEOMETRICAL PARAMETERS
130 000026
140 000026
150 000026
160 000026
170 000036
00015 DO 30 K=1,I2M 180 000037
00016 DO 20 I=1,IM 190 000040
00017 IF (MA(I).NE.K) GO TO 20 200 000050
00018 ISC(K)=1 210 000052
00019 GO TO 22 220 000053
00020 20 CONTINUE 230 000054
00021 22 L=ISC(K) 240 000056
00022 DO 25 I=L,IM 250 000057
00023 IF (MA(I).EQ.K) GO TO 25 251 000065
00024 LSC(K)=1-1 252 000070
00025 GO TO 30 253 000071
00026 25 CONTINUE 254 000072
00027 30 CONTINUE 260 000073
00028 LSC(I2M)=IM 270 000075
00029 40 IF (ISTP.GT.1.AND.IEVT(ISTP).LT.4) GO TO 70 280 000075
C
C COMPUTATION OF REGIONAL VOLUMES
290 000075
300 000075
310 000112
320 000113
330 000115
00030 DO 60 K = 1,I2M 340 000117
00031 VOL(K) = 0.0 350 000121
00032 LCR = LSC(K) 360 000122
00033 ICR=ISC(K) 365 000125
00034 DO 50 I=ICR,LCR 370 000126
00035 VOL(K) = V(I) + VOL(K) 380 000131
00036 60 CONTINUE 390 000133
00037 70 SECS = DAYS(ISTP)*86400.0 400 000133
00038 VNUM = 0.0 410 000133
00039 VDEN = 0.0 420 000133
C
C COMPUTATION OF AVERAGE VALUE OF NU
430 000133
440 000135
450 000136
00040 DO 90 I = 1,IM 460 000140
00041 K = MA(I) 470 000142
00042 MN = MZ(K) 480 000144
00043 MN = IABS(MN) 490 000147
00044 KI = IMT - 3 500 000152
00045 KID = IMT - 1 510 000153
00046 DO 80 J = 1,IGM 520 000160
00047 VDEN = C(KID,J,MN)*XN(I,J)*V(I) + VDEN 530 000165
00048 VNUM = C(KID,J,MN)*XN(I,J)*V(I) + VNUM 540 000166
00049 80 CONTINUE 550 000167
00050 90 CONTINUE 560 000167
00051 VBARP = (VNUM/VDEN)*PDW*3.1E-8 570 000167
C
C CALCULATION OF INTEGRATED FLUX FOR BURNUP CONTROL REGIONS
580 000167
590 000167
600 000167
00052 DO 140 NREG = 1,NBB 610 000174
00053 IR = LBBS(NREG) 620 000175
00054 IL=ISC(IR) 630 000177
00055 IU=LSC(IR) 640 000201
00056 UD 130 J=1,IGM 650 000203
00057 SUM = 0.0 660 000204
00058 DO 120 I = IL,IU 670 000206
00059 SUM = SUM + XN(I,J)*V(I) 680 000207
00060 RINT(NREG,J) = SUM 690 000213
00061 130 CONTINUE 700 000215
00062 140 CONTINUE 710 000216
C
C TRANSFER OF DENSITIES TO TEMPORARY ARRAY
720 000216
730 000216
740 000216
00063 DO 150 M=1,MS 750 000217
00064 150 TMD(M) = XMD(M) 760 000220
C
C BURNUP COMPUTATION LOOP
770 000220
780 000220
790 000220
800 000220
810 000222
820 000225
830 000225
00065 DO 500 I=1,NBB 840 000225
00066 IR=LBBS(I) 850 000225
00067 WRITE(9,151) IR 860 000225
00068 151 FORMAT(4H0 870 000225
00069 WRITE(9,152) REGION(13) 880 000225
00070 152 FORMAT(4H0 ELEMENT 890 000225
00071 VREGN=VOL(IR)*CRA 900 000225
00072 KI=MSEZ(I,1) 910 000225
00073 IF (KI.EQ.0) GO TO 170 920 000225
C
C CALCULATION OF REACTION COEFFICIENTS FOR U235 CHAIN
930 000225
940 000225
950 000225
960 000225
970 000225
980 000225
990 000225
00074 R2=MSEZ(2,1) 910 000225
00075 A1 = 0.0 920 000225
00076 C1 = 0.0 930 000225
00077 A2 = 0.0 940 000225
00078 F1 = 0.0 950 000225
00079 F2 = 0.0 960 000225
00080 DO 160 J = 1,IGM 970 000225
00081 L1 = MC(K1) 980 000225
00082 L2 = MC(K2) 990 000225
00083 A1 = C(IMT-2,J,L1)*RINT(I,J) + A1 1000 000225
00084 C1 = C(IMT-2,J,L1)*RINT(I,J) + C1 1010 000225
00085 A2 = C(IMT-2,J,L2)*RINT(I,J) + A2 1020 000225
00086 F1 = C(IMT-2,J,L1)*RINT(I,J) + F1 1030 000225

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00097      F2 = C(IINT-3,J,L2)*RINT(I,J) + F2
00088      160 CONTINUE
00089      A1 = (A1-VBARPI)/VREGN
00090      C1 = (C1-VBARPI)/VREGN
00091      A2 = (A2-VBARPI)/VREGN
00092      F1 = (F1-VBARPI)/VREGN
00093      F2 = (F2-VBARPI)/VREGN
C
C      SOLUTION OF BURNUP EQUATIONS FOR U235 CHAIN
C
C      U235 ISOTOPE
00094      VV = -A1*SECS
00095      TMD(K1) = XMD(K1)*EXP(VV)
C
C      U236 ISOTOPE
00096      UU = -A2*SECS
00097      CC1 = (C1-XMD(K1))/(A1-A2)
00098      TMD(K2) = XMD(K2)*EXP(UU) + CC1*SERIES(-UU,-VV)
C
C      FISSION PRODUCT PAIRS FOR U235 CHAIN
00099      K9=PSEZ(9,1)
01000      153 FORPAT(9H0 U235,E16.8,E16.8)
01001      VMAS51=(VOL(1R)*TMD(K1)*AW1+CNA)/602.252
01002      WRITE( 9,153) TMD(K1),VMAS51
01003      VMAS52=(VOL(1R)*TMD(K2)*AW2+CRA)/602.252
01004      154 FORPAT(9H0 U236,E16.8,E16.8)
01005      WRITE( 9,154) TMD(K2),VMAS52
01006      IF (K9.EQ.0) GO TO 170
01007      L9=MC(K9)
01008      TMD(K9) = XMD(K9) + (SECS/2.0)*(F1*(XMD(K1) + TMD(K1)) + F2*(XMD(K
12) + TMD(K2)))
01009      VMAS59=(VOL(1R)*TMD(K9)*AW9+CRA)/602.252
01010      155 FORPAT(9H0FISHPHUM,E16.8,E16.8)
01011      WRITE(9,155) TMD(K9),VMAS59
01012      170 K3=PSEZ(3,1)
01013      IF (K3.EQ.0) GO TO 500
C
C      CALCULATION OF REACTION COEFFICIENTS FOR U238 CHAIN
C
00114      A3 = 0.0
00115      C3 = 0.0
00116      F3 = 0.0
00117      A4 = 0.0
00118      C4 = 0.0
00119      F4 = 0.0
00120      A5 = 0.0
00121      C5 = 0.0
00122      F5 = 0.0
00123      A6 = 0.0
00124      C6 = 0.0
00125      F6 = 0.0
00126      A7 = 0.0
00127      C7 = 0.0
00128      F7 = 0.0
00129      A8 = 0.0
00130      L3 = MC(K3)
00131      K4=PSEZ(4,1)
00132      L4 = MC(K4)
00133      K5=PSEZ(5,1)
00134      L5 = MC(K5)
00135      K6=PSEZ(6,1)
00136      L6 = MC(K6)
00137      K7=PSEZ(7,1)
00138      L7 = MC(K7)
00139      K8=PSEZ(8,1)
00140      L8 = MC(K8)
00141      DO 180 J = 1,16H
00142      A3 = C(IINT-2,J,L3)*RINT(I,J) + A3
00143      C3 = C(IINT-4,J,L3)*RINT(I,J) + C3
00144      F3 = C(IINT-2,J,L3)*RINT(I,J) + F3
00145      A4 = C(IINT-2,J,L4)*RINT(I,J) + A4
00146      C4 = C(IINT-4,J,L4)*RINT(I,J) + C4
00147      F4 = C(IINT-2,J,L4)*RINT(I,J) + F4
00148      A5 = C(IINT-2,J,L5)*RINT(I,J) + A5
00149      C5 = C(IINT-4,J,L5)*RINT(I,J) + C5
00150      F5 = C(IINT-2,J,L5)*RINT(I,J) + F5
00151      A6 = C(IINT-2,J,L6)*RINT(I,J) + A6
00152      C6 = C(IINT-4,J,L6)*RINT(I,J) + C6
00153      F6 = C(IINT-2,J,L6)*RINT(I,J) + F6
00154      A7 = C(IINT-2,J,L7)*RINT(I,J) + A7
00155      C7 = C(IINT-4,J,L7)*RINT(I,J) + C7
00156      F7 = C(IINT-2,J,L7)*RINT(I,J) + F7
00157      A8 = C(IINT-2,J,L8)*RINT(I,J) + A8
00158      180 CONTINUE
00159      A3 = (A3-VBARPI)/VREGN
00160      C3 = (C3-VBARPI)/VREGN
00161      F3 = (F3-VBARPI)/VREGN
00162      A4 = (A4-VBARPI)/VREGN
00163      C4 = (C4-VBARPI)/VREGN
00164      F4 = (F4-VBARPI)/VREGN
00165      A5 = (A5-VBARPI)/VREGN
00166      C5 = (C5-VBARPI)/VREGN
00167      F5 = (F5-VBARPI)/VREGN
00168      A6 = (A6-VBARPI)/VREGN
00169      C6 = (C6-VBARPI)/VREGN
00170      F6 = (F6-VBARPI)/VREGN
00171      A7 = (A7-VBARPI)/VREGN
00172      C7 = (C7-VBARPI)/VREGN
00173      F7 = (F7-VBARPI)/VREGN
00174      A8 = (A8-VBARPI)/VREGN
C
C      SOLUTION OF BURNUP EQUATIONS FOR U238 CHAIN
C
C      U238 ISOTOPE
00175      VV = -A3*SECS
00176      TMD(K3) = XMD(K3)*EXP(VV)
C
C      NP239 ISOTOPE
00177      A41 = AML4 + A4
00178      CC1 = (C3-XMD(K3))/(A3-A41)
00179      XX = -A41*SECS
00180      TMD(K4) = XMD(K4)*EXP(XX) + CC1*SERIES(-XX,-VV)
C
C      PU239 ISOTOPE
00181      ZZ = -A5*SECS
00182      CC2 = (XMD(K4) + CC1)*AML4/(A41-A5)

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00183	CC3 = (AML8+CC1)/(A3-A5)	2080	001163
00184	TMD(K5) = XMD(K5)*EXP(ZZ) + CC2*SERIES(-ZZ,-XX) - CC3*SERIES(-ZZ,-	2090	001172
	1YY)	2100	001172
	C	2110	001172
	C	2120	001172
	C	2130	001172
00185	WM = -A6*SECS	2140	001232
00186	CC4 = (C4*XMD(K4) + C4*CC1 - C5*CC2)/(A4 - A6)	2150	001235
00187	CC5 = (C5*CC3 - C4*CC1)/(A3 - A6)	2160	001254
00188	CC6 = ((XMD(K5) + CC2 - CC3)*C5)/(A5 - A6)	2170	001267
00189	TMD(K6) = XMD(K6)*EXP(WM) + CC4*SERIES(-WM,-XX) + CC5*SERIES(-WM,-	2180	001300
	1YY) + CC6*SERIES(-WM,-ZZ)	2190	001300
	C	2200	001300
	C	2210	001300
	C	2220	001300
00190	PU 241 ISOTOPE	2230	001355
	C	2240	001360
	C	2250	001372
00191	VV = -A7*SECS	2260	001401
00192	CC7 = (C6*(XMD(K6) + CC4 + CC5 + CC6))/(A6-A7)	2270	001410
00193	CC8 = (C6*CC4)/(A4-A7)	2280	001417
00194	CC9 = (C6*CC5)/(A3-A7)	2290	001417
00195	CC10 = (C6*CC6)/(A5-A7)	2300	001417
	TMD(K7) = XMD(K7)*EXP(VV) + CC7*SERIES(-VV,-WM) - CC8*SERIES(-VV,-XX)	2310	001417
	1-CC9*SERIES(-VV,-YY) - CC10*SERIES(-VV,-ZZ)	2320	001417
	C	2330	001511
	C	2340	001514
	C	2350	001527
00196	PU 242 ISOTOPE	2360	001536
	C	2370	001545
	C	2380	001554
00197	UU = -A8*SECS	2390	001563
00198	CC11 = (C7*(XMD(K7) + CC7 - CC8 - CC9 - CC10))/(A7-A8)	2400	001563
00199	CC12 = (C7*CC7)/(A6-A8)	2410	001563
00200	CC13 = (C7*CC8)/(A4-A8)	2420	001672
00201	CC14 = (C7*CC9)/(A3-A8)	2430	001700
00202	CC15 = (C7*CC10)/(A5-A8)	2440	001700
	TMD(K8) = XMD(K8)*EXP(UU) + CC11*SERIES(-UU,-VV) - CC12*SERIES(-UU,-	2450	001724
	1,-WM) + CC13*SERIES(-UU,-XX) + CC14*SERIES(-UU,-YY) + CC15*SERIES(-	2460	001732
	2-UU,-ZZ)	2470	001732
00203	VMAS3=(VOL(IR)*TMD(K3)*AW3*CRA)/602.252	2480	001756
00204	156 FORMAT(9H0 U238,E16.8,E16.8)	2490	001756
00205	WRITE(9,156) TMD(K3),VMAS3	2500	001764
00206	VMAS4=(VOL(IR)*TMD(K4)*AW4*CRA)/602.252	2510	002010
00207	157 FORMAT(9H0 NP239,E16.8,E16.8)	2520	002016
00208	WRITE(9,157) TMD(K4),VMAS4	2530	002016
00209	158 FORMAT(9H0 PU239,E16.8,E16.8)	2540	002042
00210	VMAS5=(VOL(IR)*TMD(K5)*AW5*CRA)/602.252	2550	002050
00211	WRITE(9,158) TMD(K5),VMAS5	2560	002050
00212	VMAS6=(VOL(IR)*TMD(K6)*AW6*CRA)/602.252	2570	002074
00213	159 FORMAT(9H0 PU240,E16.8,E16.8)	2580	002102
00214	WRITE(9,159) TMD(K6),VMAS6	2590	002102
00215	VMAS7=(VOL(IR)*TMD(K7)*AW7*CRA)/602.252	2600	002126
00216	161 FORMAT(9H0 PU241,E16.8,E16.8)	2610	002130
00217	WRITE(9,161) TMD(K7),VMAS7	2620	002136
00218	VMAS8=(VOL(IR)*TMD(K8)*AW8*CRA)/602.252	2630	002136
00219	162 FORMAT(9H0 PU242,E16.8,E16.8)	2640	002136
00220	WRITE(9,162) TMD(K8),VMAS8	2650	002136
00221	K9=MSEZ(9,1)	2660	002140
00222	IF (K9.EQ.0) GO TO 500	2670	002140
00223	L9 = MC(K9)	2680	002140
	C	2690	002175
	C	2700	002203
	C	2710	002203
00224	FISSION PRODUCT PAIRS FOR U238 CHAIN	2720	002203
	C	2730	002227
	C	2740	002230
	C	2750	002231
00225	TMD(K9) = TMD(K9) + (SECS/2.0)*(F3*(XMD(K3) + TMD(K3)) + F4*(XMD(K	2760	002233
00226	14) + TMD(K4)) + F5*(XMD(K5) + TMD(K5)) + F6*(XMD(K6) + TMD(K6)) +		
00227	2F7*(XMD(K7) + TMD(K7)))		
	VMAS9=(VOL(IR)*TMD(K9)*AW9*CRA)/602.252		
	163 FORMAT(9H0FISHPIUM,E16.8,E16.8)		
	WRITE(9,163) TMD(K9),VMAS9		
00228	500 CONTINUE		
00229	DO 510 M= 1,MS		
00230	510 XMD(M) = TMD(M)		
00231	RETURN		
00232	END		

SUBTYPE,FORTAN

```

C
C
C PERFORMS BURNUP CALCULATIONS
10
20
30
00000 SUBROUTINE POBURN(LSC,MA,VOL,V,DAYS,MZ,C,LBBS,XN,XMD,MSEZ,MC,IZM,I
40
50
00001 1M,IP,NTS,IHM,IGM,MT,NB8,MS,PXMD,PTMD,MTB,ISC,IEVT,TMD)
60
70
80
90
00002 DIMENSION LSC(IZM),MA(1M),VOL(1ZP),V(1P),DAYS(NTS),MZ(1Z
100
110
120
130
140
150
160
170
180
190
00003 1M),C(1HM,IGM,MT),LBBS(NB8),XN(1M,IGM),PXMD(1M,MS),PTMD(1M,MS),XMD(
200
210
220
230
240
250
260
270
280
290
00004 COMMON A(65000),IA(8000)
300
310
320
330
340
350
360
370
380
390
00005 EQUIVALENCE (IHT,IA(13)),(ISTP,IA(195)),(POW,A(19)),(ICRA,IA(20)),
400
410
420
430
440
450
460
470
480
490
00006 I(IFN,IA(10)),(MACS,IA(74)),(MSEC,IA(80)),(MSDC,IA(96))
500
510
520
530
540
550
560
570
580
590
00007 AM1 =235.43915
600
610
620
630
640
650
660
670
680
690
00008 AM2 =236.45637
700
710
720
730
740
750
760
770
780
790
00009 AM3 =238.50770
800
810
820
830
840
850
860
870
880
890
00010 AM4 =239.52924
900
910
920
930
940
950
960
970
980
990
00011 AM5 =239.52146
1000
1010
1020
1030
1040
1050
1060
1070
1080
1090
00012 AM6 =240.53582
1100
1110
1120
1130
1140
1150
1160
1170
1180
1190
00013 AM7 =241.56737
1200
1210
1220
1230
1240
1250
1260
1270
1280
1290
00014 AM8 =242.58725
1300
1310
1320
1330
1340
1350
1360
1370
1380
1390
00015 AM9 =230.0000
1400
1410
1420
1430
1440
1450
1460
1470
1480
1490
00016 AML4 = 0.34370E-05
1500
1510
1520
1530
1540
1550
1560
1570
1580
1590
00017 IF (ISTP.NE.1) GO TO 40
1600
1610
1620
1630
1640
1650
1660
1670
1680
1690
C
C
C COMPUTATION OF GEOMETRICAL PARAMETERS
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
360
370
380
390
00018 DO 30 K=1,IZM
400
410
420
430
440
450
460
470
480
490
00019 DO 20 I=1,1M
500
510
520
530
540
550
560
570
580
590
00020 IF (MA(I).NE.K) GO TO 20
600
610
620
630
640
650
660
670
680
690
00021 LSC(K)=1
700
710
720
730
740
750
760
770
780
790
00022 GO TO 22
800
810
820
830
840
850
860
870
880
890
00023 20 CONTINUE
900
910
920
930
940
950
960
970
980
990
00024 22 L=ISC(K)
1000
1010
1020
1030
1040
1050
1060
1070
1080
1090
00025 DO 25 I=L,1M
1100
1110
1120
1130
1140
1150
1160
1170
1180
1190
00026 IF (MA(I).EQ.K) GO TO 25
1200
1210
1220
1230
1240
1250
1260
1270
1280
1290
00027 LSC(K)=I-1
1300
1310
1320
1330
1340
1350
1360
1370
1380
1390
00028 GO TO 30
1400
1410
1420
1430
1440
1450
1460
1470
1480
1490
00029 25 CONTINUE
1500
1510
1520
1530
1540
1550
1560
1570
1580
1590
00030 30 CONTINUE
1600
1610
1620
1630
1640
1650
1660
1670
1680
1690
00031 LSC(IZM)=1M
1700
1710
1720
1730
1740
1750
1760
1770
1780
1790
00032 40 IF (ISTP.GT.1.AND.IEVT(ISTP).LT.4) GO TO 70
1800
1810
1820
1830
1840
1850
1860
1870
1880
1890
C
C
C COMPUTATION OF REGIONAL VOLUMES
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
00033 DO 60 K=1,IZM
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
00034 VOL(K) = 0.0
2100
2110
2120
2130
2140
2150
2160
2170
2180
2190
00035 LCR = LSC(K)
2200
2210
2220
2230
2240
2250
2260
2270
2280
2290
00036 DO 50 I =1,LCR,LCR
2300
2310
2320
2330
2340
2350
2360
2370
2380
2390
00037 DO 50 J =1,IGM
2400
2410
2420
2430
2440
2450
2460
2470
2480
2490
00038 VOL(K) = VII + VOL(K)
2500
2510
2520
2530
2540
2550
2560
2570
2580
2590
00039 60 CONTINUE
2600
2610
2620
2630
2640
2650
2660
2670
2680
2690
00040 70 SECS = DAYS(ISTP)*86400.0
2700
2710
2720
2730
2740
2750
2760
2770
2780
2790
00041 VNUM = 0.0
2800
2810
2820
2830
2840
2850
2860
2870
2880
2890
00042 VDEN = 0.0
2900
2910
2920
2930
2940
2950
2960
2970
2980
2990
C
C
C COMPUTATION OF AVERAGE VALUE OF NU
3000
3010
3020
3030
3040
3050
3060
3070
3080
3090
00043 DO 90 I = 1,1M
3100
3110
3120
3130
3140
3150
3160
3170
3180
3190
00044 K = MA(I)
3200
3210
3220
3230
3240
3250
3260
3270
3280
3290
00045 MN = MT(K)
3300
3310
3320
3330
3340
3350
3360
3370
3380
3390
00046 MN = LABS(MN)
3400
3410
3420
3430
3440
3450
3460
3470
3480
3490
00047 KI = INT - 3
3500
3510
3520
3530
3540
3550
3560
3570
3580
3590
00048 KID = INT - 1
3600
3610
3620
3630
3640
3650
3660
3670
3680
3690
00049 DO 80 J = 1,IGM
3700
3710
3720
3730
3740
3750
3760
3770
3780
3790
00050 VDEN = C(KI,J,MN)*XN(I,J)*V(I) + VDEN
3800
3810
3820
3830
3840
3850
3860
3870
3880
3890
00051 VNUM = C(KID,J,MN)*VN(I,J)*V(I) + VNUM
3900
3910
3920
3930
3940
3950
3960
3970
3980
3990
00052 80 CONTINUE
4000
4010
4020
4030
4040
4050
4060
4070
4080
4090
00053 90 CONTINUE
4100
4110
4120
4130
4140
4150
4160
4170
4180
4190
00054 VBAP = (VNUM/VDEN)*POW*3.1E-8
4200
4210
4220
4230
4240
4250
4260
4270
4280
4290
C
C
C BURNUP COMPUTATION LOOP
4300
4310
4320
4330
4340
4350
4360
4370
4380
4390
00055 DO 900 I=1,NB8
4400
4410
4420
4430
4440
4450
4460
4470
4480
4490
00056 IR=LBBS(I)
4500
4510
4520
4530
4540
4550
4560
4570
4580
4590
00057 ICR=ISC(IR)
4600
4610
4620
4630
4640
4650
4660
4670
4680
4690
00058 LCR=LSC(IR)
4700
4710
4720
4730
4740
4750
4760
4770
4780
4790
00059 K1=MSEZ(1,I)
4800
4810
4820
4830
4840
4850
4860
4870
4880
4890
00060 K2=MSEZ(2,I)
4900
4910
4920
4930
4940
4950
4960
4970
4980
4990
00061 K3=MSEZ(3,I)
5000
5010
5020
5030
5040
5050
5060
5070
5080
5090
00062 K4=MSEZ(4,I)
5100
5110
5120
5130
5140
5150
5160
5170
5180
5190
00063 K5=MSEZ(5,I)
5200
5210
5220
5230
5240
5250
5260
5270
5280
5290
00064 K6=MSEZ(6,I)
5300
5310
5320
5330
5340
5350
5360
5370
5380
5390
00065 K7=MSEZ(7,I)
5400
5410
5420
5430
5440
5450
5460
5470
5480
5490
00066 K8=MSEZ(8,I)
5500
5510
5520
5530
5540
5550
5560
5570
5580
5590
00067 K9=MSEZ(9,I)
5600
5610
5620
5630
5640
5650
5660
5670
5680
5690
00068 IF (ISTP.NE.1) GO TO 105
5700
5710
5720
5730
5740
5750
5760
5770
5780
5790
00069 IF (IFN.EQ.2) GO TO 105
5800
5810
5820
5830
5840
5850
5860
5870
5880
5890
00070 DO 100 II=ICR,LCR
5900
5910
5920
5930
5940
5950
5960
5970
5980
5990
00071 IF (K1.EQ.0) GO TO 700
6000
6010
6020
6030
6040
6050
6060
6070
6080
6090
00072 PXMD(II,K1)=XMD(K1)
6100
6110
6120
6130
6140
6150
6160
6170
6180
6190
00073 PXMD(II,K2)=XMD(K2)
6200
6210
6220
6230
6240
6250
6260
6270
6280
6290
00074 700 IF (K3.EQ.0) GO TO 701
6300
6310
6320
6330
6340
6350
6360
6370
6380
6390
00075 PXMD(II,K3)=XMD(K3)
6400
6410
6420
6430
6440
6450
6460
6470
6480
6490
00076 PXMD(II,K4)=XMD(K4)
6500
6510
6520
6530
6540
6550
6560
6570
6580
6590
00077 PXMD(II,K5)=XMD(K5)
6600
6610
6620
6630
6640
6650
6660
6670
6680
6690
00078 PXMD(II,K6)=XMD(K6)
6700
6710
6720
6730
6740
6750
6760
6770
6780
6790
00079 PXMD(II,K7)=XMD(K7)
6800
6810
6820
6830
6840
6850
6860
6870
6880
6890
00080 PXMD(II,K8)=XMD(K8)
6900
6910
6920
6930
6940
6950
6960
6970
6980
6990
00081 701 IF (K9.EQ.0) GO TO 100
7000
7010
7020
7030
7040
7050
7060
7070
7080
7090
00082 PXMD(II,K9)=XMD(K9)
7100
7110
7120
7130
7140
7150
7160
7170
7180
7190
00083 100 CONTINUE
7200
7210
7220
7230
7240
7250
7260
7270
7280
7290
00084 GO TO 130
7300
7310
7320
7330
7340
7350
7360
7370
7380
7390
00085 105 IF (IEVT(ISTP).NE.3) GO TO 130
7400
7410
7420
7430
7440
7450
7460
7470
7480
7490
00086 IF (IR.NE.MACS) GO TO 130
7500
7510
7520
7530
7540
7550
7560
7570
7580
7590
00087 DO 106 II=ICR,LCR
7600
7610
7620
7630
7640
7650
7660
7670
7680
7690
00088 PXMD(II,MSEC)=PXMD(II,MSEC)+(XMD(MSEC)/TMD(MSEC))
7700
7710
7720
7730
7740
7750
7760
7770
7780
7790
00089 106 CONTINUE
7800
7810
7820
7830
7840
7850
7860
7870
7880
7890
00090 IF (MSDC.EQ.0) GO TO 130
7900
7910
7920
7930
7940
7950
7960
7970
7980
7990
00091 L=IABS(MSDC)
8000
8010
8020
8030
8040
8050
8060
8070
8080
8090
00092 DO 108 IRR=1,L
8100
8110
8120
8130
8140
8150
8160
8170
8180
8190
00093 NE=MSEC*IRR
8200
8210
8220
8230
8240
8250
8260
8270
8280
8290
00094 DO 107 II=ICR,LCR
8300
8310
8320
8330
8340
8350
8360
8370
8380
8390
00095 PXMD(II,NE)=PXMD(II,NE)+(XMD(NE)/TMD(NE))
8400
8410
8420
8430
8440
8450
8460
8470
8480
8490
00096 107 CONTINUE
8500
8510
8520
8530
8540
8550
8560
8570
8580
8590
00097 108 CONTINUE
8600
8610
8620
8630
8640
8650
8660
8670
8680
8690
00098 DO 140 II=ICR,LCR
8700
8710
8720
8730
8740
8750
8760
8770
8780
8790
00099 140
8800
8810
8820
8830
8840
8850
8860
8870
8880
8890
00100
8900
8910
8920
8930
8940
8950
8960
8970
8980
8990

```

00096	IF(K1.EQ.0) GO TO 702	951	000364
00097	PTMD(11,K1)=PXMD(11,K1)	960	000372
00098	PTMD(11,K2)=PXMD(11,K2)	970	000374
00099	702 IF(K3.EQ.0) GO TO 703	971	000376
00100	PTMD(11,K3)=PXMD(11,K3)	980	000404
00101	PTMD(11,K4)=PXMD(11,K4)	990	000406
00102	PTMD(11,K5)=PXMD(11,K5)	1000	000410
00103	PTMD(11,K6)=PXMD(11,K6)	1010	000412
00104	PTMD(11,K7)=PXMD(11,K7)	1020	000414
00105	PTMD(11,K8)=PXMD(11,K8)	1030	000416
00106	703 IF(K9.EQ.0) GO TO 140	1031	000420
00107	PTMD(11,K9)=PXMD(11,K9)	1040	000426
00108	140 CONTINUE	1050	000430
00109	IF (K1.EQ.0) GO TO 170	1060	000431
00110	L1=PC(K1)	1070	000437
00111	L2=PC(K2)	1080	000441
00112	D0 160 I1=ICR,LCR	1090	000443
00113	A1=0.0	1100	000444
00114	C1=0.0	1110	000446
00115	A2=0.0	1120	000450
00116	F1=0.0	1130	000452
00117	F2=0.0	1140	000454
00118	D0 150 J=1,IGM	1150	000456
00119	A1=C(IHT-2,J,L1)*XN(11,J)+A1	1160	000457
00120	C1=C(IHT-4,J,L1)*XN(11,J)+C1	1170	000463
00121	A2=C(IHT-2,J,L2)*XN(11,J)+A2	1180	000467
00122	F1=C(IHT-3,J,L1)*XN(11,J)+F1	1190	000473
00123	F2=C(IHT-3,J,L2)*XN(11,J)+F2	1200	000477
00124	150 CONTINUE	1210	000503
00125	A1=(A1+VBARP)/CRA	1220	000504
00126	C1=(C1+VBARP)/CRA	1230	000510
00127	A2=(A2+VBARP)/CRA	1240	000514
00128	F1=(F1+VBARP)/CRA	1250	000520
00129	F2=(F2+VBARP)/CRA	1260	000524
00130	VV=-A1*SECS	1270	000530
00131	PTMD(11,K1)=PXMD(11,K1)+EXP(VV)	1280	000533
00132	UU=-A2*SECS	1290	000541
00133	CC1=(C1+PXMD(11,K1))/(A1-A2)	1300	000544
00134	PTMD(11,K2)=PXMD(11,K2)+EXP(UU)+CC1+SERIES(-UU,-VV)	1310	000553
00135	IF (K9.EQ.0) GO TO 160	1320	000574
00136	L9=PC(K9)	1330	000604
00137	PTMD(11,K9)=PXMD(11,K9)+(SECS/2.0)*(F1*(PXMD(11,K1)+PTMD(11,K1))+F	1340	000606
	L2*(PXMD(11,K2)+PTMD(11,K2)))	1350	000606
00138	160 CONTINUE	1360	000624
00139	170 IF (K3.EQ.0) GO TO 200	1370	000625
00140	L3=PC(K3)	1380	000633
00141	L4=PC(K4)	1390	000635
00142	L5=PC(K5)	1400	000637
00143	L6=PC(K6)	1410	000640
00144	L7=PC(K7)	1420	000643
00145	L8=PC(K8)	1430	000645
00146	D0 190 I1=ICR,LCR	1440	000647
00147	A3=0.0	1450	000650
00148	C3=0.0	1460	000652
00149	F3=0.0	1470	000654
00150	A4=0.0	1480	000656
00151	C4=0.0	1490	000660
00152	F4=0.0	1500	000662
00153	A5=0.0	1510	000664
00154	C5=0.0	1520	000666
00155	F5=0.0	1530	000670
00156	A6=0.0	1540	000672
00157	C6=0.0	1550	000674
00158	F6=0.0	1560	000676
00159	A7=0.0	1570	000700
00160	C7=0.0	1580	000702
00161	F7=0.0	1590	000704
00162	A8=0.0	1600	000706
00163	D0 180 J=1,IGM	1610	000710
00164	A3=C(IHT-2,J,L3)*XN(11,J)+A3	1620	000711
00165	C3=C(IHT-4,J,L3)*XN(11,J)+C3	1630	000715
00166	F3=C(IHT-3,J,L3)*XN(11,J)+F3	1640	000721
00167	A4=C(IHT-2,J,L4)*XN(11,J)+A4	1650	000725
00168	C4=C(IHT-4,J,L4)*XN(11,J)+C4	1660	000731
00169	F4=C(IHT-3,J,L4)*XN(11,J)+F4	1670	000735
00170	A5=C(IHT-2,J,L5)*XN(11,J)+A5	1680	000741
00171	C5=C(IHT-4,J,L5)*XN(11,J)+C5	1690	000745
00172	F5=C(IHT-3,J,L5)*XN(11,J)+F5	1700	000751
00173	A6=C(IHT-2,J,L6)*XN(11,J)+A6	1710	000755
00174	C6=C(IHT-4,J,L6)*XN(11,J)+C6	1720	000761
00175	F6=C(IHT-3,J,L6)*XN(11,J)+F6	1730	000765
00176	A7=C(IHT-2,J,L7)*XN(11,J)+A7	1740	UUU//1
00177	C7=C(IHT-4,J,L7)*XN(11,J)+C7	1750	000775
00178	F7=C(IHT-3,J,L7)*XN(11,J)+F7	1760	001001
00179	A8=C(IHT-2,J,L8)*XN(11,J)+A8	1770	001005
00180	180 CONTINUE	1780	001011
00181	A3=(A3+VBARP)/CRA	1790	001012
00182	C3=(C3+VBARP)/CRA	1800	001016
00183	F3=(F3+VBARP)/CRA	1810	001022
00184	A4=(A4+VBARP)/CRA	1820	001026
00185	C4=(C4+VBARP)/CRA	1830	001032
00186	F4=(F4+VBARP)/CRA	1840	001036
00187	A5=(A5+VBARP)/CRA	1850	UUU42
00188	C5=(C5+VBARP)/CRA	1860	001046
00189	F5=(F5+VBARP)/CRA	1870	001052
00190	A6=(A6+VBARP)/CRA	1880	001056
00191	C6=(C6+VBARP)/CRA	1890	001063
00192	F6=(F6+VBARP)/CRA	1900	001066
00193	A7=(A7+VBARP)/CRA	1910	001072
00194	C7=(C7+VBARP)/CRA	1920	001076
00195	F7=(F7+VBARP)/CRA	1930	001102
00196	A8=(A8+VBARP)/CRA	1940	UUU106
00197	YY=-A3*SECS	1950	001112
00198	PTMD(11,K3)=PXMD(11,K3)+EXP(YY)	1960	001115
00199	AA1=AML4+AA	1970	001123
00200	CC1=(C3+PXMD(11,K3))/(A3-AA1)	1980	001126
00201	XX=-AA1*SECS	1990	001135
00202	PTMD(11,K4)=PXMD(11,K4)+EXP(XX)+CC1+SERIES(-XX,-YY)	2000	001140
00203	ZZ=-A5*SECS	2010	UUU163
00204	CC2=(C3+PXMD(11,K4)+CC1)/AML4/(AA1-A5)	2020	001166
00205	CC3=(AML4+CC1)/(A3-A5)	2030	001176
00206	PTMD(11,K5)=PXMD(11,K5)+EXP(ZZ)+CC2+SERIES(-ZZ,-XX)+CC3+SERIES(-ZZ	2040	001205
	,-YY)	2050	001205
00207	WW=-A6*SECS	2060	001245
00208	CC4=(C4+PXMD(11,K5)+CC1+CC2)/(A3-AA1)	2070	001250
00209	CC5=(C5+CC3-C4+CC1)/(A3-A6)	2080	001267
00210	CC6=(C3+PXMD(11,K5)+CC2+CC3)/C3/(A5-A6)	2090	001302
00211	PTMD(11,K6)=PXMD(11,K6)+EXP(WW)+CC4+SERIES(-WW,-XX)+CC5+SERIES(-WW	2100	001313
	,-YY)+CC6+SERIES(-WW,-ZZ)	2110	001318
00212	VV=-A7*SECS	2120	001370
00213	CC7=(C6+PXMD(11,K6)+CC4+CC5+CC6)/(A6-A7)	2130	001373
00214	CC8=(C4+CC4)/(A1-A7)	2140	001405

00330	WRITE(9,300) XMD(K2),VMAS52	2990	002647
00331	726 IF(K3.EQ.0) GO TO 727	2991	002673
00332	WRITE(9,310) XMD(K3),VMAS53	3000	002701
00333	WRITE(9,320) XMD(K4),VMAS54	3010	002725
00334	WRITE(9,330) XMD(K5),VMAS55	3020	002751
00335	WRITE(9,340) XMD(K6),VMAS56	3030	002775
00336	WRITE(9,350) XMD(K7),VMAS57	3040	003021
00337	WRITE(9,360) XMD(K8),VMAS58	3050	003045
00338	727 IF(K9.EQ.0) GO TO 728	3051	003071
00339	WRITE(9,370) XMD(K9),VMAS59	3060	003077
00340	728 IF(IR.NE.MACS) GO TO 900	3070	003123
00341	JSTP=JSTP+1	3080	003133
00342	IF(IEVT(JSTP).NE.3) GO TO 900	3090	003136
00343	TMD(MSEC)=XMD(MSEC)	4000	003146
00344	IF(MSDC.EQ.0) GO TO 900	4010	003150
00345	L=IABS(MSDC)	4020	003156
00346	DO 500 IRR=1,L	4030	003160
00347	NE=MSEC+IRR	4040	003161
00348	TMD(NE)=XMD(NE)	4050	003164
00349	500 CONTINUE	4060	003166
00350	900 CONTINUE	4100	003167
00351	RETURN	4110	003170
00352	END	4120	003171

APPENDIX IV

SAMPLE PROBLEM

SAMPLE 1 TIME STEP BURNUP PROBLEM FOR WESTINGHOUSE MODULAR FAST BREEDER

ID	IDENTIFICATION NUMBER			911
ITH	THEORY (0=REGULAR)			0
ISCT	SCATTERING (0/N=ISOTROPIC/NTH ORDER ANISOTROPIC)			0
ISN	QUADRATURE (SN, PN-1, DPN/2-1, ETC.)			4
IGE	GEOMETRY (1/2/3=PLANE/CYLINDER/SPHERE)			2
IBL/IBR	LEFT/RIGHT BOUNDARY CONDITION (0/1/2=VACUUM/REFLECTIVE/PERIODIC)	1	1	
IZN	NUMBER OF ZONES			3
IM	NUMBER OF INTERVALS			50
IFN	INPUT GUESS (0/1=FISSION/FLUX)			0
IPT	TYPE OF BURNUP CALCULATION (0/1=REGIONWISE/POINTWISE)			1
IGN	NUMBER OF GROUPS			15
INT	POSITION OF TCTAL CROSS SECTION IN TABLE			6
IHS	POSITION OF SELF-SCATTER CROSS SECTION IN TABLE			7
IHM	CROSS SECTION TABLE LENGTH			12
MS	NUMBER OF MIXTURE SPECIFICATIONS			35
MCR/MTP	NUMBER OF MATERIAL CROSS SECTIONS READ FROM CARDS/DISK	16	0	
MT	TOTAL NUMBER OF MATERIALS			19
IPVT	PARAMETRIC EIGENVALUE TYPE (0/1/2=NONE/K/ALPHA)			0
IQM	DISTRIBUTED SOURCE INDICATOR (0=NONE)			0
IIM	INNER ITERATION MAXIMUM (PER GROUP)			40
ID1	PRINT ANGULAR FLUX (0/1=NO/YES)			0
ID2	PRINT BALANCE TABLES BY GROUP (0/1=NO/YES)			0
ID3	PRINT ACTIVITIES BY ZONE (0/N=NO/YES-LENGTH OF J3)			0
ID4	PRINT ACTIVITIES BY RADIUS (0/1=NO/YES)			0
ICM	OUTER ITERATION MAXIMUM			100
MFF	DETAILED PRINT IF FLUX FIX-UP USED (0/1=YES/NO)			1
IC	ITERATION COUNT (NON-ZERO ONLY FOR PROBLEM STARTING FROM FLUX DUMP)			0
IIL	INNER ITERATION LIMIT USED UNTIL ONE MINUS LAMBDA IS WITHIN IEN*EPS			10

MACS	ZONE FOR CONCENTRATION SEARCH		1
MSEC	MIXTURE SPECIFICATION OF FIRST PRINCIPAL ELEMENT VARIED IN CONCENTRATION SEARCH		2
MSDC	SEARCH SPECIFIER (-N/N=N ADDITIONAL ELEMENTS INCLUDING ONE SECONDARY ELEMENT/N ADDITIONAL PRINCIPAL ELEMENTS)		0
NBB	NUMBER OF BURNUP CONTROL REGIONS		2
NTS	NUMBER OF TIME INTERVALS		1

EV	EIGENVALUE GUESS		.1000000E+01
EVN	EIGENVALUE MODIFIER		.1000000E-00
EPS	CONVERGENCE CRITERION		.1000000E-03
EPSA	SPECIAL CONVERGENCE CRITERION-USED ONLY IF NON-ZERO		.0000000E 00
BF	BUCKLING FACTOR		.1813800E+01
DY/DZ	BUCKLING HEIGHT/DEPTH	.2155000E+03	.0000000E 00
XNF	NORMALIZATION FACTOR		.1000000E+01
PV	PARAMETRIC EIGENVALUE		.0000000E 00
XEPS	RELAXATION FACTOR		.1000000E-02
XLAL/XLAM	LAMBDA LOWER/HIGHER LIMIT	.1000000E-01	.5000000E+00
XNPM	NEW PARAMETER MODIFIER		.1000000E+01

PDW	REACTOR POWER IN MEGAWATTS		.3571400E+03
CRA	HEIGHT OR CROSS-SECTIONAL AREA		.1905000E+03

INTEGER STORAGE= 367
 FLOATING POINT STORAGE=13212
 TOTAL DATA STORAGE= 13579 WORDS

IEVT VALUES 2 3

RADII	51												
.00000E 00	.16764E+01	.33528E+01	.50292E+01	.67056E+01	.83820E+01	.10058E+02	.11735E+02	.13411E+02	.15088E+02				
.16764E+02	.18440E+02	.20117E+02	.21793E+02	.2347CE+02	.25146E+02	.26822E+02	.28499E+02	.30175E+02	.31852E+02				
.33528E+02	.35204E+02	.36881E+02	.38557E+02	.40234E+02	.41910E+02	.43487E+02	.45063E+02	.46640E+02	.48217E+02				
.49793E+02	.51370E+02	.52947E+02	.54523E+02	.56100E+02	.57677E+02	.59253E+02	.60830E+02	.62407E+02	.63983E+02				
.65560E+02	.66179E+02	.66799E+02	.67418E+02	.68038E+02	.68657E+02	.69277E+02	.69896E+02	.70516E+02	.71135E+02				
.71755E+02													

ZONE NUMBERS	50												
1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	2	2	2	2	2	2	2	2
2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3	3

MATERIAL NO.	3	18	19										
17													

FISSION FRAC	15												
.22500E-00	.34700E-00	.16100E-00	.17000E-00	.84000E-01	.13000E-01	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00
.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00	.00000E 00

VELOCITIES	15												
.28500E 02	.19900E+02	.14700E+02	.11000E+02	.6700CE+01	.27000E+01	.12370E+01	.50710E+00	.18660E-00	.85400E-01				
.51800E-01	.31400E-01	.19100E-01	.11600E-01	.4050CE-02									

WEIGHTS	8												
.00000E 00	.16667E-00	.16667E-00	.00000E 00	.16667E-00	.16667E-00	.16667E-00	.16667E-00	.16667E-00	.16667E-00				

DIRECTIONS	8												
-.47140E-00	-.33333E-00	.33333E-00	-.94281E+00	-.88192E+00	-.33333E-00	.33333E-00	.88192E+00						

FISSIONS	50												
.10000E+01	.10000E+01	.10000E+01	.10000E+01	.1000CE+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01
.10000E+01	.10000E+01	.10000E+01	.10000E+01	.1000CE+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01
.10000E+01	.10000E+01	.10000E+01	.10000E+01	.1000CE+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01
.10000E+01	.10000E+01	.10000E+01	.10000E+01	.1000CE+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01
.10000E+01	.10000E+01	.10000E+01	.10000E+01	.1000CE+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01	.10000E+01

MIX NUMBER	35	17	17	17	17	17	17	17	17	17
17	17	17	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	18	18	18
19	19	19	19	19	19	19	19	19	19	19

MIX COMMAND	35	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9	0
10	11	12	13	0	14	15	2	3	4	5
5	6	7	8	16	9	10	11	12	0	1
9	10	11	12	13						

MIX DENSITY	35	17	17	17	17	17	17	17	17	17
.00000E 00	.68510E-02	.72650E-02	.00000E 00	.14105E-02	.6207CE-03	.87700E-04	.21400E-04	.00000E 00	.91420E-02	.00000E 00
.23510E-02	.14700E-02	.11840E-01	.94053E-02	.00000E 00	.35800E-04	.00000E 00	.11904E-01	.00000E 00	.00000E 00	.00000E 00
.00000E 00	.00000E 00	.00000E 00	.00000E 00	.2388CE-01	.11800E-01	.30330E-02	.18970E-02	.53720E-02	.00000E 00	.00000E 00
.29490E-02	.75820E-03	.47410E-03	.10800E-02	.7200CE-01						

GP	TA	LAMS-2941, 1-14 MILLS	G15 LETHARGY WTD.
15 GP	U238	LAMS-2941, 1-14 MILLSNUCLIDE 1253	G15 FM NAA-SR-11378
15 GP	NP239	NAA-SR-11378, LIBRARY 9W088	
15 GP	PU239	LAMS-2941, 1-14 MILLS	G15 FM NAA-SR-11378
15 GP	PU240	LAMS-2941, 1-14 MILLS	G15 FM NAA-SR-11378
15 GP	PU241	NAA-SR-11378, LIBRARY 9W088	
15 GP	PU242	NAA-SR-11378, LIBRARY 9W088	
15 GP	FP	NAA-SR-11378, LIBRARY 9W088	
15 GP	FE	LAMS-2941, 1-14 MILLS	G15 FM NAA-SR-11378
15 GP	CR	APDA, 1-14 MILLS	G15 FM TEMPEST PD950
15 GP	NI	APDA, 1-14 MILLS	G15 FM TEMPEST PD950
15 GP	NA	LAMS-2941, 1-14 MILLS	G15 FM NAA-SR-11378
15 GP	C	LAMS-2941, 1-14 MILLS	G15 FM NAA-SR-11378
15 GP	U235	LAMS-2941, 1-14 MILLS	G15 FM NAA-SR-11378
15 GP	U236	NAA-SR-11378, LIBRARY 9W088	
15 GP	0	LAMS-2941, 1-14 MILLS	G15 FM NAA-SR-11378

TURNIP R.NOS	2	1	2
1	2	1	2

MSEZ NUMBERS	18	0	3	4	5	6	7	8	9	16
0	18	0	3	4	5	6	7	8	9	16
17	18	19	20	21	22	23	24			

TIME WIDTHS	1	1
.50000E+02	1	1

DIRECTION NO.	REFLECTED DIRECTION NO.	WEIGHT	DIRECTION COSINE	WEIGHT X DIRECTION
1	3	.0000000E 00	-4.7140000E-01	-.0000000E 00
2	3	1.6667000E-01	-3.3333000E-01	-5.5556111E-02
3	2	1.6667000E-01	3.3333000E-01	5.5556111E-02
4	8	.0000000E 00	-9.4281000E-01	-.0000000E 00
5	8	1.6667000E-01	-8.8192000E-01	-1.4698961E-01
6	7	1.6667000E-01	-3.3333000E-01	-5.5556111E-02
7	6	1.6667000E-01	3.3333000E-01	5.5556111E-02
8	5	1.6667000E-01	0.0192000E-01	1.4698961E-01

CHI	CHI/PV	VELOCITIES	GROUP
.2250000E-00	.2250000E-00	.2850000E+02	1
.3470000E-00	.3470000E-00	.1990000E+02	2
.1610000E-00	.1610000E-00	.1470000E+02	3
.1700000E-00	.1700000E-00	.1100000E+02	4
.8400000E-01	.8400000E-01	.6700000E+01	5
.1300000E-01	.1300000E-01	.2700000E+01	6
.0000000E 00	.0000000E 00	.1237000E+01	7
.0000000E 00	.0000000E 00	.5071000E+00	8
.0000000E 00	.0000000E 00	.1866000E-00	9
.0000000E 00	.0000000E 00	.8540000E+01	10
.0000000E 00	.0000000E 00	.5180000E-01	11
.0000000E 00	.0000000E 00	.3140000E-01	12
.0000000E 00	.0000000E 00	.1910000E-01	13
.0000000E 00	.0000000E 00	.1160000E-01	14
.0000000E 00	.0000000E 00	.4050000E-02	15
.1000000E+01	.1000000E+01	.0000000E 00	16

EDIT FOR TIME STEP 1

MIXTURE NUMBER	MIX COMMAND	MATERIAL ATOMIC DENSITY	
17	0	.0000000E 00	1
17	1	.6859800E-02	2
17	2	.7265000E-02	3
17	3	.0000000E 00	4
17	4	.1410500E-02	5
17	5	.6207000E-03	6
17	6	.8770000E-04	7
17	7	.2140000E-04	8
17	8	.0000000E 00	9
17	9	.9142000E-02	10
17	10	.2351000E-02	11
17	11	.1470000E-02	12
17	12	.1184000E-01	13
17	13	.9405300E-02	14
18	0	.0000000E 00	15
18	14	.3580000E-04	16
18	15	.0000000E 00	17
18	2	.1190400E-01	18
18	3	.0000000E 00	19
18	4	.0000000E 00	20
18	5	.0000000E 00	21
18	6	.0000000E 00	22
18	7	.0000000E 00	23
18	8	.0000000E 00	24
18	16	.2386000E-01	25
18	9	.1180000E-01	26
18	10	.3033000E-02	27
18	11	.1897000E-02	28
18	12	.5372000E-02	29
19	0	.0000000E 00	30
19	9	.2949000E-02	31
19	10	.7582000E-03	32
19	11	.4741000E-03	33
19	12	.1080000E-02	34
19	13	.7200000E-01	35

CROSS SECTION OF MATERIAL 1
THE STANDARD LISTING OF CROSS SECTION MATERIALS WHICH USUALLY FOLLOWS HAS BEEN
OMITTED FROM THIS LISTING.

AVG RADIUS	RADIUS	VOLUME	AREA	
.8382000E+00	.0000000E 00	.8828871E+01	.0000000E 00	1
.2514000E+01	.1676400E+C1	.2648661E+02	.1053313E+02	2
.4191000E+01	.3352800E+C1	.4414436E+02	.2106626E+02	3
.5867400E+01	.5029200E+01	.6180210E+02	.3159940E+02	4
.7543800E+01	.6705600E+01	.7945984E+02	.4213253E+02	5
.9220000E+01	.8382000E+01	.9709230E+02	.5266566E+02	6
.1089650E+02	.1005800E+02	.1148153E+03	.6319628E+02	7
.1257300E+02	.1173500E+02	.1324015E+03	.7373318E+02	8
.1424950E+02	.1341100E+C2	.1501456E+03	.8426380E+02	9
.1592600E+02	.1508800E+02	.1677106E+03	.9480070E+C2	10
.1760200E+02	.1676400E+02	.1853599E+03	.1053313E+C3	11
.1927850E+02	.1844000E+02	.2031357E+03	.1158619E+C3	12
.2095500E+02	.2011700E+02	.2206691E+03	.1263988E+C3	13
.2263150E+02	.2179300E+02	.2384659E+03	.1369295E+C3	14
.2430800E+02	.2347000E+C2	.2559783E+03	.1474664E+C3	15
.2598400E+02	.2514600E+02	.2736276E+03	.1579970E+C3	16
.2766050E+02	.2682200E+02	.2914560E+03	.1685276E+C3	17
.2933700E+02	.2849900E+02	.3089368E+03	.1750645E+C3	18
.3101350E+02	.3017500E+C2	.3267862E+03	.1855951E+C3	19
.3269000E+02	.3185200E+02	.3442459E+03	.2001320E+C3	20
.3436600E+02	.3352800E+C2	.3618952E+03	.2106626E+C3	21
.3604250E+02	.3520400E+02	.3797763E+03	.2211933E+C3	22
.3771900E+02	.3688100E+02	.3972044E+03	.2317302E+C3	23
.3939550E+02	.3855700E+02	.4151065E+03	.2422608E+C3	24
.4107200E+02	.4023400E+02	.4325136E+03	.2527977E+C3	25
.4269850E+02	.4191000E+02	.4423081E+03	.2633283E+C3	26
.4427500E+02	.4348700E+02	.4584243E+03	.2732369E+C3	27
.4585150E+02	.4506300E+02	.4743734E+03	.2831392E+C3	28
.4742850E+02	.4664000E+02	.4899492E+03	.2930478E+C3	29
.4900500E+02	.4821700E+02	.5052622E+03	.3029563E+C3	30
.5058150E+02	.4979300E+02	.5211910E+03	.3128586E+C3	31
.5215850E+02	.5137000E+02	.5368168E+03	.3227672E+C3	32
.5373500E+02	.5294700E+02	.5521001E+03	.3326758E+C3	33
.5531150E+02	.5452300E+02	.5680586E+03	.3425781E+C3	34
.5688850E+02	.5610000E+02	.5836844E+03	.3524867E+C3	35
.5846500E+02	.5767700E+02	.5989380E+03	.3623953E+C3	36
.6004150E+02	.5925300E+02	.6149262E+03	.3722976E+C3	37
.6161850E+02	.6083000E+02	.6305520E+03	.3822062E+C3	38
.6319500E+02	.6240700E+02	.6457759E+03	.3921147E+C3	39
.6477150E+02	.6398300E+02	.6614785E+03	.4020170E+C3	40
.6634850E+02	.6556000E+02	.6761857E+03	.4119256E+C3	41
.6792500E+02	.6713700E+02	.6912995E+03	.4218342E+C3	42
.6950150E+02	.6871400E+02	.7064045E+03	.4317428E+C3	43
.7107850E+02	.7029100E+02	.7215195E+03	.4416514E+C3	44
.7265500E+02	.7186800E+02	.7366345E+03	.4515600E+C3	45
.7423150E+02	.7344500E+02	.7517495E+03	.4614686E+C3	46
.7580850E+02	.7502200E+02	.7668645E+03	.4713772E+C3	47
.7738500E+02	.7659900E+02	.7819795E+03	.4812858E+C3	48
.7896150E+02	.7817600E+02	.7970945E+03	.4911944E+C3	49
.8053850E+02	.7975300E+02	.8122095E+03	.5011030E+C3	50
.8211500E+02	.8133000E+02	.8273245E+03	.5110116E+C3	51

ITERATION MONITOR	EPS=	.10000000E-03	EPSA=	.00000000E 00	PRCBLEM ID	911
TIME IN MINUTES	OUTER ITERATIONS	INNER ITERATIONS	NEUTRON BALANCE	EIGENVALUE	EIGENVALUE SLOPE	LAMBDA
76.617	0	0	.0000000E 00	.1000000E+01	.0000000E 00	.0000000E 00
77.067	1	194	-.2582030E-02	.1000000E+01	.0000000E 00	.58007850E+00
77.500	2	385	-.2598462E-02	.1000000E+01	.0000000E 00	.74792452E+00
77.950	3	582	-.2604223E-02	.1000000E+01	.0000000E 00	.84781375E+00
78.400	4	773	-.2601078E-02	.1000000E+01	.0000000E 00	.90684818E+00
78.833	5	964	-.2594133E-02	.1000000E+01	.0000000E 00	.94240016E+00
79.267	6	1155	-.2586794E-02	.1000000E+01	.0000000E 00	.96441487E+00
79.700	7	1342	-.2580509E-02	.1000000E+01	.0000000E 00	.97828488E+00
80.117	8	1525	-.2575779E-02	.1000000E+01	.0000000E 00	.98709971E+00
80.533	9	1706	-.2572256E-02	.1000000E+01	.0000000E 00	.99272731E+00
80.967	10	1890	-.2569998E-02	.1000000E+01	.0000000E 00	.99632677E+00
81.400	11	2075	-.2568486E-02	.1000000E+01	.0000000E 00	.99863155E+00
81.833	12	2262	-.2567494E-02	.1000000E+01	.0000000E 00	.10001077E+01
82.267	13	2586	-.2566027E-02	.1000000E+01	.0000000E 00	.10020701E+01
82.700	14	2902	-.2565697E-02	.1000000E+01	.0000000E 00	.10025264E+01
83.133	15	3199	-.2565822E-02	.1000000E+01	.0000000E 00	.10027166E+01
83.567	16	3477	-.2565658E-02	.1100000E+01	.0000000E 00	.10028099E+01
83.999	17	3828	-.2573467E-02	.1100000E+01	.0000000E 00	.99370570E+00
84.433	18	4141	-.2573284E-02	.1032278E+01	-.11487382E+02	.99410472E+00

86.850	19	4468	-.25682362E-02	.10383222E+01	-.11487382E+02	.10005261E+01
87.383	20	4697	-.25685111E-02	.10363187E+01	-.11487382E+02	.99982560E+00
87.950	21	4941	-.25685429E-02	.10363187E+01	-.11487382E+02	.99994778E+00

NEG. FLUX FIX-UP USED IN GROUP 1

NEG. FLUX FIX-UP USED IN GROUP 2

NEG. FLUX FIX-UP USED IN GROUP 3

NEG. FLUX FIX-UP USED IN GROUP 4

NEG. FLUX FIX-UP USED IN GROUP 5

NEG. FLUX FIX-UP USED IN GROUP 6

NEG. FLUX FIX-UP USED IN GROUP 7

NEG. FLUX FIX-UP USED IN GROUP 8

NEG. FLUX FIX-UP USED IN GROUP 9

NEG. FLUX FIX-UP USED IN GROUP 10

NEG. FLUX FIX-UP USED IN GROUP 11

NEG. FLUX FIX-UP USED IN GROUP 12

NEG. FLUX FIX-UP USED IN GROUP 13

NEG. FLUX FIX-UP USED IN GROUP 14

NEG. FLUX FIX-UP USED IN GROUP 15

	SOURCE	FISSION SOURCE	IN SCATTER	SELF SCATTER	OUT SCATTER	NET LEAKAGE
1	.00000000E 00	2.25000000E-01	8.8817842CE-16	3.73143702E-01	1.86761680E-01	9.83295114E-07
2	.00000000E 00	3.47000000E-01	1.10436748E-01	1.10110355E+00	3.73585698E-01	5.64152065E-06
3	.00000000E 00	1.61000000E-01	2.17131642E-01	1.24862528E+00	3.31724201E-01	2.78046035E-06
4	.00000000E 00	1.70000000E-01	3.98862886E-01	4.40473928E+00	4.49228290E-01	5.86144163E-07
5	.00000000E 00	0.40000000E 02	3.70702139E-01	9.94568188E+00	4.56994292E-01	-4.39492790E-07
6	.00000000E 00	1.30000000E-02	4.95160046E-01	7.29378516E+00	2.99540414E-01	-3.86947770E-07
7	.00000000E 00	.00000000E 00	2.99740506E-01	4.04592119E+00	2.11625819E-01	-2.17172280E-07
8	.00000000E 00	.00000000E 00	2.1162602CE-01	2.02316952E+00	1.16478676E-01	2.26672290E-07
9	.00000000E 00	.00000000E 00	1.1647859CE-01	3.74103925E-01	2.23047118E-02	3.46418768E-06
10	.00000000E 00	.00000000E 00	2.23046775E-02	6.98387698E-02	1.16226573E-02	3.83405366E-06
11	.00000000E 00	.00000000E 00	1.16226555E-02	4.23208534E-02	7.29979181E-03	4.45248524E-06
12	.00000000E 00	.00000000E 00	7.29979086E-03	2.58841982E-02	4.54143483E-03	5.34441383E-06
13	.00000000E 00	.00000000E 00	4.54143424E-03	3.06900150E-02	4.02426434E-03	3.18773498E-06
14	.00000000E 00	.00000000E 00	4.02426935E-03	2.66011916E-02	3.25767314E-03	3.49527307E-06
15	.00000000E 00	.00000000E 00	3.25767318E-03	6.16913071E-02	-3.19189120E-16	3.31491057E-06
16	.00000000E 00	1.00000000E+00	2.47898996E+00	3.10673124E+01	2.47898960E+00	3.62675388E-05

	ABSORPTION	NEUTRON BALANCE	RIGHT LEAKAGE	FISSION NEUTRONS	NEUTRON DENSITY	NEUTRON FLUX
1	3.82492994E-02	-5.31683289E-05	9.83295114E-07	1.09295843E-01	1.51985322E-01	4.33158169E+00
2	8.38765792E-02	-6.81423302E-05	5.64152065E-06	1.93869277E-01	4.90907421E-01	9.76905768E+00
3	4.64371955E-02	-8.60418300E-05	2.78046035E-06	8.59120426E-02	5.69570954E-01	8.37269302E+00
4	1.19733482E-01	-1.74861193E-04	5.86144163E-07	1.75765093E-01	2.23945806E+00	2.46340386E+01
5	2.03921214E-01	-3.21063830E-04	-4.39492790E-07	2.19144966E-01	6.36911030E+00	4.26730390E+01
6	2.08776059E-01	-3.07066455E-04	-3.86947770E-07	1.32513191E-01	9.33195044E+00	2.51962662E+01
7	8.80018940E-02	-2.90142209E-04	-2.17172280E-07	4.24618999E-02	6.22312333E+00	7.69800356E+00
8	9.51918131E-02	-2.11202341E-04	2.26672290E-07	2.64079058E-02	8.09539117E+00	4.10517284E+00
9	4.41811274E-02	-8.42781649E-05	3.48410760E-06	1.29374355E-02	5.79261444E+00	1.08090279E+00
10	1.06800290E-02	-8.26225324E-05	3.83405366E-06	2.24480422E-04	2.63395311E+00	2.24939595E-01
11	4.31949051E-03	-9.28247546E-05	4.45248524E-06	3.27611131E-05	2.65223065E+00	1.37385548E-01
12	2.75367530E-03	-9.09176432E-05	5.34441383E-06	3.75867619E-06	2.68919027E+00	8.44405745E-02
13	5.14686788E-04	-1.55155606E-04	3.18773498E-06	7.10480517E-05	4.88942196E+00	9.3879594E-02
14	7.63713442E-04	-1.52203832E-04	3.49527307E-06	1.81813365E-04	6.88678467E+00	7.98867021E-02
15	3.25565725E-03	-3.98744604E-04	3.31491057E-06	9.81998452E-04	4.11662241E+01	1.66723208E-01
16	1.00065501E+00	-2.56839315E-03	3.62675388E-05	9.99903514E-01	1.00181921E+02	1.28647519E+02

ITERATION MONITOR EPS= .10000000E-03 EPSA= .00000000E 00 PROBLEM ID 911

TIME IN	OUTER	INNER	NEUTRON	EIGENVALUE	EIGENVALUE	LAMBDA
MINUTES	ITERATIONS	ITERATIONS	BALANCE		SLOPE	
88.517	22	5185	-.25683931E-02	.10363187E+01	-.11487382E+02	.99990351E+00

EXECUTION TIME= 12.250 MINUTES

SEARCH DENSITY OF FIRST PRINCIPAL ELEMENT= .70997989E-02

ZONE	FINAL RADII	AVERAGE RADII	FISSIONS	VOLUME
1	1 .000000E+00	.838200E+00	.268223E-03	.882887E+01
2	1 .167640E+01	.251460E+01	.267498E-03	.264866E+02
3	1 .335280E+01	.419100E+01	.266028E-03	.441443E+02
4	1 .502920E+01	.586740E+01	.263866E-03	.618021E+02
5	1 .670560E+01	.754380E+01	.261027E-03	.794598E+02
6	1 .838200E+01	.922000E+01	.257523E-03	.9709230E+02
7	1 .100580E+02	.1089650E+02	.253367E-03	.1148153E+03
8	1 .117350E+02	.1257300E+02	.248576E-03	.1324015E+03
9	1 .134110E+02	.1424950E+02	.2431705E-03	.1501456E+03
10	1 .150880E+02	.1592600E+02	.2371707E-03	.1677106E+03
11	1 .167640E+02	.1760200E+02	.230643E-03	.1853599E+03
12	1 .184400E+02	.1927850E+02	.2234955E-03	.2031357E+03
13	1 .201170E+02	.2095500E+02	.215876E-03	.2206691E+03
14	1 .217930E+02	.2263150E+02	.207781E-03	.2384659E+03
15	1 .234700E+02	.2430800E+02	.1992467E-03	.2559783E+03
16	1 .251460E+02	.2598400E+02	.190313E-03	.2736276E+03
17	1 .268220E+02	.2766050E+02	.181017E-03	.2914560E+03
18	1 .284990E+02	.2933700E+02	.1714080E-03	.3089368E+03
19	1 .301750E+02	.3101350E+02	.1615304E-03	.3267862E+03
20	1 .318520E+02	.3269000E+02	.151433E-03	.3442459E+03
21	1 .335280E+02	.3436600E+02	.141166E-03	.3618952E+03
22	1 .352040E+02	.3604250E+02	.1307602E-03	.3797763E+03
23	1 .368810E+02	.3771900E+02	.120232E-03	.3972044E+03
24	1 .385570E+02	.3939550E+02	.1095390E-03	.4151065E+03
25	1 .402340E+02	.4107200E+02	.986627E-04	.4325136E+03
26	2 .419100E+02	.4269850E+02	.145155E-04	.4230816E+03
27	2 .434870E+02	.4427500E+02	.116993E-04	.4384243E+03
28	2 .450630E+02	.4585150E+02	.9614230E-05	.4543234E+03
29	2 .466400E+02	.4742850E+02	.801427E-05	.4699492E+03
30	2 .482170E+02	.4900500E+02	.67561CE-05	.4852622E+03
31	2 .497930E+02	.5058150E+02	.5749503E-05	.5011910E+03
32	2 .513700E+02	.5215850E+02	.4936473E-05	.5168168E+03
33	2 .529470E+02	.5373500E+02	.4278513E-05	.5321001E+03
34	2 .545230E+02	.5531150E+02	.3748638E-05	.5480586E+03
35	2 .561000E+02	.5688850E+02	.3328206E-05	.5638444E+03
36	2 .576770E+02	.5846500E+02	.3005667E-05	.5789380E+03
37	2 .592530E+02	.6004150E+02	.2774126E-05	.5949262E+03
38	2 .608300E+02	.6161850E+02	.2635845E-05	.6105520E+03
39	2 .624070E+02	.6319500E+02	.2601251E-05	.6257759E+03
40	2 .639830E+02	.6477150E+02	.2844546E-05	.6417938E+03
41	3 .655600E+02	.6586950E+02	.0000000E+00	.2561857E+03
42	3 .661790E+02	.6648900E+02	.0000000E+00	.2590129E+03
43	3 .667990E+02	.6710850E+02	.0000000E+00	.2610045E+03
44	3 .674180E+02	.6772800E+02	.0000000E+00	.2638395E+03
45	3 .680380E+02	.6834750E+02	.0000000E+00	.2658234E+03
46	3 .686570E+02	.6896700E+02	.0000000E+00	.2686661E+03
47	3 .692770E+02	.6958650E+02	.0000000E+00	.2706422E+03
48	3 .698960E+02	.7020600E+02	.0000000E+00	.2734927E+03
49	3 .705160E+02	.7082550E+02	.0000000E+00	.2754610E+03
50	3 .711350E+02	.7144500E+02	.0000000E+00	.2783193E+03
51	17 .717550E+02	.0000000E+00	.0000000E+00	.0000000E+00

FLUX BY GROUP AND SPACE POINT

ZONE	AVG RADIUS	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7
1	1 8.38200E-01	1.08659E-03	2.37387E-03	2.06506E-03	5.56192E-03	8.05169E-03	3.72798E-03	7.47441E-04
2	1 2.51460E+00	1.08378E-03	2.36750E-03	2.05935E-03	5.54643E-03	8.02960E-03	3.71808E-03	7.45495E-04
3	1 4.19100E+00	1.07773E-03	2.35424E-03	2.04777E-03	5.51509E-03	7.98573E-03	3.69866E-03	7.41690E-04
4	1 5.86740E+00	1.06879E-03	2.33472E-03	2.03074E-03	5.46902E-03	7.92128E-03	3.67009E-03	7.36053E-04
5	1 7.54380E+00	1.05708E-03	2.30913E-03	2.00839E-03	5.40855E-03	7.83662E-03	3.63253E-03	7.28619E-04
6	1 9.22000E+00	1.04265E-03	2.27757E-03	1.98079E-03	5.33391E-03	7.73211E-03	3.58618E-03	7.19436E-04
7	1 1.08965E+01	1.02554E-03	2.24013E-03	1.94803E-03	5.24531E-03	7.60816E-03	3.53128E-03	7.08557E-04
8	1 1.25730E+01	1.00582E-03	2.19694E-03	1.91019E-03	5.14305E-03	7.46532E-03	3.46814E-03	6.96053E-04
9	1 1.42495E+01	9.83546E-04	2.14812E-03	1.86739E-03	5.02747E-03	7.30421E-03	3.39714E-03	6.82005E-04
10	1 1.59260E+01	9.58765E-04	2.09382E-03	1.81975E-03	4.89896E-03	7.12557E-03	3.31871E-03	6.66509E-04
11	1 1.76020E+01	9.31625E-04	2.03423E-03	1.76742E-03	4.75799E-03	6.93032E-03	3.23339E-03	6.49680E-04
12	1 1.92785E+01	9.02132E-04	1.96948E-03	1.71053E-03	4.60497E-03	6.71926E-03	3.14169E-03	6.31636E-04
13	1 2.09550E+01	8.70403E-04	1.89977E-03	1.64923E-03	4.44047E-03	6.49352E-03	3.04428E-03	6.12530E-04
14	1 2.26315E+01	8.36523E-04	1.82529E-03	1.58367E-03	4.26506E-03	6.25426E-03	2.94189E-03	5.92535E-04
15	1 2.43080E+01	8.00581E-04	1.74622E-03	1.51401E-03	4.07934E-03	6.00275E-03	2.83533E-03	5.71853E-04
16	1 2.59840E+01	7.62664E-04	1.66274E-03	1.44040E-03	3.88402E-03	5.74046E-03	2.72554E-03	5.50733E-04
17	1 2.76605E+01	7.22815E-04	1.57493E-03	1.36293E-03	3.67967E-03	5.46876E-03	2.61347E-03	5.29462E-04
18	1 2.93370E+01	6.81078E-04	1.48292E-03	1.28171E-03	3.46706E-03	5.18941E-03	2.50029E-03	5.08426E-04
19	1 3.10135E+01	6.37436E-04	1.38669E-03	1.19679E-03	3.24692E-03	4.90423E-03	2.38728E-03	4.88123E-04
20	1 3.26900E+01	5.91782E-04	1.28609E-03	1.10814E-03	3.02002E-03	4.61522E-03	2.27588E-03	4.69233E-04
21	1 3.43660E+01	5.43056E-04	1.18076E-03	1.01561E-03	2.78716E-03	4.32473E-03	2.16778E-03	4.52730E-04
22	1 3.60425E+01	4.93045E-04	1.06970E-03	9.18740E-04	2.54889E-03	4.03515E-03	2.06484E-03	4.40027E-04
23	1 3.77190E+01	4.38197E-04	9.51094E-04	8.16631E-04	2.30581E-03	3.74975E-03	1.96957E-03	4.33339E-04
24	1 3.93955E+01	3.76997E-04	8.21162E-04	7.07326E-04	2.05809E-03	3.47295E-03	1.88579E-03	4.35613E-04
25	1 4.10720E+01	3.04852E-04	6.72111E-04	5.86552E-04	1.80515E-03	3.21247E-03	1.82182E-03	4.56740E-04
26	2 4.26985E+01	2.33149E-04	5.32086E-04	4.68296E-04	1.55953E-03	2.96901E-03	1.77212E-03	4.87871E-04
27	2 4.42750E+01	1.78848E-04	4.28541E-04	3.74272E-04	1.34135E-03	2.72902E-03	1.71090E-03	5.04543E-04
28	2 4.58515E+01	1.40679E-04	3.50519E-04	3.04060E-04	1.15469E-03	2.48948E-03	1.63055E-03	5.04909E-04
29	2 4.74285E+01	1.12710E-04	2.89967E-04	2.49600E-04	9.94368E-04	2.25921E-03	1.54090E-03	4.96244E-04
30	2 4.90050E+01	9.15691E-05	2.42019E-04	2.06427E-04	8.56582E-04	2.04233E-03	1.44719E-03	4.81712E-04
31	2 5.05815E+01	7.52068E-05	2.03497E-04	1.71735E-04	7.38144E-04	1.84051E-03	1.35271E-03	4.63702E-04
32	2 5.21585E+01	6.23244E-05	1.72254E-04	1.43634E-04	6.36385E-04	1.65433E-03	1.25977E-03	4.44128E-04
33	2 5.37350E+01	5.20733E-05	1.46807E-04	1.20793E-04	5.49114E-04	1.48385E-03	1.17020E-03	4.24610E-04
34	2 5.53115E+01	4.38562E-05	1.26054E-04	1.02189E-04	4.74338E-04	1.32856E-03	1.08529E-03	4.06564E-04
35	2 5.68862E+01	3.72419E-05	1.09168E-04	8.70308E-05	4.10309E-04	1.18768E-03	1.00602E-03	3.91345E-04
36	2 5.84650E+01	3.19122E-05	9.55292E-05	7.40718E-05	3.55530E-04	1.06037E-03	9.33219E-04	3.80381E-04
37	2 6.00415E+01	2.76097E-05	8.46552E-05	6.46869E-05	3.08586E-04	9.45484E-04	8.67475E-04	3.75280E-04
38	2 6.16185E+01	2.41136E-05	7.61689E-05	5.65430E-05	2.68124E-04	8.41653E-04	8.09313E-04	3.70233E-04
39	2 6.31950E+01	2.12106E-05	6.97921E-05	4.98594E-05	2.32760E-04	7.47169E-04	7.59398E-04	3.61374E-04
40	2 6.47715E+01	1.86216E-05	6.52753E-05	4.41385E-05	2.00706E-04	6.59115E-04	7.18797E-04	3.52338E-04
41	3 6.58695E+01	1.69777E-05	6.29652E-05	4.05669E-05	1.79344E-04	5.99620E-04	6.94692E-04	4.53111E-04
42	3 6.64890E+01	1.62530E-05	6.20224E-05	3.9437E-05	1.68483E-04	5.68868E-04	6.82267E-04	4.66193E-04
43	3 6.71085E+01	1.56167E-05	6.11371E-05	3.75741E-05	1.59375E-04	5.42748E-04	6.70461E-04	4.75814E-04
44	3 6.77280E+01	1.50581E-05	6.03149E-05	3.64227E-05	1.51779E-04	5.2721E-04	6.59645E-04	4.82946E-04
45	3 6.82475E+01	1.45474E-05	5.95891E-05	3.5407E-05	1.45804E-04	5.02249E-04	6.48060E-04	4.88214E-04
46	3 6.89670E+01	1.41350E-05	5.88665E-05	3.46659E-05	1.40404E-04	4.87382E-04	6.41688E-04	4.92151E-04
47	3 6.95865E+01	1.37580E-05	5.82372E-05	3.40192E-05	1.36357E-04	4.75503E-04	6.35166E-04	4.94980E-04
48	3 7.02060E+01	1.34382E-05	5.76645E-05	3.35049E-05	1.33266E-04	4.66527E-04	6.30016E-04	4.96951E-04
49	3 7.08255E+01	1.31731E-05	5.71397E-05	3.31082E-05	1.31039E-04	4.60260E-04	6.26433E-04	4.98224E-04
50	3 7.14450E+01	1.29570E-05	5.66506E-05	3.28152E-05	1.29594E-04	4.56523E-04	6.24406E-04	4.98916E-04
ZONE	AVG RADIUS	GROUP 8	GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14
1	1 8.38200E-01	3.23432E-04	4.43661E-05	6.16941E-07	2.93440E-09	1.79139E-11	1.21170E-12	1.82806E-14
2	1 2.51460E+00	3.22601E-04	4.42522E-05	6.15364E-07	2.92659E-09	1.78689E-11	1.20865E-12	1.82290E-14
3	1 4.19100E+00	3.20973E-04	4.40296E-05	6.12272E-07	2.91243E-09	1.77779E-11	1.20272E-12	1.81524E-14
4	1 5.86740E+00	3.18558E-04	4.36995E-05	6.07685E-07	2.88977E-09	1.76464E-11	1.19404E-12	1.79975E-14

5	1	7.54380E+00	3.15372E-04	4.32639E-05	6.41631E-07	2.86217E-09	1.74685E-11	1.18288E-12	1.78745E-14
6	1	9.22000E+00	3.11434E-04	4.27256E-05	5.64152E-07	2.82499E-09	1.72540E-11	1.16981E-12	1.75978E-14
7	1	1.08965E+01	3.06770E-04	4.20882E-05	5.65294E-07	2.78496E-09	1.69938E-11	1.15614E-12	1.75433E-14
8	1	1.25730E+01	3.01413E-04	4.13562E-05	5.75122E-07	2.73388E-09	1.67017E-11	1.14488E-12	1.71131E-14
9	1	1.42495E+01	2.95400E-04	4.05348E-05	5.63709E-07	2.68305E-09	1.63672E-11	1.14308E-12	1.76009E-14
10	1	1.59280E+01	2.88776E-04	3.96304E-05	5.51144E-07	2.61893E-09	1.60050E-11	1.16759E-12	1.71153E-14
11	1	1.76020E+01	2.81594E-04	3.86508E-05	5.37534E-07	2.55970E-09	1.56084E-11	1.25895E-12	2.02927E-14
12	1	1.92785E+01	2.73813E-04	3.76136E-05	5.22992E-07	2.49362E-09	1.51856E-11	1.51569E-12	2.13451E-14
13	1	2.09550E+01	2.65805E-04	3.65001E-05	5.07670E-07	2.41947E-09	1.47450E-11	2.17697E-12	3.78137E-14
14	1	2.26315E+01	2.57357E-04	3.53524E-05	4.91740E-07	2.33272E-09	1.42725E-11	3.82933E-12	5.39604E-14
15	1	2.43080E+01	2.48675E-04	3.41758E-05	4.75419E-07	2.26899E-09	1.38180E-11	7.90090E-12	1.43544E-13
16	1	2.59840E+01	2.39889E-04	3.29894E-05	4.58966E-07	2.17313E-09	1.33071E-11	1.79021E-11	2.53142E-13
17	1	2.76605E+01	2.31154E-04	3.18159E-05	4.42726E-07	2.11842E-09	1.28910E-11	4.25232E-11	7.82187E-13
18	1	2.93370E+01	2.22679E-04	3.06851E-05	4.27058E-07	2.01489E-09	1.23472E-11	1.03163E-10	1.45943E-12
19	1	3.10135E+01	2.14729E-04	2.96341E-05	4.12621E-07	1.98419E-09	1.20723E-11	2.52873E-10	4.66380E-12
20	1	3.26900E+01	2.07646E-04	2.87080E-05	3.99702E-07	1.87231E-09	1.14636E-11	6.23052E-10	8.80626E-12
21	1	3.43660E+01	2.01868E-04	2.79585E-05	3.89805E-07	1.89405E-09	1.15866E-11	1.54080E-09	2.84969E-11
22	1	3.60425E+01	1.97926E-04	2.74346E-05	3.81614E-07	1.75862E-09	1.06587E-11	3.81850E-09	5.32789E-11
23	1	3.77190E+01	1.96402E-04	2.71504E-05	3.79903E-07	1.89082E-09	1.18101E-11	9.55886E-09	1.80185E-10
24	1	3.93955E+01	1.97861E-04	2.70875E-05	3.72445E-07	1.64256E-09	9.34273E-12	2.29399E-08	2.56249E-10
25	1	4.10720E+01	2.02105E-04	2.63695E-05	3.87637E-07	2.30572E-09	1.95429E-11	7.09867E-08	3.92545E-08
26	2	4.26985E+01	2.06622E-04	2.48293E-05	4.26082E-07	9.21215E-09	1.10326E-10	1.54472E-07	1.99999E-07
27	2	4.42750E+01	2.09257E-04	2.39132E-05	4.48765E-07	1.15831E-08	1.50960E-10	2.48001E-07	3.46504E-07
28	2	4.58515E+01	2.09741E-04	2.36812E-05	4.38846E-07	1.10347E-08	1.43456E-10	3.57364E-07	5.04343E-07
29	2	4.74285E+01	2.08148E-04	2.34162E-05	4.35588E-07	1.10797E-08	1.43757E-10	4.95972E-07	6.93378E-07
30	2	4.90050E+01	2.05006E-04	2.30861E-05	4.28966E-07	1.08622E-08	1.41267E-10	6.76523E-07	9.27911E-07
31	2	5.05815E+01	2.00981E-04	2.27169E-05	4.22566E-07	1.07210E-08	1.39046E-10	9.15019E-07	1.22394E-06
32	2	5.21585E+01	1.96822E-04	2.23848E-05	4.17090E-07	1.05974E-08	1.38073E-10	1.23246E-06	1.60079E-06
33	2	5.37350E+01	1.93356E-04	2.22053E-05	4.13889E-07	1.04944E-08	1.35885E-10	1.65643E-06	2.08186E-06
34	2	5.53115E+01	1.91507E-04	2.23496E-05	4.20020E-07	1.07695E-08	1.40974E-10	2.22428E-06	2.69652E-06
35	2	5.68885E+01	1.92347E-04	2.30951E-05	4.30624E-07	1.08453E-08	1.39341E-10	2.98609E-06	3.48097E-06
36	2	5.84650E+01	1.97195E-04	2.49427E-05	4.90271E-07	1.31327E-08	1.78345E-10	4.00857E-06	4.47882E-06
37	2	6.00415E+01	2.07738E-04	2.88826E-05	5.41485E-07	1.39653E-08	1.56146E-10	5.38385E-06	5.74439E-06
38	2	6.16185E+01	2.26233E-04	3.70665E-05	1.02939E-06	4.64004E-08	1.03585E-09	7.24408E-06	7.34598E-06
39	2	6.31950E+01	2.55979E-04	5.32329E-05	2.18679E-06	2.70647E-07	2.64034E-09	9.81275E-06	9.38103E-06
40	2	6.47715E+01	3.01657E-04	1.04429E-04	1.67725E-05	8.14556E-06	2.73318E-06	1.35156E-05	1.20741E-05
41	3	6.58695E+01	3.49576E-04	1.59709E-04	2.27911E-05	2.53914E-05	1.50283E-05	1.66496E-05	1.42251E-05
42	3	6.64805E+01	3.68873E-04	1.86523E-04	5.44415E-05	3.31126E-05	2.01023E-05	1.85116E-05	1.53779E-05
43	3	6.71085E+01	3.64765E-04	2.08580E-04	6.42454E-05	3.97924E-05	2.45187E-05	2.03345E-05	1.64378E-05
44	3	6.77280E+01	3.97858E-04	2.26789E-04	7.24484E-05	4.55249E-05	2.83325E-05	2.20425E-05	1.73977E-05
45	3	6.83475E+01	4.08567E-04	2.41744E-04	7.52601E-05	5.03807E-05	3.15822E-05	2.35821E-05	1.82466E-05
46	3	6.89670E+01	4.17175E-04	2.53825E-04	8.40116E-05	5.43971E-05	3.42494E-05	2.49144E-05	1.89731E-05
47	3	6.95865E+01	4.23889E-04	2.63298E-04	8.91938E-05	5.76072E-05	3.64504E-05	2.60121E-05	1.95672E-05
48	3	7.02060E+01	4.28857E-04	2.70345E-04	9.24686E-05	6.00231E-05	3.80841E-05	2.68564E-05	2.00211E-05
49	3	7.08255E+01	4.32206E-04	2.75116E-04	9.46893E-05	6.16673E-05	3.91950E-05	2.74372E-05	2.03310E-05
50	3	7.14450E+01	4.34038E-04	2.77738E-04	9.59037E-05	6.25628E-05	3.97957E-05	2.77516E-05	2.04962E-05

ZONE	AVG RADIUS	GROUP	15	GROUP
1	1.8.38200E-01	1.13604E-16		
2	1.2.51460E+00	1.13133E-16		
3	1.4.19100E+00	1.12917E-16		
4	1.5.86740E+00	1.11563E-16		
5	1.7.54380E+00	1.11329E-16		
6	1.9.22000E+00	1.08960E-16		
7	1.1.08965E+01	1.09348E-16		
8	1.1.25730E+01	1.06031E-16		
9	1.1.42495E+01	1.09386E-16		
10	1.1.59280E+01	1.07073E-16		
11	1.1.76020E+01	1.24275E-16		
12	1.1.92785E+01	1.38026E-16		
13	1.2.09550E+01	2.28494E-16		
14	1.2.26315E+01	3.61541E-16		
15	1.2.43080E+01	8.69889E-16		
16	1.2.59840E+01	1.7199E-15		
17	1.2.76605E+01	4.74822E-15		
18	1.2.93370E+01	9.79611E-15		
19	1.3.10135E+01	2.85863E-14		
20	1.3.26900E+01	5.61560E-14		
21	1.3.43660E+01	1.83189E-13		
22	1.3.60425E+01	3.20618E-13		
23	1.3.77190E+01	1.17975E-12		
24	1.3.93955E+01	1.44023E-12		
25	1.4.10720E+01	2.13662E-08		
26	2.4.26985E+01	2.50776E-07		
27	2.4.42750E+01	4.43998E-07		
28	2.4.58515E+01	6.56141E-07		
29	2.4.74285E+01	9.16006E-07		
30	2.4.90050E+01	1.24699E-06		
31	2.5.05815E+01	1.67735E-06		
32	2.5.21585E+01	2.24381E-06		
33	2.5.37350E+01	2.99463E-06		
34	2.5.53115E+01	3.99547E-06		
35	2.5.68885E+01	5.33338E-06		
36	2.5.84650E+01	7.13474E-06		
37	2.6.00415E+01	9.56318E-06		
38	2.6.16185E+01	1.28704E-05		
39	2.6.31950E+01	1.74943E-05		
40	2.6.47715E+01	2.45825E-05		
41	3.6.58695E+01	3.08584E-05		
42	3.6.64805E+01	3.44009E-05		
43	3.6.71085E+01	3.74645E-05		
44	3.6.77280E+01	4.00948E-05		
45	3.6.83475E+01	4.29309E-05		
46	3.6.89670E+01	4.41880E-05		
47	3.6.95865E+01	4.56735E-05		
48	3.7.02060E+01	4.67927E-05		
49	3.7.08255E+01	4.73923E-05		
50	3.7.14450E+01	4.79621E-05		

REGION 1

POINTWISE ISOTOPIC DENSITIES

PT	U238	NP239	PU239	PU240	PU241	PU242
1	.72235E-02	.21963E-05	.13872E-02	.61935E-03	.86427E-04	.21252E-04
2	.72236E-02	.21905E-05	.13872E-02	.61935E-03	.86430E-04	.21253E-04
3	.72239E-02	.21789E-05	.13874E-02	.61936E-03	.86437E-04	.21253E-04
4	.72242E-02	.21619E-05	.13878E-02	.61938E-03	.86447E-04	.21255E-04
5	.72246E-02	.21395E-05	.13878E-02	.61939E-03	.86460E-04	.21256E-04
6	.72251E-02	.21118E-05	.13881E-02	.61942E-03	.86477E-04	.21258E-04
7	.72258E-02	.20790E-05	.13895E-02	.61944E-03	.86496E-04	.21261E-04
8	.72265E-02	.20413E-05	.13889E-02	.61947E-03	.86518E-04	.21264E-04
9	.72273E-02	.19987E-05	.13894E-02	.61951E-03	.86544E-04	.21267E-04
10	.72282E-02	.19517E-05	.13899E-02	.61955E-03	.86572E-04	.21270E-04
11	.72292E-02	.19004E-05	.13905E-02	.61959E-03	.86603E-04	.21274E-04
12	.72303E-02	.18451E-05	.13911E-02	.61964E-03	.86636E-04	.21278E-04
13	.72314E-02	.17862E-05	.13918E-02	.61969E-03	.86672E-04	.21283E-04
14	.72326E-02	.17240E-05	.13925E-02	.61975E-03	.86710E-04	.21287E-04
15	.72339E-02	.16591E-05	.13932E-02	.61981E-03	.86750E-04	.21293E-04
16	.72352E-02	.15920E-05	.13941E-02	.61989E-03	.86792E-04	.21298E-04
17	.72365E-02	.15232E-05	.13951E-02	.61998E-03	.86836E-04	.21304E-04
18	.72379E-02	.14536E-05	.13958E-02	.62005E-03	.86882E-04	.21310E-04
19	.72393E-02	.13839E-05	.13967E-02	.62015E-03	.86928E-04	.21317E-04

20	.72407E-02	.13152E-05	.13977E-02	.62026E-03	.86978E-04	.21324E-04
21	.72421E-02	.12489E-05	.13987E-02	.62039E-03	.87025E-04	.21331E-04
22	.72434E-02	.11863E-05	.13997E-02	.62054E-03	.87074E-04	.21339E-04
23	.72447E-02	.11289E-05	.14008E-02	.62071E-03	.87125E-04	.21347E-04
24	.72459E-02	.10784E-05	.14019E-02	.62093E-03	.87176E-04	.21357E-04
25	.72472E-02	.10337E-05	.14030E-02	.62118E-03	.87251E-04	.21368E-04

PT FISHPIUM

1	.64907E-04
2	.64733E-04
3	.64380E-04
4	.63861E-04
5	.63178E-04
6	.62336E-04
7	.61337E-04
8	.60185E-04
9	.58885E-04
10	.57442E-04
11	.55862E-04
12	.54151E-04
13	.52317E-04
14	.50367E-04
15	.48312E-04
16	.46159E-04
17	.43919E-04
18	.41602E-04
19	.39221E-04
20	.36786E-04
21	.34310E-04
22	.31802E-04
23	.29268E-04
24	.26701E-04
25	.24120E-04

REGIONWISE ISOTOPIIC DENSITIES AND MASSES

ELEMENT	DENSITY	MASS
U238	.72372813E-02	.30128657E+04
NP239	.14959873E-05	.62544181E+00
PU239	.13957683E-02	.58352531E+03
PU240	.62015042E-03	.26036592E+03
PU241	.86874487E-04	.36629623E+02
PU242	.21311596E-04	.90237255E+01
FISHPIUM	.42100214E-04	.16901065E+02

REGION 2

POINTWISE ISOTOPIIC DENSITIES

PT	U235	U236
26	.35281E-04	.94479E-07
27	.35309E-04	.91387E-07
28	.35336E-04	.87725E-07
29	.35364E-04	.83789E-07
30	.35390E-04	.79795E-07
31	.35414E-04	.75951E-07
32	.35435E-04	.72458E-07
33	.35453E-04	.69533E-07
34	.35466E-04	.67426E-07
35	.35473E-04	.66430E-07
36	.35473E-04	.66991E-07
37	.35462E-04	.69646E-07
38	.35436E-04	.75812E-07
39	.35387E-04	.87535E-07
40	.35230E-04	.13561E-06

PT	U238	NP239	PU239	PU24C	PU241	PU242
26	.11877E-01	.16253E-05	.22377E-04	.38727E-C7	.33446E-1C	.18748E-13
27	.11878E-01	.15577E-05	.21446E-04	.37017E-C7	.32603E-1C	.18286E-13
28	.11880E-01	.14866E-05	.20480E-C4	.35170E-C7	.31542E-1C	.17630E-13
29	.11881E-01	.14128E-05	.19468E-04	.33326E-07	.30703E-1C	.17091E-13
30	.11883E-01	.13379E-05	.18438E-04	.31686E-07	.30441E-1C	.16943E-13
31	.11884E-01	.12642E-05	.17424E-04	.30441E-C7	.311C8E-1C	.17473E-13
32	.11885E-01	.11944E-05	.16462E-04	.29782E-C7	.33142E-1C	.19088E-13
33	.11886E-01	.11315E-05	.15592E-04	.28922E-C7	.37187E-1C	.22379E-13
34	.11887E-01	.10788E-05	.14861E-04	.31145E-C7	.44344E-1C	.28663E-13
35	.11888E-01	.10404E-05	.14327E-04	.33871E-C7	.56595E-1C	.40533E-13
36	.11888E-01	.10252E-05	.14102E-04	.38908E-C7	.77956E-1C	.64056E-13
37	.11888E-01	.10426E-05	.14322E-04	.47697E-C7	.11675E-09	.11406E-12
38	.11887E-01	.11300E-05	.15495E-04	.64500E-C7	.19615E-09	.23796E-12
39	.11884E-01	.13398E-05	.18323E-C4	.98966E-C7	.38019E-09	.60005E-12
40	.11862E-01	.27688E-05	.37708E-C4	.24475E-C6	.15244E-08	.37575E-11

PT FISHPIUM

26	.37297E-05
27	.30307E-05
28	.25090E-05
29	.21059E-05
30	.17872E-05
31	.15315E-05
32	.13250E-05
33	.11589E-05
34	.10270E-05
35	.92561E-06
36	.85333E-06
37	.81093E-06
38	.80599E-06
39	.85604E-06
40	.12197E-05

REGIONWISE ISOTOPIIC DENSITIES AND MASSES

ELEMENT	DENSITY	MASS
U235	.35396862E-04	.21048734E+02
U236	.81807100E-07	.48857024E-01
U238	.11882649E-01	.71581482E+04
NP239	.13661822E-05	.87651769E+00
PU239	.18765519E-04	.11352461E+02
PU240	.A7689636E-07	.38571954E-01
PU241	.20429557E-09	.12664711E-03
PU242	.41160047E-12	.25219056E-06
FISHPIUM	.14833287E-05	.86168838E+00

EDIT FOR TIME STEP 2

MIXTURE NUMBER	MIX COMMAND	MATERIAL ATOMIC DENSITY
17	0	.00000000E 00
17	1	.70997989E-02
17	2	.72372813E-02
17	3	.14959823E-05
17	4	.13957683E-02
17	5	.62015042E-03
17	6	.86874487E-04
17	7	.21311596E-04
17	8	.42100214E-04
17	9	.91420000E-02
17	10	.23510000E-02
17	11	.14700000E-02
17	12	.11840000E-01
17	13	.94053000E-02
18	0	.00000000E 00
18	14	.35396662E-04
18	15	.81807100E-07
18	2	.11882649E-01
18	3	.13661822E-05
18	4	.18765519E-04
18	5	.63489436E-07
18	6	.20429557E-09
18	7	.41160047E-12
18	8	.1483287E-05
18	16	.23880000E-01
18	9	.11800000E-01
18	10	.30330000E-02
18	11	.18970000E-02
18	12	.53720000E-02
19	0	.00000000E 00
19	9	.29490000E-02
19	10	.75820000E-03
19	11	.47410000E-03
19	12	.10000000E-02
19	13	.72000000E-01

CROSS SECTION OF MATERIAL 17

GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
1 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
2 7.12401E-04	1.78876E-03	1.88521E-03	2.22794E-03	3.08320E-03	7.33964E-03	1.43252E-02	3.33652E-02
3 7.77272E-03	6.80123E-03	3.92976E-03	3.05438E-03	2.60190E-03	3.24254E-03	4.92432E-03	6.85373E-03
4 8.48517E-03	8.58999E-03	5.81497E-03	5.20232E-03	3.68910E-03	1.09822E-02	1.92496E-02	4.02189E-02
5 2.60266E-02	2.10675E-02	1.18473E-02	9.01152E-03	7.39188E-03	9.10016E-03	1.37895E-02	1.92038E-02
6 1.39449E-01	1.64627E-01	1.94713E-01	1.99304E-01	2.44644E-01	3.11903E-01	6.68794E-01	6.88582E-01
7 8.88438E-02	1.18063E-01	1.51207E-01	1.77821E-01	2.29658E-01	2.90728E-01	6.16983E-01	6.14262E-01
8 .000000E 00	2.52958E-02	2.07617E-02	2.93101E-02	1.55088E-02	9.30011E-03	1.05933E-02	3.25609E-02
9 .000000E 00	.000000E 00	4.40036E-03	1.05717E-02	7.29864E-03	6.92322E-04	1.16687E-07	.000000E 00
10 .000000E 00	.000000E 00	.000000E 00	.000000E 00	5.87604E-03	1.08220E-03	5.75953E-07	.000000E 00
11 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.77605E-03	7.64964E-04	.000000E 00	.000000E 00
12 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	5.98593E-04	.000000E 00	.000000E 00
GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15	GROUP
1 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
2 2.32189E-01	6.92277E-01	3.19947E+00	2.54982E+00	1.85428E-01	8.02190E-01	1.11434E+00	.000000E 00
3 5.21570E-03	7.14903E-03	1.32192E-01	6.09967E-02	3.68880E-02	2.32096E-01	1.40965E+00	.000000E 00
4 2.57409E-01	6.99428E-01	4.33166E+00	2.61081E+00	2.20116E-01	1.03429E+00	2.52399E+00	.000000E 00
5 6.95616E-02	5.68907E-02	3.77943E-01	1.74479E-01	9.92102E-02	6.63808E-01	4.04585E+00	.000000E 00
6 5.83162E-01	1.04565E+00	3.67770E+00	2.98635E+00	5.65063E-01	1.37863E+00	2.84972E+00	.000000E 00
7 3.35802E-01	3.30299E-01	3.30808E-01	1.29547E-01	3.29066E-01	7.28542E-01	3.25735E-01	.000000E 00
8 3.41011E-02	9.95570E-03	1.59254E-02	1.60377E-02	1.59863E-02	1.58805E-02	1.58040E-02	.000000E 00
9 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
10 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
11 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
12 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00

CROSS SECTION OF MATERIAL 18

GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
1 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
2 1.28286E-03	1.59376E-03	1.37634E-03	1.82881E-03	2.08096E-03	5.57871E-03	8.56085E-03	2.42595E-02
3 6.57825E-03	4.93604E-03	5.78100E-04	7.45491E-05	8.24670E-05	1.28022E-04	2.09229E-04	3.61590E-04
4 7.86111E-03	6.52900E-03	1.95444E-03	1.90350E-03	2.18345E-03	3.70674E-03	8.77000E-03	2.44211E-02
5 2.07531E-02	1.46435E-02	1.49730E-03	1.99536E-04	2.14790E-04	3.26219E-04	5.29619E-04	9.05860E-04
6 1.27800E-01	1.33272E-01	1.90790E-01	2.08453E-01	2.53793E-01	3.02448E-01	5.42440E-01	5.42360E-01
7 7.05948E-02	8.60331E-02	1.40285E-01	1.82565E-01	2.39900E-01	2.86225E-01	5.12668E-01	4.94877E-01
8 .000000E 00	2.37432E-02	1.64740E-02	3.70940E-02	2.30294E-02	1.17299E-02	1.05168E-02	2.07316E-02
9 .000000E 00	.000000E 00	6.07298E-03	1.49370E-02	9.94796E-03	9.54660E-04	1.06562E-07	.000000E 00
10 .000000E 00	.000000E 00	.000000E 00	1.00890E-02	8.22515E-03	1.48882E-03	5.25980E-07	.000000E 00
11 .000000E 00	.000000E 00	.000000E 00	.000000E 00	6.60456E-03	1.07318E-03	.000000E 00	.000000E 00
12 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	8.36831E-04	.000000E 00	.000000E 00
GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15	GROUP
1 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
2 1.91443E-01	5.67208E-01	7.58848E-01	1.51342E+00	1.22405E-02	1.09751E-02	5.01499E-02	.000000E 00
3 4.46221E-04	2.12762E-03	3.70743E-03	1.48151E-03	1.28142E-03	4.93389E-03	2.51174E-02	.000000E 00
4 1.92089E-01	5.69336E-01	7.62555E-01	1.51490E+00	1.35420E-02	2.39090E-02	7.52674E-02	.000000E 00
5 2.34227E-03	5.75250E-03	9.80061E-03	3.90347E-03	3.32549E-03	1.32629E-02	6.88544E-02	.000000E 00
6 5.90228E-01	9.67886E-01	1.16108E+00	1.91299E+00	4.10838E-01	4.20389E-01	4.35687E-01	.000000E 00
7 3.87176E-01	3.78760E-01	3.78593E-01	3.78223E-01	3.77566E-01	3.74848E-01	3.60420E-01	.000000E 00
8 2.29019E-02	1.09627E-02	1.97898E-02	1.99339E-02	1.98675E-02	1.97309E-02	1.96323E-02	.000000E 00
9 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
10 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
11 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
12 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00

CROSS SECTION OF MATERIAL 19

GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
1 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
2 2.10452E-05	2.04976E-05	3.84753E-05	3.90777E-05	4.16751E-05	4.90929E-05	3.88334E-05	1.40838E-04
3 .000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
4 2.10452E-05	2.04976E-05	3.84753E-05	3.90777E-05	4.16751E-05	4.90929E-05	3.88334E-05	1.40838E-04

5	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
6	1.00045E-01	1.14685E-01	1.76513E-01	2.24832E-01	2.74460E-01	3.25219E-01	3.85376E-01	3.74650E-01
7	5.96885E-02	8.91385E-02	1.12510E-01	1.80433E-01	2.42632E-01	2.95440E-01	3.51444E-01	3.44304E-01
8	.000000E 00	3.99500E-02	2.44325E-02	6.30373E-02	4.43596E-02	3.17888E-02	2.97297E-02	3.38928E-02
9	.000000E 00	.000000E 00	1.46971E-04	6.74188E-04	8.52656E-04	2.94900E-11	.000000E 00	.000000E 00
10	.000000E 00	.000000E 00	.000000E 00	1.67831E-04	1.49052E-04	7.41440E-05	.000000E 00	.000000E 00
11	.000000E 00	.000000E 00	.000000E 00	.000000E 00	7.11150E-05	.000000E 00	.000000E 00	.000000E 00
12	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00

GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14	GROUP 15	GROUP
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1	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
2	2.22399E-04	3.70764E-04	5.62382E-04	8.91057E-04	1.44624E-03	2.37512E-03	6.27913E-03
3	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
4	2.22399E-04	3.70764E-04	5.62382E-04	8.91057E-04	1.44624E-03	2.37512E-03	6.27913E-03
5	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
6	3.59752E-01	3.60001E-01	3.60187E-01	3.60409E-01	3.60766E-01	3.61193E-01	3.81036E-01
7	3.31799E-01	3.05146E-01	3.05105E-01	3.05015E-01	3.04851E-01	3.04673E-01	3.74757E-01
8	3.02050E-02	2.77305E-02	5.44239E-02	5.45200E-02	5.45034E-02	5.44692E-02	5.44446E-02
9	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
10	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
11	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00
12	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00	.000000E 00

AVG RADIUS	RADIUS	VOLUME	AREA
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.8382000E+00	.0000000E 00	.8828871E+01	.0000000E 00
.2514600E+01	.1676400E+01	.2648661E+02	.1053313E+02
.4191000E+01	.3352800E+01	.4414436E+02	.2106626E+02
.5867400E+01	.5029200E+01	.6180210E+02	.3159940E+02
.7543800E+01	.6705600E+01	.7945584E+02	.4213253E+02
.9220000E+01	.8382000E+01	.9709230E+02	.5266566E+02
.1089650E+02	.1005800E+02	.1148153E+03	.6319628E+02
.1257300E+02	.1173500E+02	.1324015E+03	.7373318E+02
.1424950E+02	.1341100E+02	.1501456E+03	.8426300E+02
.1592600E+02	.1508800E+02	.1677106E+03	.9486007E+02
.1760200E+02	.1676400E+02	.1853599E+03	.1053313E+03
.1927850E+02	.1844000E+02	.2031357E+03	.1158619E+03
.2095500E+02	.2011700E+02	.2204691E+03	.1263988E+03
.2263150E+02	.2179300E+02	.2384659E+03	.1369295E+03
.2430800E+02	.2347000E+02	.2559783E+03	.1474664E+03
.2598400E+02	.2514600E+02	.2736276E+03	.1579970E+03
.2766050E+02	.2682200E+02	.2914560E+03	.1685276E+03
.2933700E+02	.2849900E+02	.3089368E+03	.1790645E+03
.3101350E+02	.3017500E+02	.3267862E+03	.1895951E+03
.3269000E+02	.3185200E+02	.3442459E+03	.2001320E+03
.3436600E+02	.3352800E+02	.3618952E+03	.2106626E+03
.3604250E+02	.3520400E+02	.3797763E+03	.2211933E+03
.3771900E+02	.3688100E+02	.3972044E+03	.2317302E+03
.3939550E+02	.3855700E+02	.4151065E+03	.2422608E+03
.4107200E+02	.4023400E+02	.4325136E+03	.2527977E+03
.4269850E+02	.4191000E+02	.4499166E+03	.2633283E+03
.4427500E+02	.4348700E+02	.4684243E+03	.2722369E+03
.4585150E+02	.4506300E+02	.4845234E+03	.2831392E+03
.4742850E+02	.4664000E+02	.4999492E+03	.2930478E+03
.4900500E+02	.4821700E+02	.5152622E+03	.3029563E+03
.5058150E+02	.4979300E+02	.5301910E+03	.3128586E+03
.5215850E+02	.5137000E+02	.5468168E+03	.3227672E+03
.5373500E+02	.5294700E+02	.5632101E+03	.3326758E+03
.5531150E+02	.5452300E+02	.5805866E+03	.3425781E+03
.5688850E+02	.5610000E+02	.5968444E+03	.3524867E+03
.5846500E+02	.5767700E+02	.6129380E+03	.3623953E+03
.6004150E+02	.5925300E+02	.6294926E+03	.3722976E+03
.6161850E+02	.6083000E+02	.6455520E+03	.3822062E+03
.6319500E+02	.6240700E+02	.6625775E+03	.3921147E+03
.6477150E+02	.6398300E+02	.6817538E+03	.4020170E+03
.6634850E+02	.6556000E+02	.7018575E+03	.4119256E+03
.6792500E+02	.6713700E+02	.7229012E+03	.4218342E+03
.6950150E+02	.6871400E+02	.7440045E+03	.4317428E+03
.7107850E+02	.7029100E+02	.7650839E+03	.4416514E+03
.7265500E+02	.7186800E+02	.7861823E+03	.4515600E+03
.7423150E+02	.7344500E+02	.8072807E+03	.4614686E+03
.7580850E+02	.7502200E+02	.8283791E+03	.4713772E+03
.7738500E+02	.7659900E+02	.8494775E+03	.4812858E+03
.7896150E+02	.7817600E+02	.8705759E+03	.4911944E+03
.8053850E+02	.7975300E+02	.8916743E+03	.5011030E+03
.8211500E+02	.8133000E+02	.9127727E+03	.5110116E+03
.8369150E+02	.8290700E+02	.9338711E+03	.5209202E+03
.8526850E+02	.8448400E+02	.9549695E+03	.5308288E+03
.8684500E+02	.8606100E+02	.9760679E+03	.5407374E+03
.8842150E+02	.8763800E+02	.9971663E+03	.5506460E+03
.9000000E 00	.8921500E+02	.1018151E+04	.5605546E+03

ITERATION MONITOR	EPS=.1000000E-C3	EPSA=.0000000E 00	PROBLEM ID	911
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TIME IN MINUTES	OUTER ITERATIONS	INNER ITERATIONS	NEUTRON BALANCE	EIGENVALUE	EIGENVALUE SLOPE	LAMBDA
88.683	0	0	.0000000E 00	.1000000E+01	.0000000E 00	.0000000E 00
89.250	1	240	-.2485351E-02	.1000000E+01	.0000000E 00	.99657210E+00
89.717	2	440	-.2491266E-02	.1000000E+01	.0000000E 00	.99593562E+00
90.167	3	635	-.2491730E-02	.1000000E+01	.0000000E 00	.99552844E+00
90.617	4	827	-.2491957E-02	.1000000E+01	.0000000E 00	.99528481E+00
91.067	5	1018	-.2492077E-02	.1000000E+01	.0000000E 00	.99512519E+00
91.517	6	1208	-.2492149E-02	.1000000E+01	.0000000E 00	.99502213E+00
91.967	7	1398	-.2492194E-02	.1000000E+01	.0000000E 00	.99495607E+00
92.417	8	1590	-.24847301E-02	.1000000E+01	.0000000E 00	.10045924E+01
92.867	9	1784	-.24845878E-02	.9464472E+00	-.10616783E+02	.10043751E+01
93.317	10	1979	-.24877192E-02	.94290565E+00	-.10616783E+02	.99966566E+00
93.767	11	2160	-.24877107E-02	.94290565E+00	-.10616783E+02	.99999686E+00

NEG. FLUX FIX-UP USED IN GROUP 1

NEG. FLUX FIX-UP USED IN GROUP 2

NEG. FLUX FIX-UP USED IN GROUP 3

NEG. FLUX FIX-UP USED IN GROUP 4

NEG. FLUX FIX-UP USED IN GROUP 5

NEG. FLUX FIX-UP USED IN GROUP 6

NEG. FLUX FIX-UP USED IN GROUP 7

NEG. FLUX FIX-UP USED IN GROUP 8

NEG. FLUX FIX-UP USED IN GROUP 9

NEG. FLUX FIX-UP USED IN GROUP 10

NEG. FLUX FIX-UP USED IN GROUP 11

NEG. FLUX FIX-UP USED IN GROUP 12

NEG. FLUX FIX-UP USED IN GROUP 13

NEG. FLUX FIX-UP USED IN GROUP 14

NEG. FLUX FIX-UP USED IN GROUP 15

	SOURCE	FISSION SOURCE	IN SCATTER	SELF SCATTER	OUT SCATTER	NET LEAKAGE
1	.00000000E+00	2.25000000E-01	-8.8817442E-16	3.70042072E-01	1.86646380E-01	3.03804534E-06
2	.00000000E+00	3.47000000E-01	1.09872704E-01	1.09056203E+00	3.72973697E-01	3.84962080E-06
3	.00000000E+00	1.61000000E-01	2.15432913E-01	1.23596907E+00	3.30452163E-01	1.42223741E-06
4	.00000000E+00	1.70000000E-01	3.98400261E-01	4.35549939E+00	4.50404725E-01	2.13980185E-07
5	.00000000E+00	8.40000000E-02	5.78541698E-01	9.92011996E+00	4.60898099E-01	-4.74224504E-07
6	.00000000E+00	1.30000000E-02	4.99107167E-01	7.33809316E+00	3.03846311E-01	-6.38306486E-07
7	.00000000E+00	.00000000E+00	3.03864909E-01	4.10550358E+00	2.15502100E-01	-2.36433358E-07
8	.00000000E+00	.00000000E+00	2.15502305E-01	2.06402473E+00	1.19231519E-01	4.09870638E-07
9	.00000000E+00	.00000000E+00	1.19231432E-01	3.85144391E-01	2.29822965E-02	3.58425478E-06
10	.00000000E+00	.00000000E+00	2.29822604E-02	7.20159499E-02	1.19831696E-02	3.95209051E-06
11	.00000000E+00	.00000000E+00	1.19831681E-02	4.36243878E-02	7.52510021E-03	4.58904527E-06
12	.00000000E+00	.00000000E+00	7.52509923E-03	2.66849605E-02	4.68186216E-03	5.50963898E-06
13	.00000000E+00	.00000000E+00	4.68186155E-03	3.14752556E-02	4.13696662E-03	2.27433549E-06
14	.00000000E+00	.00000000E+00	4.13697173E-03	2.62800108E-02	3.27582178E-03	3.55956819E-06
15	.00000000E+00	.00000000E+00	3.27582181E-03	5.04222340E-02	-4.71844785E-16	3.00433022E-06
16	.00000000E+00	1.00000000E+00	4.97353053E+00	6.21827739E+01	4.97352981E+00	7.15254922E-05

	ABSORPTION	NEUTRON BALANCE	RIGHT LEAKAGE	FISSION NEUTRONS	NEUTRON DENSITY	NEUTRON FLUX
1	3.83624831E-02	-5.28926284E-05	3.03804534E-06	1.09435449E-01	1.53241344E-01	4.36737831E+00
2	8.39261059E-02	-6.77403012E-05	3.84962080E-06	1.94084171E-01	4.95303565E-01	9.85654093E+00
3	4.60115755E-02	-8.56674284E-05	1.42223741E-06	8.51869472E-02	5.71700706E-01	8.40400388E+00
4	1.18093800E-01	-1.73254658E-04	2.13980185E-07	1.73512307E-01	2.24089679E+00	2.46498667E+01
5	2.01855727E-01	-3.19456471E-04	-4.74224504E-07	2.17883481E-01	6.41182084E+00	4.29591996E+01
6	2.08420301E-01	-3.06583158E-04	-4.38306486E-07	1.32980846E-01	9.45475931E+00	2.55278501E+01
7	8.84512333E-02	-2.90219019E-04	-2.36433358E-07	4.30068173E-02	6.33977289E+00	7.84229901E+00
8	9.63159662E-02	-2.11594770E-04	4.09870638E-07	2.70724405E-02	8.28737844E+00	4.20252961E+00
9	9.62556384E-02	-8.46045066E-05	3.58425478E-06	1.35261008E-02	5.96893056E+00	1.11380244E+00
10	1.09970387E-02	-8.26709021E-05	3.95209051E-06	2.42135315E-04	2.71615965E+00	2.31960034E-01
11	4.45459102E-03	-9.28094395E-05	4.58904527E-06	6.04289868E-05	2.73396260E+00	1.41619263E-01
12	2.83841163E-03	-9.09225476E-05	5.50963898E-06	7.09078808E-06	2.77236947E+00	8.70524013E-02
13	5.42343739E-04	-1.54456157E-04	3.27433549E-06	1.08052994E-04	5.01697285E+00	9.58241814E-02
14	8.58198724E-04	-1.47049506E-04	3.55956819E-06	4.04396869E-04	6.82009823E+00	7.92059394E-02
15	3.27389145E-03	-3.27844790E-04	3.00433022E-06	2.39708972E-03	3.35486418E+01	1.35871999E-01
16	2.00131232E+00	-2.48772628E-03	7.15254922E-05	1.99989127E+00	1.973721930E+02	2.58342518E+02

ITERATION MONITOR EPS= .10000000E-03 EPSA= .00000000E+00 PROBLEM ID 911

TIME IN MINUTES	OUTER ITERATIONS	INNER ITERATIONS	NEUTRON BALANCE	EIGENVALUE	EIGENVALUE SLOPE	LAMRDA
94.533	12	2499	-1.24877263E-02	.94290963E+00	-1.0616783E+02	.99998775E+00

EXECUTION TIME= 18.267 MINUTES

SEARCH DENSITY OF FIRST PRINCIPAL ELEMENT= .66944689E-02

ZONE	FINAL RADII	AVERAGE RADII	FISSICNS	VOLUME
1	1 .0000000E+00	.8382000E+00	.2644675E-03	.8828871E+01
2	1 .1676400E+01	.2514600E+01	.2637632E-03	.2648661E+02
3	1 .3352800E+01	.4191000E+01	.2623327E-03	.4414436E+02
4	1 .5029200E+01	.5867400E+01	.2602273E-03	.6180210E+02
5	1 .6705600E+01	.7543800E+01	.2574629E-03	.7945984E+02
6	1 .8382000E+01	.9220000E+01	.2540519E-03	.9709230E+02
7	1 .1005800E+02	.1089650E+02	.2500062E-03	.1148153E+03
8	1 .1173500E+02	.1257300E+02	.2453423E-03	.1324015E+03
9	1 .1341100E+02	.1424950E+02	.2400785E-03	.1501456E+03
10	1 .1508800E+02	.1592600E+02	.2342365E-03	.1677106E+03
11	1 .1676400E+02	.1760200E+02	.2278419E-03	.1853599E+03
12	1 .1844000E+02	.1927850E+02	.2209181E-03	.2031357E+03
13	1 .2011700E+02	.2095500E+02	.2134964E-03	.2206691E+03
14	1 .2179300E+02	.2263150E+02	.2056090E-03	.2384659E+03
15	1 .2347000E+02	.2430800E+02	.1972911E-03	.2559783E+03
16	1 .2514600E+02	.2598400E+02	.1885826E-03	.2736276E+03
17	1 .2682200E+02	.2766050E+02	.1795189E-03	.2914560E+03
18	1 .2849900E+02	.2933700E+02	.1701454E-03	.3089368E+03
19	1 .3017500E+02	.3101350E+02	.1605073E-03	.3267862E+03
20	1 .3185200E+02	.3269000E+02	.1506506E-03	.3442459E+03
21	1 .3352800E+02	.3436600E+02	.1406226E-03	.3618952E+03
22	1 .3520400E+02	.3604250E+02	.1304519E-03	.3797763E+03
23	1 .3688100E+02	.3771900E+02	.1201527E-03	.3972044E+03
24	1 .3855700E+02	.3939550E+02	.1096791E-03	.4151065E+03
25	1 .4023400E+02	.4107200E+02	.9894580E-04	.4325136E+03
26	2 .4191000E+02	.4269850E+02	.1566119E-04	.4230816E+03
27	2 .4358700E+02	.4427500E+02	.1276416E-04	.4384243E+03
28	2 .4506300E+02	.4585150E+02	.1060444E-04	.4543234E+03
29	2 .4664000E+02	.4742800E+02	.8936709E-05	.4699492E+03
30	2 .4821700E+02	.4900500E+02	.7617489E-05	.4852622E+03
31	2 .4979300E+02	.5058150E+02	.6558390E-05	.5011910E+03
32	2 .5137000E+02	.5215850E+02	.5702361E-05	.5168168E+03
33	2 .5294700E+02	.5373500E+02	.5013181E-05	.5321001E+03
34	2 .5452300E+02	.5531150E+02	.4467087E-05	.5480586E+03
35	2 .5610000E+02	.5688850E+02	.4050300E-05	.5636844E+03
36	2 .5767700E+02	.5846500E+02	.3758772E-05	.5789380E+03
37	2 .5925300E+02	.6004150E+02	.3597717E-05	.5949262E+03
38	2 .6083000E+02	.6161850E+02	.3587479E-05	.6105520E+03
39	2 .6240700E+02	.6319500E+02	.3776548E-05	.6257759E+03
40	2 .6398300E+02	.6477150E+02	.4514393E-05	.6417938E+03
41	3 .6556000E+02	.6634850E+02	.0000000E+00	.2561857E+03
42	3 .6617900E+02	.6648900E+02	.0000000E+00	.2590129E+03
43	3 .6679900E+02	.6710850E+02	.0000000E+00	.2619045E+03
44	3 .6741800E+02	.6772800E+02	.0000000E+00	.2638395E+03
45	3 .6803800E+02	.6834750E+02	.0000000E+00	.2658234E+03
46	3 .6865700E+02	.6896700E+02	.0000000E+00	.2678661E+03
47	3 .6927700E+02	.6958650E+02	.0000000E+00	.2706422E+03
48	3 .6989600E+02	.7020600E+02	.0000000E+00	.2734927E+03
49	3 .7051600E+02	.7082550E+02	.0000000E+00	.2754610E+03
50	3 .7113500E+02	.7144500E+02	.0000000E+00	.2783193E+03
51	17 .7175500E+02	.0000000E+00	.0000000E+00	.0000000E+00

FLUX BY GROUP AND SPACE POINT

	ZONE	AVG RADIUS	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7
1	1	8.38200E-01	1.08118E-03	2.36033E-03	2.04623E-03	5.48967E-03	7.99422E-03	3.72561E-03	7.51140E-04
2	1	2.51460E+00	1.07843E-03	2.35409E-03	2.04065E-03	5.47458E-03	7.97258E-03	3.71585E-03	7.49215E-04
3	1	4.19100E+00	1.07247E-03	2.34106E-03	2.02931E-03	5.44400E-03	7.92958E-03	3.69673E-03	7.45449E-04
4	1	5.86740E+00	1.06369E-03	2.32188E-03	2.01263E-03	5.39905E-03	7.86641E-03	3.66860E-03	7.39869E-04
5	1	7.54380E+00	1.05217E-03	2.29673E-03	1.99073E-03	5.34005E-03	7.78344E-03	3.63162E-03	7.32513E-04
6	1	9.22000E+00	1.03798E-03	2.26571E-03	1.96369E-03	5.26723E-03	7.68103E-03	3.58599E-03	7.23425E-04
7	1	1.08965E+01	1.02116E-03	2.22892E-03	1.93159E-03	5.18078E-03	7.55955E-03	3.53193E-03	7.12659E-04
8	1	1.25730E+01	1.00177E-03	2.18646E-03	1.89451E-03	5.08101E-03	7.41956E-03	3.46977E-03	7.00286E-04
9	1	1.42495E+01	9.79856E-04	2.13847E-03	1.85257E-03	4.96823E-03	7.26166E-03	3.39987E-03	6.86384E-04
10	1	1.59260E+01	9.55499E-04	2.08509E-03	1.80588E-03	4.84281E-03	7.08657E-03	3.32266E-03	6.71050E-04
11	1	1.76020E+01	9.29776E-04	2.02649E-03	1.75459E-03	4.70522E-03	6.89517E-03	3.23865E-03	6.54397E-04
12	1	1.92785E+01	8.99752E-04	1.96281E-03	1.69880E-03	4.55584E-03	6.68826E-03	3.14837E-03	6.36542E-04
13	1	2.09550E+01	8.68517E-04	1.89423E-03	1.63867E-03	4.39522E-03	6.46692E-03	3.05245E-03	6.17637E-04
14	1	2.26315E+01	8.35154E-04	1.82093E-03	1.57435E-03	4.22390E-03	6.23228E-03	2.95163E-03	5.97852E-04
15	1	2.43080E+01	7.99747E-04	1.74308E-03	1.50597E-03	4.04248E-03	5.98559E-03	2.84669E-03	5.77389E-04
16	1	2.59840E+01	7.62377E-04	1.66085E-03	1.43370E-03	3.85162E-03	5.72828E-03	2.73857E-03	5.56496E-04
17	1	2.76605E+01	7.23082E-04	1.57433E-03	1.35759E-03	3.65188E-03	5.46167E-03	2.62818E-03	5.35458E-04
18	1	2.93370E+01	6.81900E-04	1.48362E-03	1.27777E-03	3.44400E-03	5.18749E-03	2.51668E-03	5.14658E-04
19	1	3.10135E+01	6.38807E-04	1.38869E-03	1.19426E-03	3.22868E-03	4.90750E-03	2.40532E-03	4.94593E-04
20	1	3.26900E+01	5.93690E-04	1.28940E-03	1.10702E-03	3.00665E-03	4.62366E-03	2.29553E-03	4.75940E-04
21	1	3.43660E+01	5.46280E-04	1.18534E-03	1.01592E-03	2.77870E-03	4.33826E-03	2.18893E-03	4.59670E-04
22	1	3.60425E+01	4.95961E-04	1.07555E-03	9.20463E-04	2.54535E-03	4.05365E-03	2.08737E-03	4.47185E-04
23	1	3.77190E+01	4.41580E-04	9.58198E-04	8.19764E-04	2.30719E-03	3.77300E-03	1.99330E-03	4.40882E-04
24	1	3.93955E+01	3.80848E-04	8.29565E-04	7.11861E-04	2.06438E-03	3.50069E-03	1.91049E-03	4.30686E-04
25	1	4.10720E+01	3.09264E-04	6.82068E-04	5.92631E-04	1.81642E-03	3.24427E-03	1.84708E-03	4.16419E-04
26	2	4.26985E+01	2.37738E-04	5.42684E-04	4.75102E-04	1.57394E-03	3.00280E-03	1.79727E-03	4.05249E-04
27	2	4.42750E+01	1.83160E-04	4.38661E-04	3.80902E-04	1.35675E-03	2.76296E-03	1.73565E-03	3.91896E-04
28	2	4.58515E+01	1.44742E-04	3.60181E-04	3.10487E-04	1.17066E-03	2.52348E-03	1.65499E-03	3.82242E-04
29	2	4.74285E+01	1.16551E-04	2.99205E-04	2.55817E-04	1.01064E-03	2.29318E-03	1.56509E-03	3.70573E-04
30	2	4.90050E+01	9.52152E-05	2.50877E-04	2.12441E-04	8.72978E-04	2.07615E-03	1.47116E-03	3.60050E-04
31	2	5.05815E+01	7.86858E-05	2.12026E-04	1.77563E-04	7.54542E-04	1.87409E-03	1.37646E-03	3.47109E-04
32	2	5.21585E+01	6.56660E-05	1.80513E-04	1.49300E-04	6.52702E-04	1.68755E-03	1.28333E-03	3.35088E-04
33	2	5.37350E+01	5.53098E-05	1.54863E-04	1.26324E-04	5.65292E-04	1.51663E-03	1.19356E-03	3.23219E-04
34	2	5.53115E+01	4.70221E-05	1.33977E-04	1.07619E-04	4.90337E-04	1.36079E-03	1.10847E-03	3.14363E-04
35	2	5.68885E+01	4.03731E-05	1.17033E-04	9.23931E-05	4.26095E-04	1.21927E-03	1.02902E-03	3.09416E-04
36	2	5.84650E+01	3.50428E-05	1.03414E-04	8.00274E-05	3.71063E-04	1.09119E-03	9.56041E-04	3.08883E-04
37	2	6.00415E+01	3.07650E-05	9.26196E-05	6.99951E-05	3.23800E-04	9.75390E-04	8.90139E-04	3.04282E-04
38	2	6.16185E+01	2.72934E-05	8.42404E-05	6.18257E-05	2.82898E-04	8.70461E-04	8.31848E-04	3.01793E-04
39	2	6.31950E+01	2.43549E-05	7.79132E-05	5.50453E-05	2.46867E-04	7.74611E-04	7.81857E-04	3.02235E-04
40	2	6.47715E+01	2.15188E-05	7.31769E-05	4.89973E-05	2.13681E-04	6.84754E-04	7.12929E-04	3.05916E-04
41	3	6.58695E+01	1.95764E-05	7.05307E-05	4.50506E-05	1.91238E-04	6.23740E-04	7.17270E-04	3.04671E-04
42	3	6.64890E+01	1.86770E-05	6.93620E-05	4.32003E-05	1.79722E-04	5.92105E-04	7.04870E-04	3.04801E-04
43	3	6.71085E+01	1.78940E-05	6.82815E-05	4.16463E-05	1.70078E-04	5.65236E-04	6.93045E-04	3.04902E-04
44	3	6.77280E+01	1.72127E-05	6.72922E-05	4.03453E-05	1.62042E-04	5.42579E-04	6.82183E-04	3.04947E-04
45	3	6.83475E+01	1.66198E-05	6.63939E-05	3.92629E-05	1.55411E-04	5.23703E-04	6.72541E-04	3.04054E-04
46	3	6.89670E+01	1.61036E-05	6.55844E-05	3.83723E-05	1.50025E-04	5.08288E-04	6.64289E-04	3.04020E-04
47	3	6.95865E+01	1.56550E-05	6.48570E-05	3.76510E-05	1.45756E-04	4.96069E-04	6.57531E-04	3.04121E-04
48	3	7.02060E+01	1.52750E-05	6.42105E-05	3.70807E-05	1.42496E-04	4.86837E-04	6.52338E-04	3.04320E-04
49	3	7.08255E+01	1.49634E-05	6.36289E-05	3.66444E-05	1.40152E-04	4.80392E-04	6.48722E-04	3.04682E-04
50	3	7.14450E+01	1.47129E-05	6.31010E-05	3.63265E-05	1.38634E-04	4.76550E-04	6.46678E-04	3.04522E-04
	ZONE	AVG RADIUS	GROUP 8	GROUP 9	GROUP 10	GROUP 11	GROUP 12	GROUP 13	GROUP 14
1	1	8.38200E-01	3.28379E-04	4.58743E-05	6.52898E-07	3.24886E-09	2.05155E-11	1.39625E-12	2.11510E-14
2	1	2.51460E+00	3.27548E-04	4.57584E-05	6.51255E-07	3.24039E-09	2.04648E-11	1.39280E-12	2.10928E-14
3	1	4.19100E+00	3.25921E-04	4.55318E-05	6.48034E-07	3.22489E-09	2.03622E-11	1.38608E-12	2.10045E-14
4	1	5.86740E+00	3.23507E-04	4.51959E-05	6.43256E-07	3.20030E-09	2.02141E-11	1.37624E-12	2.08301E-14

5	1	7.54380E+00	3.20323E-04	4.47526E-05	6.36951E-07	3.17009E-09	2.00134E-11	1.36358E-12	2.06866E-14
6	1	9.22000E+00	3.16387E-04	4.42048E-05	6.29162E-07	3.12976E-09	1.97718E-11	1.34875E-12	2.03772E-14
7	1	1.08965E+01	3.11727E-04	4.35562E-05	6.19937E-07	3.08593E-09	1.94784E-11	1.33319E-12	2.03039E-14
8	1	1.25730E+01	3.06373E-04	4.28113E-05	6.09344E-07	3.03054E-09	1.91495E-11	1.32021E-12	1.98288E-14
9	1	1.42495E+01	3.00364E-04	4.19756E-05	5.97459E-07	2.97485E-09	1.87721E-11	1.31753E-12	2.03424E-14
10	1	1.59260E+01	2.93745E-04	4.10554E-05	5.84376E-07	2.90535E-09	1.83647E-11	1.34344E-12	1.98135E-14
11	1	1.76020E+01	2.86569E-04	4.00587E-05	5.70206E-07	2.84044E-09	1.79168E-11	1.44163E-12	2.32478E-14
12	1	1.92785E+01	2.78893E-04	3.89937E-05	5.55068E-07	2.75802E-09	1.74420E-11	1.71765E-12	2.43898E-14
13	1	2.09550E+01	2.70794E-04	3.78714E-05	5.39120E-07	2.68770E-09	1.69438E-11	2.42598E-12	4.21556E-14
14	1	2.26315E+01	2.62357E-04	3.67044E-05	5.22544E-07	2.59376E-09	1.64143E-11	4.18637E-12	5.91782E-14
15	1	2.43080E+01	2.53686E-04	3.55085E-05	5.05567E-07	2.52390E-09	1.58994E-11	8.49978E-12	1.54824E-13
16	1	2.59840E+01	2.44915E-04	3.43029E-05	4.88460E-07	2.42011E-09	1.53287E-11	1.90249E-11	2.69929E-13
17	1	2.76605E+01	2.36198E-04	3.31110E-05	4.71579E-07	2.36019E-09	1.48557E-11	4.47670E-11	8.26242E-13
18	1	2.93370E+01	2.27744E-04	3.19629E-05	4.55307E-07	2.24798E-09	1.42504E-11	1.07756E-10	1.52963E-12
19	1	3.10135E+01	2.19817E-04	3.08960E-05	4.40297E-07	2.21452E-09	1.39342E-11	2.62234E-10	4.85360E-12
20	1	3.26900E+01	2.12756E-04	2.99550E-05	4.26886E-07	2.09257E-09	1.32573E-11	6.41675E-10	9.10148E-12
21	1	3.43660E+01	2.06992E-04	2.91900E-05	4.16484E-07	2.11684E-09	1.33645E-11	1.57607E-09	2.92500E-11
22	1	3.60425E+01	2.03040E-04	2.86458E-05	4.07888E-07	1.96630E-09	1.23362E-11	3.88024E-09	5.43600E-11
23	1	3.77190E+01	2.01448E-04	2.83277E-05	4.05409E-07	2.11283E-09	1.36437E-11	9.64158E-09	1.82319E-10
24	1	3.93955E+01	2.02736E-04	2.82001E-05	3.97068E-07	1.82641E-09	1.07258E-11	2.30388E-08	2.58177E-10
25	1	4.10720E+01	2.06535E-04	2.72936E-05	4.08393E-07	2.53176E-09	2.18052E-11	7.05980E-08	3.33526E-08
26	2	4.26985E+01	2.10469E-04	2.54617E-05	4.49627E-07	9.48375E-09	1.13730E-10	1.53260E-07	1.68784E-07
27	2	4.42750E+01	2.12719E-04	2.43599E-05	4.57893E-07	1.18100E-08	1.54062E-10	2.46283E-07	2.93654E-07
28	2	4.58515E+01	2.13004E-04	2.40672E-05	4.46617E-07	1.12041E-08	1.45795E-10	3.55454E-07	4.29474E-07
29	2	4.74285E+01	2.11305E-04	2.37723E-05	4.42681E-07	1.12384E-08	1.45917E-10	4.94298E-07	5.95365E-07
30	2	4.90050E+01	2.08128E-04	2.34310E-05	4.35828E-07	1.10115E-08	1.43328E-10	6.75739E-07	8.03659E-07
31	2	5.05815E+01	2.04125E-04	2.30623E-05	4.29416E-07	1.08715E-08	1.41100E-10	9.16142E-07	1.07036E-06
32	2	5.21585E+01	2.00046E-04	2.27403E-05	4.24135E-07	1.07532E-08	1.40211E-10	1.23705E-06	1.41478E-06
33	2	5.37350E+01	1.96721E-04	2.25808E-05	4.21299E-07	1.06587E-08	1.38116E-10	1.66696E-06	1.86678E-06
34	2	5.53115E+01	1.95086E-04	2.27579E-05	4.28141E-07	1.09546E-08	1.43505E-10	2.24410E-06	2.43916E-06
35	2	5.68885E+01	1.96238E-04	2.35557E-05	4.39649E-07	1.10476E-08	1.42053E-10	3.02063E-06	3.18873E-06
36	2	5.84650E+01	2.01525E-04	2.54895E-05	5.01728E-07	1.34102E-08	1.82259E-10	4.06566E-06	4.15772E-06
37	2	6.00415E+01	2.12685E-04	2.95783E-05	5.55300E-07	1.42805E-08	1.59754E-10	5.47504E-06	5.40804E-06
38	2	6.16185E+01	2.32045E-04	3.80401E-05	1.05991E-06	4.72304E-08	1.05347E-09	7.38659E-06	7.02039E-06
39	2	6.31950E+01	2.63013E-04	5.47263E-05	2.25640E-06	2.74374E-07	2.67862E-09	1.00338E-05	9.11480E-06
40	2	6.47715E+01	3.15514E-04	1.07536E-04	1.72482E-06	8.38423E-06	2.81940E-06	1.28642E-05	1.19760E-05
41	3	6.58695E+01	3.60077E-04	1.64554E-04	4.40576E-05	2.61695E-05	1.54917E-05	1.71117E-05	1.43007E-05
42	3	6.64890E+01	3.80074E-04	1.92210E-04	5.61193E-05	3.41300E-05	2.07219E-05	1.90394E-05	1.55434E-05
43	3	6.71085E+01	3.96553E-04	2.14965E-04	6.62253E-05	4.10166E-05	2.52744E-05	2.09248E-05	1.66772E-05
44	3	6.77280E+01	4.10137E-04	2.33754E-04	7.46820E-05	4.69267E-05	2.92058E-05	2.26902E-05	1.76983E-05
45	3	6.83475E+01	4.21253E-04	2.49188E-04	8.17651E-05	5.19330E-05	3.25557E-05	2.42809E-05	1.85980E-05
46	3	6.89670E+01	4.30191E-04	2.61657E-04	8.74292E-05	5.60759E-05	3.53419E-05	2.56571E-05	1.93659E-05
47	3	6.95865E+01	4.37164E-04	2.71436E-04	9.19480E-05	5.93835E-05	3.75743E-05	2.67908E-05	1.99926E-05
48	3	7.02060E+01	4.42326E-04	2.78711E-04	9.53251E-05	6.18743E-05	3.92584E-05	2.76626E-05	2.04710E-05
49	3	7.08255E+01	4.45805E-04	2.83637E-04	9.76151E-05	6.35695E-05	4.06036E-05	2.82624E-05	2.07974E-05
50	3	7.14450E+01	4.47709E-04	2.86344E-04	9.88675E-05	6.44929E-05	4.10228E-05	2.85870E-05	2.09715E-05

ZONE	AVG RADIUS	GROUP 15	GROUP
1	1	8.38200E-01	1.32700E-16
2	1	2.51440E+00	1.32156E-16
3	1	4.19100E+00	1.31913E-16
4	1	5.86740E+00	1.30347E-16
5	1	7.54380E+00	1.30094E-16
6	1	9.22000E+00	1.27345E-16
7	1	1.08965E+01	1.27820E-16
8	1	1.25730E+01	1.23940E-16
9	1	1.42495E+01	1.27782E-16
10	1	1.59260E+01	1.24892E-16
11	1	1.76020E+01	1.44078E-16
12	1	1.92785E+01	1.58559E-16
13	1	2.09550E+01	2.57172E-16
14	1	2.26315E+01	3.99926E-16
15	1	2.43080E+01	9.46609E-16
16	1	2.59840E+01	1.84247E-15
17	1	2.76605E+01	5.06057E-15
18	1	2.93370E+01	1.03631E-14
19	1	3.10135E+01	3.00248E-14
20	1	3.26900E+01	5.06545E-14
21	1	3.43660E+01	1.89643E-13
22	1	3.60425E+01	3.30611E-13
23	1	3.77190E+01	1.20474E-12
24	1	3.93955E+01	1.46392E-12
25	1	4.10720E+01	6.99789E-09
26	2	4.26985E+01	8.18961E-08
27	2	4.42750E+01	1.48584E-07
28	2	4.58515E+01	2.24976E-07
29	2	4.74285E+01	3.23681E-07
30	2	4.90050E+01	4.56704E-07
31	2	5.05815E+01	6.41370E-07
32	2	5.21585E+01	9.01248E-07
33	2	5.37350E+01	1.27193E-06
34	2	5.53115E+01	1.80676E-06
35	2	5.68885E+01	2.58627E-06
36	2	5.84650E+01	3.73236E-06
37	2	6.00415E+01	5.43504E-06
38	2	6.16185E+01	8.00203E-06
39	2	6.31950E+01	1.20167E-05
40	2	6.47715E+01	1.92411E-05
41	3	6.58695E+01	2.60551E-05
42	3	6.64890E+01	2.98810E-05
43	3	6.71085E+01	3.31701E-05
44	3	6.77280E+01	3.59915E-05
45	3	6.83475E+01	3.83839E-05
46	3	6.89670E+01	4.03668E-05
47	3	6.95865E+01	4.19518E-05
48	3	7.02060E+01	4.31455E-05
49	3	7.08255E+01	4.39956E-05
50	3	7.14450E+01	4.43936E-05