ACTIVE: A PROGRAM TO CALCULATE AND PLOT REACTION
RATES FROM ANISN CALCULATED FLUXES

J. L. Judd

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EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

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ABSTRACT

The ACTIVE code calculates spatial heating rates, tritium production rates, neutron reaction rates, and energy spectra from particle fluxes calculated by ANISN. ACTIVE has a variety of input options including the capability to plot all calculated spatial distributions. The code was primarily designed for use with fusion first wall/blanket systems, but could be applied to any one-dimensional problem.

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1.0 INTRODUCTION

It is often very convenient, especially for the analysis of fusion first wall/blanket systems, to have the capability of calculating and displaying the various spatial neutron and gamma reaction rates. In general use, this capability is more economic and flexible if it is performed exterior to more costly flux calculations because it allows the user to change editing features without running the flux calculation over again. The computer code ACTIVE was written for this purpose.

ACTIVE interfaces with the ANISN transport theory code by using ANISN calculated particle fluxes to calculate heating rates, tritium production, neutron reaction rates, and energy spectra. ACTIVE requires the user to input the spatial mesh, material description, kerma factors, tritium production factors, reaction cross sections and energy group structures. The code is variably dimensioned, so there are no fixed limits on the number of spatial points, energy groups, etc., just on the total memory required for a problem. ACTIVE has the capability to plot the calculated data using the DISSPLA² plotting system. The plotting is done using self-scaling axes. Section 2 describes the input required by ACTIVE. Section 3 discusses the calculations and normalizations performed. A sample problem using ACTIVE is discussed in Section 4.

2.0 ACTIVE INPUT INFORMATION

The following section describes the input required to run ACTIVE.

2.1 Input Card Description

Except for the first three cards, ACTIVE uses the FIDO system (See Appendix A) for card input. The input is described below.

Card 1 Problem title card

Maximum of 80 characters allowed. This title is printed at the beginning of each edit.

Card 2 Control variables

Free format: NINT, NNGRP, NGGRP, NZONES, NZ1, NZ2, NISO, NMAT,
IGEOM, JPLOT, IHEAT, ITRIT, IFISS, IXS, ISPECI,
ISPECZ, INORM, IDIVID, ANORM, FNORM

NINT = number of spatial intervals
NNGRP = number of neutron energy groups
NGGRP = number of gamma energy groups
NZONES = number of zones in the problem
NZ1 = first spatial interval at which to perform calculations
NZ2 = last spatial interval at which to perform calculations
NISO = number of isotopes in the problem
NMAT = number of macroscopic materials to mix
IGEOM = geometry flag, slab/cylinder/sphere, 0/1/2
JPLOT = plotting flag, no/yes, 0/1
IHEAT = calculate heating rates, no/yes, 0/1
ITRIT = calculate tritium breeding, no/yes, 0/1
IFISS = calculate fission and capture rates, no/yes, 0/1
IXS = calculate user defined reaction rates, no/N types, 0/N
ISPECI = calculate energy spectra, no/N intervals, 0/N
ISPECZ = calculate energy spectra, no/N zones, 0/N

INORM = spectra calculation flag
= 0: no normalization and plotted as smooth curve
= 1: normalized to total flux and plotted as smooth curve
= 2: no normalization and plotted as histogram
= 3: normalized to total flux and plotted as histogram
IDIVID = spectra calculated per eV/per unit lethargy, 0/1
ANORM = factor to convert kerma factors to watts
FNORM = flux normalization factor

Card 3 X-axis title for plots

Maximum of 60 characters allowable. The last character must be a "\$". This card is read in only if JPLOT = 1 and IHEAT, ITRIT, IFISS, or IXS is greater than zero.

Card(s) 4 1\$\$ array

Free form FIDO: (JISO(I), I = 1,NISO)

Array must be followed by a T.

JISO(I) is the ENDF/B number of the isotope for use in extracting data from the data libraries unit. This card is only read in if IHEAT, ITRIT, IFISS or IXS is greater than zero.

Card(s) 5 11J array

(10A6): (JFLAG(I), I = 1,NISO)

Array must be followed by a T.

JFLAG(I) is a 6 character identifier for JISO(I) and is used for output purposes. These cards are read in only if IHEAT, ITRIT, IFISS, or IXS is greater than zero.

Card(s) 6 2** array

Free form FIDO: (BISO(I,J),J=1,NMAT),I=1,NISO)

Array must be followed by a T.

BISO(I,J) is the number density of isotope I in material J in units of atoms/bn-cm. Values for all isotopes are read in for one material before reading data for next material. These cards are only read in if IHEAT, ITRIT, IFISS, or IXS is greater than zero.

Card(s) 7 3\$\$ array

Free form FIDO: (IZONE(I), I=1,NINT)

Array must be followed by a T.

IZONE(I) is the zone number at spatial interval I. These cards are always read in.

Card(s) 8 6\$\$ array

Free form FIDO: (IMAT(I), I = 1,NZONES)

Array must be followed by a T.

IMAT(I) is the material number present in zone I. These cards are read in only if IHEAT, ITRIT, IFISS, or IXS is greater than zero.

Card(s) 9 7** array

Free form FIDO: (ENERN(I), I = 1,NNGRP+1)

Array must be followed by a T.

ENERN(I) are the energy group boundaries for the neutron energy structure in eV. These cards are read in only if ISPECI or ISPECZ is greater than zero. ENERN(1) is the upper energy of the first neutron group. ENERN(NNGRP+1) is the lower energy of the last neutron group.

Card(s) 10 8** array

Free form FIDO: (ENERG(I), I = 1,NGGRP+1)

Array must be followed by a T.

ENERG(I) are the energy group boundaries for the gamma energy group structure in eV. These cards are read in only if ISPECI or ISPECZ is greater than zero. ENERG(1) is the upper energy of the first gamma group. ENERG(NGGRP+1) is the lower energy of the last gamma group.

Card(s) 11 9\$\$ array

Free form FIDO: (ISINT(I), I = 1,ISPECI)

Array must be followed by a T.

ISINT are the spatial interval numbers at which spectrum calculations are desired. These cards are read in only if ISPECI is greater than zero.

Card(s) 12 10\$\$ array

Free form FIDO: (ISZONE(I), I = 1,ISPECZ)

Array must be followed by a T.

ISZONE are the zone numbers for which spectrum calculations are to be performed. These cards are read in only if ISPECZ is greater than zero.

Card(s) 13 12W array

(7A10): (TYPE(I), I= 1,IXS)

Array must be followed by a T.

TYPE(I) is the reaction type label for the Ith set of reaction cross sections in the library on TAPE4. These labels are used for output purposes. These cards are read in only if IXS is greater than zero.

Card(s) 14 4** array

Free form FIDO: (X(I), I = 1,NINT)

Array must be followed by a T.

X are the spatial interval boundaries. These data are the same as in the ANISN problem and is always read in.

Free form FIDO: FLUX(I,J), J = 1,NNRGP+NGGRP), I = 1,NINT)
Array must be followed by a T.

FLUX (I,J) is the flux at spatial point I and energy group J from the ANISN problem. These fluxes are always read in. The fluxes can be punched out during the appropriate ANISN run.

2.2 Required Input File

Depending on the ACTIVE options requested, several input files may be required for execution. If heating rate or tritium breeding calculations are requested (IHEAT or ITRIT greater than zero) then ACTIVE expects a library containing neutron and gamma kerma's and tritium production factors to be loaded on TAPE1. If fission and capture rates are requested (IFISS=1), ACTIVE expects a library of microscopic absorption and fission cross sections loaded on TAPE3. ACTIVE will calculate the capture cross section. If additional reaction rates are requested (IXS is greater than zero), a library of these reaction cross sections is loaded on TAPE4. Formats for these libraries are given in Appendix B.

2.3 Control Cards Required to Execute ACTIVE

The current version of ACTIVE is version 5 and is cataloged as ACTIVE5,ID=RPB. Table 1 contains a sample set of control cards for executing ACTIVE.

A FORTRAN source listing of the current version of ACTIVE (ACTIVEV05) is given in Appendix D.

TABLE 1. CYBER 176 (NOS/BE) CONTROL CARDS TO EXECUTE ACTIVE

JOB CARD

ACCOUNT CARD

ATTACH,ACTIVE,ACTIVE 5,ID=RPB,MR=1. (load module)

ATTACH,TAPE1 (kerma and tritium production factors)

ATTACH,TAPE3 (fission and absorption library)

ATTACH,TAPE4 (reaction cross section library)

REWIND,TAPE1,TAPE3,TAPE4.

ATTACH,JLJPROC,ID=JLJ,MR=1. (plotting procedure, See Appendix C)

BEGIN,DISPLAY,JLJPROC,IABS=1,LGO=ACTIVE,I=3,UID=JLJ.

7/8/9

(input cards)

6/7/8/9

3.0 METHOD OF CALCULATIONS

The following section describes the calculations performed by ACTIVE.

Neutron and gamma heating rates are calculated by the following equation

$$HR_{i,k} = \sum_{j=1}^G N_{i,k} * KF_{i,j} * \phi_{j,k} * FNORM * ANORM \quad (1)$$

where

$HR_{i,k}$ = heating rate for isotope i at mesh point k in w/cc

$N_{i,k}$ = concentration of isotope i at mesh point k in atoms/barn-cm

$KF_{i,j}$ = KERMA factor for isotope i for energy group j in eV-barn/atom

$\phi_{j,k}$ = flux at mesh point k for energy group j in particles/cm²-sec

FNORM = flux normalization factor

ANORM = conversion factor to convert heating rates to w/cc

G = number of energy groups

Equation 2 is used to calculate tritium breeding rate.

$$TB_{i,k} = \sum_{j=1}^G N_{i,k} * TF_{i,j} * \phi_{j,k} \quad (2)$$

where

$TB_{i,k}$ = tritium production rate for isotope i at mesh point k in triton/cm³-secs

$TF_{i,j}$ = tritium production factor for isotope i for energy group j in barns.

The tritium production rate is unnormalized by ACTIVE and is dependent on the source normalization in ANISN. If the source normalization in ANISN is set to 1.0 then the tritium production rate is per source neutron.

Neutron reaction rates are calculated by Equation 3.

$$RR_{l,i,k} = \sum_{j=1}^N N_{i,k} * \sigma_{l,i,j} * \phi_{j,k} * FNORM \quad (3)$$

where

$RR_{l,i,k}$ = reaction rate of the l th type for isotope i at mesh point k in reactions/cm³-sec.

$\sigma_{l,i,j}$ = microscopic cross section of the l th type for isotope i and energy group j in barns.

Volume integrals over each zone in the problem are calculated for each of the previously mentioned rates summed over all isotopes in the problem. These integrals are calculated using Equation 4.

$$VI_m = \sum_{i=1}^{NISO} \sum_{k=k1}^{k2} R_{m,i,k} V_k \quad (4)$$

where

VI_m = volume integral of rate m over all isotopes

$R_{m,i,k}$ = rate m for isotope i at mesh point k

V_k = volume of mesh interval k (geometry-dependent)

$NISO$ = number of isotopes in the problem

$k1$ = first mesh point in a zone

$k2$ = last mesh point in a zone.

Energy spectra for neutrons and gammas are also calculated. These spectra can be normalized to the total flux at a mesh point or in a zone or can be calculated from ANISN fluxes directly. The spectra can also be calculated per unit lethargy or per eV. Equation 5 is used to calculate normalized energy spectra and Equation 6 is used for renormalized energy spectra.

$$SN_{j,k} = \frac{\phi_{j,k}}{\left(\sum_{i=1}^G \phi_{i,k} \right) * \Delta E_j} \quad (5)$$

$$SU_{j,k} = \frac{\phi_{j,k}}{\Delta E_j} \quad (6)$$

where

$SN_{j,k}$ = relative flux per ΔE_j for energy group j at mesh point or zone k

$SU_{j,k}$ = flux per ΔE_j for energy group j at mesh point of zone k

ΔE_j = width of energy group j in units of lethargy or eV.

4.0 SAMPLE PROBLEM

The sample problem models the Engineering Test Reactor (ETR) with a fusion/fission hybrid first wall/blanket test module placed next to the core for simulation of a fusion environment. The ACTIVE calculations are normalized to 175 MW ETR core power. The ANISN problem had the source normalized to 1.0. The ACTIVE input deck is shown in Figure 1 and includes the NOS/BE control cards used to execute ACTIVE on the CYBER 176. The kerma library was generated from the MACKLIB-IV³ library and the cross section libraries were extracted from DLC-37F⁴.

4.1 Printed Output

Input data from cards and mounted libraries are printed out for user reference. All calculated data are printed. Isotopic contributions to all reaction rates and their fractions of the total are also printed. Zone volume integrals are performed on the input fluxes. The integrals and all calculated data are printed. Portions of the printed output are shown in Figure 2.

4.2 Plotted Output

Plotted output can be obtained on various media, (see Appendix C). All plots are self-scaled. In other words, the limits on the axes correspond to the limits of the data. For all plots, except the energy spectra plots, zone boundaries are drawn in over the range of plotted data. The x-axis title read from the input file is printed at the bottom of all the plots except the energy spectra plots. Figures 3 through 12 show sample plots generated by ACTIVE. If all of the calculated data for a plot are zero, the plot is not drawn and a message is printed.

5.0 REFERENCES

1. W. W. Engle, Jr., A User's Manual for ANISN, A One-Dimensional Discrete Ordinates Transport Code with Anisotropic Scattering, K-1963, Computing Technology Center (1967)
2. Integrated Software Systems Corporation, DISSPLA User's Manual, Sixth printing, (December 1978)
3. Y. Gohar and M. A. Abdou, MACKLIB-IV A Library of Nuclear Response Functions Generated with the MACK-IV Computer Program from ENDF/B-IV, ANL/FPP/TM-106, (March 1978).
4. D. M. Plaster, R. T. Santoro, W. E. Ford, III, Coupled 100-Group Neutron and 21-Group Gamma-Ray Sections for EPR Calculations, DLC37, ONRL-TM-4812, April 1975, updated to DLC37F (October 4, 1979)


```

JLJAC,P1,T37,STANY,EC1.
ACCOUNT,3220,G3421902C,TD3.
ATTACH,TAPE1,HEATL7B36GP,ID=TSB.
REWIND,TAPE1.
ATTACH,TAPE3,ACTIVEXSLIB,ID=JLJ.
REWIND,TAPE3.
COPY,TAPE3,TAPE4.
REWIND,TAPE3,TAPE4.
ATTACH,ACTIVE,ACTDEBUG5,ID=JLJ.
ATTACH,JLJPROC,ID=JLJ.
BEGIN,DISPLAY,JLJPROC,IABS=1,I=1,UID=JLJ,LGO=ACTIVE.
*EOR
FB/BC004S ACTIVE 1.0 CM FW ,MULTIPLIER, 40 CM BLANKET
187 23 13 5 3 167 14 7 0 1 1 1 1 2 3 2 3 0
1.6021-19 4.4363+13
(D)ISTANCE FROM THE FIRST WALL (( )CM)$
1$$ 1190 1191 1192 1197 1270 1274 1276
1193 1271 1272 1269 1289 1194 1287
T
11J
NI CR FE MN HELIUMCARBONOOXYGENAL LI-6 LI-7
HYDRO BE-9 SI MO
T
2** 9.880-3 1.581-2 5.657-2 1.760-3 0.0 3.200-4 6Z
1.720-3 1.260-3
4Z 2.663-5 9Z
5Z 8.32656-2 8Z
6Z 6.211-2 3.106-2 2.3295-3 2.87305-2 4Z
6Z 3.34427-2 3Z 6.68854-2 3Z
11Z 1.236-1 2Z
8Z 3.09224-3 3.81377-2 4Z
T
3$$ 2R1 5R2 10R3 150R4 20R5
T
6$$ 2 1 6 4 3
T
7** 1.4918+7 1.3499+7 1.2214+7 1.1052+7 1.0000+7 9.0484+6
7.4082+6 6.0563+6 4.9659+6 4.0657+6 3.3287+6 2.7253+6
2.2313+6 1.8268+6 1.0026+6 5.5023+5 2.0242+5 4.0868+4
3.3546+3 2.7537+2 2.2603+1 1.8554+0 4.1400-1 1.0000-4 T
8** 1.4+7 1.2+7 8.0+6 7.0+6 6.0+6 5.0+6 4.0+6 3.0+6 2.0+6
1.0+6 4.0+5 2.0+5 1.0+5 1.0+4 T
9$$ 7 17 167 T
10$$ 2 4 T
12W
ABSORPTION FISSION
T
4** 1I0.0 4I200.0 9I201.0 149I206.0 19I246.0 276.0
T
5**
ANISN FLUXES
T

```

Figure 1. Input deck for the ACTIVE sample problem.

FB/BC0045 ACTIVE 1.0 CM FM ,MULTIPLIER, 40 CM BLANKET

```

NUMBER OF SPATIAL INTERVALS          187
NUMBER OF NEUTRON ENERGY GROUPS     23
NUMBER OF GAMMA ENERGY GROUPS       13
NUMBER OF ZONES IN THE PROBLEM       63
FIRST INTERVAL FOR CALCULATIONS       7
LAST INTERVAL FOR CALCULATIONS       167
NUMBER OF ISOTOPES IN THE PROBLEM    14
NUMBER OF MACRO MATERIALS IN THE PROBLEM 7
GEOMETRY, 0/1/2 , SLAB/CYL/SPHERE   0
PLOT DATA, 0/1 , NO/YES              1
CALCULATE HEATING RATES, 0/1 , NO/YES 1
CALCULATE TRITIUM BREEDING, 0/1 , NO/YES 1
CALCULATE FISSION RATES, 0/1 , NO/YES 1
CALCULATE REACTION RATES, 0/N , NO/N REACTIONS 2
CALCULATE SPECTRA BY INTERVALS, 0/N , NO/N INTERVALS 2
CALCULATE SPECTRA BY ZONES, 0/N , NO/N ZONES 2
NORMALIZE SPECTRA TO TOTAL FLUX, 0/1 , NO/YES 1
SPECTRA CALCULATED PER EV/PER UNIT LETHARGY, 0/1 1
CONVERSION FACTOR TO M/CC             1.60210E-19
FLUX NORMALIZATION FACTOR             4.43630E+13

```

FB/BC0045 ACTIVE 1.0 CM FM ,MULTIPLIER, 40 CM BLANKET

MATERIAL NUMBER	ISOTOPE	ID NUMBER	CONCENTRATION
1	NI	1190	9.80000E-03
	CR	1191	1.58100E-02
	FE	1192	5.65700E-02
	WM	1197	7.60000E-03
	CARBON	1274	3.20000E-04
	SI	1194	1.72000E-03
2	HELIUM	1270	2.66300E-05
3	CARBON	1274	8.32656E-02
4	OXYGEN	1276	6.21100E-02
	LI-6	1271	3.32950E-03
	LI-7	1272	2.87305E-02
5	OXYGEN	1276	3.34427E-02
	HYDRO	1269	6.68654E-02
6	BE-9	1289	1.23600E-01
7	LI-6	1271	3.09224E-03
	LI-7	1272	1.81377E-02

FB/BC0045 ACTIVE 1.0 CM FM ,MULTIPLIER, 40 CM BLANKET

INTERVAL	INSIDE RADIUS	OUTSIDE RADIUS	INTERVAL MIDPOINT	INTERVAL VOLUME	ZONE NUMBER	MATERIAL NUMBER
1	0.	1.00000E+02	5.00000E+01	1.00000E+02	1	2
2	1.00000E+02	1.00000E+02	1.00000E+02	1.00000E+02	1	1
3	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
4	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
5	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
6	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
7	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
8	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
9	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
10	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
11	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
12	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
13	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
14	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
15	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
16	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
17	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
18	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
19	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
20	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
21	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
22	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
23	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
24	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
25	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
26	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
27	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
28	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
29	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
30	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
31	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
32	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
33	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
34	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
35	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
36	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
37	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
38	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
39	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
40	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
41	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
42	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
43	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
44	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
45	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
46	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
47	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
48	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
49	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
50	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
51	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
52	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
53	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
54	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
55	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
56	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1
57	0.00000E+00	0.00000E+00	0.00000E+00	0.00000E+00	1	1

Figure 2. Printed output data from the ACTIVE sample problem.

FB/BC0045 ACTIVE 1.0 CM FM, MULTIPLIER, 40 CM BLANKET

ENERGY GROUP	NI KERMA	CR KERMA	FE KERMA	HM KERMA	HELIUM KERMA	CARBON KERMA
1	7.27720E+06	3.44600E+06	3.68150E+06	2.30330E+06	2.48900E+06	6.27890E+06
2	7.81720E+06	2.23380E+06	2.50000E+06	1.58610E+06	2.48900E+06	6.27890E+06
3	7.92590E+06	1.72000E+06	2.42000E+06	1.48000E+06	2.48900E+06	6.27890E+06
4	7.95910E+06	1.44720E+06	1.77100E+06	1.42190E+06	2.48900E+06	6.27890E+06
5	6.83530E+06	1.16300E+06	1.62190E+06	1.31000E+06	2.48900E+06	6.27890E+06
6	5.46100E+06	8.80000E+05	1.16300E+06	8.80000E+05	2.48900E+06	6.27890E+06
7	4.01890E+06	6.40000E+05	7.61900E+05	2.60730E+05	2.48900E+06	6.27890E+06
8	2.73370E+06	3.31100E+05	5.19000E+05	3.68000E+05	2.48900E+06	6.27890E+06
9	1.75230E+06	2.60000E+05	2.97300E+05	2.60000E+05	2.48900E+06	6.27890E+06
10	1.17700E+06	1.68000E+05	2.44600E+05	2.27600E+05	2.48900E+06	6.27890E+06
11	6.46130E+05	1.31100E+05	1.59900E+05	1.25500E+05	2.48900E+06	6.27890E+06
12	2.00900E+05	1.68000E+05	1.04100E+05	1.34000E+05	2.48900E+06	6.27890E+06
13	1.21500E+05	7.22000E+04	5.97500E+04	7.41500E+04	2.48900E+06	6.27890E+06
14	6.03470E+04	3.56400E+04	4.21360E+04	4.27600E+04	2.48900E+06	6.27890E+06
15	2.40100E+04	2.39160E+04	1.69400E+04	4.27600E+04	2.48900E+06	6.27890E+06
16	1.17920E+04	5.12500E+03	9.06600E+03	5.38930E+04	2.48900E+06	6.27890E+06
17	7.29000E+03	1.87400E+03	4.70000E+02	2.72010E+06	2.48900E+06	6.27890E+06
18	2.44700E+03	1.47500E+03	1.80100E+01	4.37070E+05	2.48900E+06	6.27890E+06
19	6.64300E+03	1.46900E+03	4.78000E+05	1.88000E+06	2.48900E+06	6.27890E+06
20	1.52110E+04	2.65470E+07	3.02600E+07	2.83910E+07	2.48900E+06	6.27890E+06
21	2.44700E+03	1.47500E+03	1.80100E+01	4.37070E+05	2.48900E+06	6.27890E+06
22	6.64300E+03	1.46900E+03	4.78000E+05	1.88000E+06	2.48900E+06	6.27890E+06
23	1.52110E+04	2.65470E+07	3.02600E+07	2.83910E+07	2.48900E+06	6.27890E+06
24	2.44700E+03	1.47500E+03	1.80100E+01	4.37070E+05	2.48900E+06	6.27890E+06
25	6.64300E+03	1.46900E+03	4.78000E+05	1.88000E+06	2.48900E+06	6.27890E+06
26	1.52110E+04	2.65470E+07	3.02600E+07	2.83910E+07	2.48900E+06	6.27890E+06
27	1.41940E+07	1.69900E+07	1.91810E+07	1.47400E+07	6.81120E+05	6.27890E+06
28	1.87200E+07	1.95100E+07	1.60000E+07	1.21130E+07	6.81120E+05	6.27890E+06
29	9.51650E+06	7.83530E+06	8.66100E+06	8.59210E+06	4.34420E+05	6.27890E+06
30	7.30320E+06	6.05900E+06	6.66600E+06	6.66600E+06	3.41300E+05	6.27890E+06
31	5.27400E+06	4.78000E+06	3.19230E+06	3.66600E+06	2.48900E+06	6.27890E+06
32	3.94000E+06	2.93300E+06	1.80750E+06	9.77650E+05	2.48900E+06	6.27890E+06
33	1.96750E+06	1.68000E+06	1.00750E+06	9.77650E+05	2.48900E+06	6.27890E+06
34	1.12120E+06	8.99500E+05	1.28200E+06	1.10270E+06	2.48900E+06	6.27890E+06
35	1.58320E+06	9.67400E+05	1.68900E+07	1.51190E+07	6.80950E+03	6.27890E+06
36	2.38590E+07	1.30900E+07				6.27890E+06

FB/BC0045 ACTIVE 1.0 CM FM, MULTIPLIER, 40 CM BLANKET

ENERGY GROUP	OXYGEN TRITIUM PRODUCTION FACTOR	AL TRITIUM PRODUCTION FACTOR	LI-6 TRITIUM PRODUCTION FACTOR	LI-7 TRITIUM PRODUCTION FACTOR	HYDRO TRITIUM PRODUCTION FACTOR	BE-9 TRITIUM PRODUCTION FACTOR
1	0.	5.30790E-03	2.12350E-02	2.94000E-01	0.	6.87810E-02
2	0.	5.64900E-06	2.91830E-02	2.74000E-01	0.	1.62000E-02
3	0.	1.23850E-06	2.91830E-02	3.67790E-01	0.	9.24610E-04
4	0.	0.	2.91830E-02	4.08140E-01	0.	0.
5	0.	0.	0.02000E-02	4.16000E-01	0.	0.
6	0.	0.	0.06150E-02	4.27200E-01	0.	0.
7	0.	0.	5.67100E-06	4.67030E-01	0.	0.
8	0.	0.	7.60040E-09	2.99910E-01	0.	0.
9	0.	0.	9.44140E-02	7.22240E-02	0.	0.
10	0.	0.	1.18120E-01	1.24000E-02	0.	0.
11	0.	0.	1.44870E-01	2.10770E-03	0.	0.
12	0.	0.	1.92330E-01	0.	0.	0.
13	0.	0.	2.30460E-01	0.	0.	0.
14	0.	0.	2.62040E-01	0.	0.	0.
15	0.	0.	2.83790E-01	0.	0.	0.
16	0.	0.	1.39900E+00	0.	0.	0.
17	0.	0.	9.07810E-01	0.	0.	0.
18	0.	0.	1.46350E+00	0.	0.	0.
19	0.	0.	5.11270E+00	0.	0.	0.
20	0.	0.	1.77910E+01	0.	0.	0.
21	0.	0.	4.23160E+01	0.	0.	0.
22	0.	0.	1.71350E+02	0.	0.	0.
23	0.	0.	5.07500E+02	0.	0.	0.
24	0.	0.	0.	0.	0.	0.
25	0.	0.	0.	0.	0.	0.
26	0.	0.	0.	0.	0.	0.
27	0.	0.	0.	0.	0.	0.
28	0.	0.	0.	0.	0.	0.
29	0.	0.	0.	0.	0.	0.
30	0.	0.	0.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.	0.
33	0.	0.	0.	0.	0.	0.
34	0.	0.	0.	0.	0.	0.
35	0.	0.	0.	0.	0.	0.
36	0.	0.	0.	0.	0.	0.

FB/BC0045 ACTIVE 1.0 CM FM, MULTIPLIER, 40 CM BLANKET

ENERGY GROUP	NI CAPTURE CROSS SECTION	CR CAPTURE CROSS SECTION	FE CAPTURE CROSS SECTION	HM CAPTURE CROSS SECTION	HELIUM CAPTURE CROSS SECTION	CARBON CAPTURE CROSS SECTION
1	4.3296E-01	1.40840E-01	1.00890E-01	8.58150E-02	0.	8.11420E-02
2	4.3297E-01	1.23140E-01	1.78190E-01	7.76310E-02	0.	7.4888E-02
3	4.3297E-01	1.02340E-01	1.68020E-01	6.04200E-02	0.	7.97590E-02
4	6.27270E-01	8.41490E-02	1.38000E-01	4.78000E-02	0.	1.24210E-01
5	6.24010E-01	6.88910E-02	1.18000E-01	4.11710E-02	0.	2.43200E-01
6	5.79650E-01	4.65000E-02	8.22500E-02	3.36100E-02	0.	1.09010E-01
7	4.87520E-01	2.57360E-02	5.78890E-02	2.46020E-02	0.	1.64940E-03
8	4.03880E-01	2.08020E-02	2.42500E-02	1.38210E-02	0.	0.
9	2.98670E-01	1.69190E-03	1.41620E-02	1.62640E-03	0.	0.
10	1.12160E-01	3.49720E-03	8.34870E-03	1.28300E-03	0.	0.
11	7.29440E-02	3.42100E-03	4.94150E-03	1.62240E-03	0.	0.
12	3.23160E-02	3.57510E-03	2.65040E-03	2.39610E-03	0.	0.
13	1.44810E-02	6.04200E-03	5.17890E-03	3.31580E-03	0.	0.
14	7.70790E-03	6.00430E-03	4.69060E-03	3.10210E-03	0.	0.
15	8.36190E-03	3.90790E-03	2.40430E-03	2.10780E-03	0.	0.
16	1.70030E-02	9.57300E-03	1.45780E-02	6.92900E-02	0.	1.24390E-07
17	5.20330E-02	4.81350E-02	1.01200E-01	3.26650E+00	0.	1.79950E-05
18	3.34410E-02	4.46300E-02	4.06450E-02	4.40000E-01	0.	6.46070E-05
19	8.72230E-02	5.98410E-02	1.76200E-01	4.18000E-01	0.	2.26040E-04
20	3.04130E-01	2.06930E-01	4.43500E-01	2.31360E+00	0.	5.89110E-04
21	7.92000E-01	5.37800E-01	1.38230E+00	7.18400E+00	0.	1.82990E-03
22	2.46700E+00	1.67300E+00				
23						

Figure 2. (Continued)

PB/BC0045 ACTIVE 1.0 CM PH, MULTIPLIER, 40 CM BLANKET						
ENERGY GROUP	HI FISSION CROSS SECTION	CR FISSION CROSS SECTION	FE FISSION CROSS SECTION	HM FISSION CROSS SECTION	HELIUM FISSION CROSS SECTION	CARBON FISSION CROSS SECTION
1	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.
22	0.	0.	0.	0.	0.	0.
23	0.	0.	0.	0.	0.	0.

PB/BC0045 ACTIVE 1.0 CM PH, MULTIPLIER, 40 CM BLANKET						
ENERGY GROUP	HI ABSORPTION CROSS SECTION	CR ABSORPTION CROSS SECTION	FE ABSORPTION CROSS SECTION	HM ABSORPTION CROSS SECTION	HELIUM ABSORPTION CROSS SECTION	CARBON ABSORPTION CROSS SECTION
1	4.3240E-01	1.4080E-01	1.80090E-01	8.58150E-02	0.	8.11420E-02
2	5.24970E-01	1.23140E-01	1.78160E-01	7.78310E-02	0.	5.40040E-02
3	5.24870E-01	1.02340E-01	1.60010E-01	6.01760E-02	0.	7.77500E-02
4	6.27270E-01	8.41490E-02	1.38830E-01	4.78280E-02	0.	2.24110E-01
5	8.74680E-01	6.88510E-02	1.18830E-01	4.11710E-02	0.	2.24110E-01
6	7.74500E-01	4.69290E-02	8.92500E-02	3.36100E-02	0.	1.64940E-01
7	5.07420E-01	2.57360E-02	4.78090E-02	2.46020E-02	0.	0.
8	4.03880E-01	1.29650E-02	2.45510E-02	1.24650E-02	0.	0.
9	3.98470E-01	7.86700E-03	1.2730E-02	6.2440E-03	0.	0.
10	3.12160E-01	4.6190E-03	1.41650E-02	1.8390E-03	0.	0.
11	1.30430E-01	3.49720E-03	8.34870E-03	1.2480E-03	0.	0.
12	7.29440E-02	3.42120E-03	4.54150E-03	1.0240E-03	0.	0.
13	3.23160E-02	2.57510E-03	0.55060E-03	4.610E-04	0.	0.
14	1.44010E-02	6.6238E-04	1.7890E-03	3.1500E-03	0.	0.
15	7.70790E-03	6.00430E-03	4.69060E-03	5.10210E-03	0.	0.
16	8.36190E-03	3.90750E-03	2.40430E-03	0.00040E-02	0.	1.24390E-07
17	1.70030E-02	5.57300E-03	7.14780E-03	6.9290E-02	0.	1.79950E-05
18	5.26330E-02	4.83260E-02	1.45780E-02	6.9290E-02	0.	6.46070E-05
19	3.34410E-02	4.46300E-02	1.01280E-01	2.6650E+00	0.	2.6640E-04
20	8.72230E-02	4.98410E-02	4.86450E-02	5.0000E-01	0.	1.89110E-04
21	1.04130E-01	2.06930E-01	7.0200E-01	2.31360E+00	0.	1.82950E-03
22	7.92000E-01	5.37800E-01	4.7560E-01	7.10480E+00	0.	0.
23	2.46700E+00	6.7300E+00	1.38230E+00	0.	0.	0.

PB/BC0045 ACTIVE 1.0 CM PH, MULTIPLIER, 40 CM BLANKET					
ENERGY GROUP	HM NEUTRON HEATING	HM /TOTAL NEUTRON FRACTION	CARBON NEUTRON HEATING	CARBON/TOTAL NEUTRON FRACTION	OXYGEN NEUTRON HEATING
1	2.2371E-01	2.7785E-02	4.4749E-02	5.5579E-03	0.
2	5.1782E-01	5.3191E-02	4.1324E-02	4.5446E-03	0.
3	5.1293E-01	5.0788E-02	3.8243E-02	4.5107E-03	0.
4	7.10057E-01	1.2464E-02	3.6833E-02	4.4838E-03	0.
5	8.09158E-01	4.7724E-02	4.34009E-02	0.	0.
6	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	0.
17	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.
22	0.	0.	0.	0.	0.
23	0.	0.	0.	0.	0.
24	0.	0.	0.	0.	0.
25	0.	0.	0.	0.	0.
26	0.	0.	0.	0.	0.
27	0.	0.	0.	0.	0.
28	0.	0.	0.	0.	0.
29	0.	0.	0.	0.	0.
30	0.	0.	0.	0.	0.
31	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.
33	0.	0.	0.	0.	0.
34	0.	0.	0.	0.	0.
35	0.	0.	0.	0.	0.
36	0.	0.	0.	0.	0.
37	0.	0.	0.	0.	0.
38	0.	0.	0.	0.	0.
39	0.	0.	0.	0.	0.
40	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.
43	0.	0.	0.	0.	0.
44	0.	0.	0.	0.	0.
45	0.	0.	0.	0.	0.
46	0.	0.	0.	0.	0.
47	0.	0.	0.	0.	0.
48	0.	0.	0.	0.	0.
49	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.
51	0.	0.	0.	0.	0.
52	0.	0.	0.	0.	0.
53	0.	0.	0.	0.	0.
54	0.	0.	0.	0.	0.
55	0.	0.	0.	0.	0.

Figure 2. (Continued)

INTERVAL	DISTANCE	TOTAL HEATING	NEUTRON HEATING	BROWN HEATING	TOTAL HEATING	PISTON RATE	CAPTURE RATE
1	1.00000E-01	1.93294E+01	8.09147E+00	1.18779E+01	1.18779E+01	0.	1.00000E+13
2	3.00000E-01	1.18779E+01	5.15610E+00	1.10394E+01	1.10394E+01	0.	1.18779E+13
3	5.00000E-01	1.00000E+01	4.71610E+00	1.07610E+01	1.07610E+01	0.	1.00000E+13
4	7.00000E-01	1.00000E+01	4.71610E+00	1.07610E+01	1.07610E+01	0.	1.00000E+13
5	9.00000E-01	1.17329E+01	4.01700E+00	9.11200E+00	9.11200E+00	0.	1.00000E+13
6	1.00000E+00	1.07610E+01	3.91301E+00	1.16194E+01	1.16194E+01	0.	1.07610E+13
7	1.20000E+00	9.11200E+00	3.07610E+00	1.07610E+01	1.07610E+01	0.	1.07610E+13
8	1.40000E+00	7.16100E+00	2.71610E+00	9.11200E+00	9.11200E+00	0.	1.07610E+13
9	1.60000E+00	5.15610E+00	2.47610E+00	8.09147E+00	8.09147E+00	0.	1.07610E+13
10	1.80000E+00	3.70000E+00	2.27610E+00	7.16100E+00	7.16100E+00	0.	1.07610E+13
11	2.00000E+00	2.71610E+00	2.07610E+00	6.25000E+00	6.25000E+00	0.	1.07610E+13
12	2.20000E+00	2.07610E+00	1.87610E+00	5.15610E+00	5.15610E+00	0.	1.07610E+13
13	2.40000E+00	1.61000E+00	1.67610E+00	4.01700E+00	4.01700E+00	0.	1.07610E+13
14	2.60000E+00	1.20000E+00	1.47610E+00	2.71610E+00	2.71610E+00	0.	1.07610E+13
15	2.80000E+00	9.11200E+00	1.27610E+00	1.61000E+00	1.61000E+00	0.	1.07610E+13
16	3.00000E+00	7.16100E+00	1.07610E+00	1.07610E+00	1.07610E+00	0.	1.07610E+13
17	3.20000E+00	5.15610E+00	8.09147E+00	8.09147E+00	8.09147E+00	0.	1.07610E+13
18	3.40000E+00	4.01700E+00	6.25000E+00	6.25000E+00	6.25000E+00	0.	1.07610E+13
19	3.60000E+00	3.07610E+00	5.15610E+00	5.15610E+00	5.15610E+00	0.	1.07610E+13
20	3.80000E+00	2.27610E+00	4.01700E+00	4.01700E+00	4.01700E+00	0.	1.07610E+13
21	4.00000E+00	1.61000E+00	2.71610E+00	2.71610E+00	2.71610E+00	0.	1.07610E+13
22	4.20000E+00	1.07610E+00	1.61000E+00	1.61000E+00	1.61000E+00	0.	1.07610E+13
23	4.40000E+00	8.09147E+00	1.27610E+00	1.27610E+00	1.27610E+00	0.	1.07610E+13
24	4.60000E+00	6.25000E+00	1.07610E+00	1.07610E+00	1.07610E+00	0.	1.07610E+13
25	4.80000E+00	5.15610E+00	8.09147E+00	8.09147E+00	8.09147E+00	0.	1.07610E+13
26	5.00000E+00	4.01700E+00	6.25000E+00	6.25000E+00	6.25000E+00	0.	1.07610E+13
27	5.20000E+00	3.07610E+00	5.15610E+00	5.15610E+00	5.15610E+00	0.	1.07610E+13
28	5.40000E+00	2.27610E+00	4.01700E+00	4.01700E+00	4.01700E+00	0.	1.07610E+13
29	5.60000E+00	1.61000E+00	2.71610E+00	2.71610E+00	2.71610E+00	0.	1.07610E+13
30	5.80000E+00	1.07610E+00	1.61000E+00	1.61000E+00	1.61000E+00	0.	1.07610E+13
31	6.00000E+00	8.09147E+00	1.27610E+00	1.27610E+00	1.27610E+00	0.	1.07610E+13
32	6.20000E+00	6.25000E+00	1.07610E+00	1.07610E+00	1.07610E+00	0.	1.07610E+13
33	6.40000E+00	5.15610E+00	8.09147E+00	8.09147E+00	8.09147E+00	0.	1.07610E+13
34	6.60000E+00	4.01700E+00	6.25000E+00	6.25000E+00	6.25000E+00	0.	1.07610E+13
35	6.80000E+00	3.07610E+00	5.15610E+00	5.15610E+00	5.15610E+00	0.	1.07610E+13
36	7.00000E+00	2					

INTERVAL	X	TRITIUM BREEDING RATE	INTEGRATED TRITIUM BREEDING	ADDITION RATE	FINAL REACTION RATE
1	1.00000E+01	1.41672E-03	4.07394E-04	1.00000E+13	0.
2	1.00000E+01	1.41672E-03	8.14788E-04	1.03120E+13	0.
3	1.00000E+01	1.41672E-03	1.22218E-03	1.06240E+13	0.
4	1.00000E+01	1.06794E-03	1.79402E-03	1.09360E+13	0.
5	1.00000E+01	9.74999E-04	2.41837E-03	1.12480E+13	0.
6	1.00000E+01	1.33231E-02	3.18067E-03	1.15600E+13	0.
7	1.00000E+01	1.06794E-03	3.95251E-03	1.18720E+13	0.
8	1.00000E+01	9.74999E-04	4.72435E-03	1.21840E+13	0.
9	1.00000E+01	1.06794E-03	5.49619E-03	1.24960E+13	0.
10	1.00000E+01	9.74999E-04	6.26803E-03	1.28080E+13	0.
11	1.00000E+01	6.92779E-03	7.03987E-03	1.31200E+13	0.
12	1.00000E+01	6.02214E-03	7.81171E-03	1.34320E+13	0.
13	1.00000E+01	4.62214E-03	8.58355E-03	1.37440E+13	0.
14	1.00000E+01	4.08570E-03	9.35539E-03	1.40560E+13	0.
15	1.00000E+01	3.63231E-03	1.01272E-02	1.43680E+13	0.
16	1.00000E+01	1.33231E-02	1.09006E-02	1.46800E+13	0.
17	1.00000E+01	2.85231E-03	1.16739E-02	1.49920E+13	0.
18	1.00000E+01	2.27231E-03	1.24473E-02	1.53040E+13	0.
19	1.00000E+01	1.92000E-01	1.32207E-02	1.56160E+13	0.
20	1.00000E+01	1.67614E-01	1.39941E-02	1.59280E+13	0.
21	1.00000E+01	1.43228E-01	1.47675E-02	1.62400E+13	0.
22	1.00000E+01	1.35813E-01	1.55409E-02	1.65520E+13	0.
23	1.00000E+01	1.24993E-01	1.63143E-02	1.68640E+13	0.
24	1.00000E+01	1.19349E-01	1.70877E-02	1.71760E+13	0.
25	1.00000E+01	1.00000E-01	1.78611E-02	1.74880E+13	0.
26	1.00000E+01	1.01995E-01	1.86345E-02	1.78000E+13	0.
27	1.00666E+00	9.63201E-02	1.94079E-02	1.81120E+13	0.
28	9.33333E+00	9.13346E-02	2.01813E-02	1.84240E+13	0.
29	8.60000E+00	8.60000E-02	2.09547E-02	1.87360E+13	0.
30	8.06667E+00	8.06667E-02	2.17281E-02	1.90480E+13	0.
31	1.01333E+01	7.59127E-02	2.25015E-02	1.93600E+13	0.
32	1.04000E+01	7.58730E-02	2.32749E-02	1.96720E+13	0.
33	1.06667E+01	7.20110E-02	2.40483E-02	1.99840E+13	0.
34	1.09333E+01	6.30817E-02	2.48217E-02	2.02960E+13	0.
35	1.12000E+01	6.73395E-02	2.55951E-02	2.06080E+13	0.
36	1.14667E+01	6.49216E-02	2.63685E-02	2.09200E+13	0.
37	1.17333E+01	6.24676E-02	2.71419E-02	2.12320E+13	0.
38	1.20000E+01	6.05180E-02	2.79153E-02	2.15440E+13	0.
39	1.22667E+01	5.85620E-02	2.86887E-02	2.18560E+13	0.
40	1.25333E+01	5.66033E-02	2.94621E-02	2.21680E+13	0.
41	1.28000E+01	5.46493E-02	3.02355E-02	2.24800E+13	0.
42	1.30667E+01	5.31949E-02	3.10089E-02	2.27920E+13	0.
43	1.33333E+01	5.16909E-02	3.17823E-02	2.31040E+13	0.
44	1.36000E+01	5.01869E-02	3.25557E-02	2.34160E+13	0.
45	1.38667E+01	4.86734E-02	3.33291E-02	2.37280E+13	0.
46	1.41333E+01	4.73112E-02	3.41025E-02	2.40400E+13	0.
47	1.44000E+01	4.60116E-02	3.48759E-02	2.43520E+13	0.
48	1.46667E+01	4.47700E-02	3.56493E-02	2.46640E+13	0.
49	1.49333E+01	4.35820E-02	3.64227E-02	2.49760E+13	0.

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FB/BC0045 ACTIVE 1.0 CM FH, MULTIPLIER, 40 CM BLANKET

ZONE NUMBER	ZONE VOLUME	TOTAL HEATING	NEUTRON HEATING	GAMMA HEATING	TRITIUM BREEDING	TOTAL FISSIONS	TOTAL CAPTURES
2	1.00000E+00	1.75990E+01	6.97465E+00	1.06252E+01	1.10337E-03	0.	1.03006E+13
3	5.00000E+00	3.65625E+01	3.01600E+01	6.39371E+00	3.63345E-02	0.	3.51959E+12
4	4.00000E+01	9.57640E+01	7.40824E+01	2.16824E+01	1.41212E+00	0.	6.44687E+13

FB/BC0045 ACTIVE 1.0 CM FH, MULTIPLIER, 40 CM BLANKET

ZONE NUMBER	ZONE VOLUME	TOTAL ABSORPTION REACTIONS/SEC	TOTAL FISSION REACTIONS/SEC
2	1.00000E+00	1.03886E+13	0.
3	5.00000E+00	3.51959E+12	0.
4	4.00000E+01	6.44687E+13	0.

FB/BC0045 ACTIVE 1.0 CM FH, MULTIPLIER, 40 CM BLANKET

INTEGRATED TRITIUM BREEDING DATA

ISOTOPE	INTEGRATED TRITIUM BREEDING	FRACTION
CR	1.95742E-04	1.35020E-04
FE	9.87633E-04	6.01257E-04
AL	2.81904E-04	1.94507E-04
LI-6	1.34547E+00	9.20143E-01
LI-7	6.63652E-02	4.57806E-02
BE-9	3.63345E-02	2.50659E-02

FB/BC0045 ACTIVE 1.0 CM FH, MULTIPLIER, 40 CM BLANKET

INTEGRATED FISSION AND CAPTURE RATES PER SOURCE NEUTRON

ISOTOPE	FISSIONS PER SOURCE NEUTRON	FRACTION OF FISSIONS	FRACTION OF TOTAL REACTIONS	CAPTURES PER SOURCE NEUTRON	FRACTION OF CAPTURES	FRACTION OF TOTAL REACTIONS
TOTAL	0.	1.00000E+00	0.	1.76477E+00	1.00000E+00	1.00000E+00
NI	0.	0.	0.	3.2111E-02	1.8207E-02	1.0207E-02
CR	0.	0.	0.	1.8442E-01	1.0456E-01	5.928E-02
FE	0.	0.	0.	2.4424E-02	1.3851E-02	7.851E-03
MM	0.	0.	0.	0.0000E+00	0.0000E+00	0.0000E+00
HELIUM	0.	0.	0.	0.0000E+00	0.0000E+00	0.0000E+00
OXYGEN	0.	0.	0.	4.7077E-02	2.6707E-02	1.5127E-02
AL	0.	0.	0.	1.2442E+00	7.0511E-01	3.9677E-01
LI-6	0.	0.	0.	1.2442E+00	7.0511E-01	3.9677E-01
LI-7	0.	0.	0.	7.4542E-02	4.2242E-02	2.3942E-02
BE-9	0.	0.	0.	2.4424E-02	1.3851E-02	7.851E-03
SI	0.	0.	0.	2.4424E-02	1.3851E-02	7.851E-03
MO	0.	0.	0.	2.4424E-02	1.3851E-02	7.851E-03

FB/BC0045 ACTIVE 1.0 CM FH, MULTIPLIER, 40 CM BLANKET

ISOTOPE	ABSORPTION REACTIONS/SEC	FISSION REACTIONS/SEC
TOTAL	7.83769E+13	0.
NI	1.71329E+12	0.
CR	1.46037E+13	0.
FE	4.87399E+12	0.
MM	1.06775E+12	0.
HELIUM	0.	0.
CARBON	3.50652E+09	0.
OXYGEN	2.81904E+12	0.
AL	3.12305E+12	0.
LI-6	5.96071E+13	0.
LI-7	6.47531E+10	0.
HYDRO	0.	0.
BE-9	3.51959E+12	0.
SI	9.84701E+10	0.
MO	1.17113E+12	0.

Figure 2. (Continued)

PS-DC0045 ACTIVE 1.0 CM PM, MULTIPLIER, 40 CM BLANKET
VOLUME INTEGRATED FLUXES BY ZONE

GROUP	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
1	2.3300E+16	9.3217E+13	1.7980E+14	7.5083E+13	1.3927E+11
2	5.4767E+15	1.1313E+14	6.2119E+13	2.5111E+13	1.5609E+11
3	6.1230E+15	3.1113E+13	1.1727E+13	1.4780E+13	1.9124E+11
4	7.8309E+15	3.9997E+13	1.3056E+13	1.2962E+13	1.2994E+11
5	8.2240E+15	4.1291E+13	1.8194E+13	1.7793E+13	9.5900E+10
6	1.5102E+15	7.8460E+12	1.2801E+13	2.0004E+13	7.1397E+11
7	1.2058E+15	7.8460E+12	1.2801E+13	2.0004E+13	8.4423E+11
8	1.4652E+15	6.4541E+12	1.2801E+13	2.0004E+13	4.0821E+11
9	1.4651E+15	6.4541E+12	1.2801E+13	2.0004E+13	4.3873E+11
10	1.4651E+15	6.4541E+12	1.2801E+13	2.0004E+13	2.8629E+11
11	1.4651E+15	6.4541E+12	1.2801E+13	2.0004E+13	1.1118E+11
12	1.7931E+15	8.7617E+12	3.4439E+13	7.5044E+13	8.4272E+11
13	2.2053E+15	1.0790E+13	4.2407E+13	6.1373E+13	8.0956E+11
14	8.8415E+15	4.3310E+13	1.6061E+14	2.0496E+14	3.6160E+12
15	8.2611E+15	4.3310E+13	1.6061E+14	2.0496E+14	3.6084E+12
16	1.6070E+16	7.2884E+13	3.1579E+14	3.6117E+14	5.0049E+12
17	2.1665E+16	1.0811E+14	6.8711E+14	1.0890E+15	1.4879E+13
18	2.2953E+16	1.1494E+14	5.5529E+14	1.4781E+15	3.7289E+13
19	1.7030E+16	9.0139E+13	6.4219E+14	1.0033E+15	4.5609E+13
20	1.4782E+16	7.4471E+13	3.4813E+14	4.0400E+14	4.3472E+13
21	1.1500E+16	5.8058E+13	2.4950E+14	8.7261E+13	3.5904E+13
22	4.2640E+15	2.1841E+13	9.8154E+13	1.1070E+14	1.6961E+13
23	1.2510E+16	2.7579E+13	1.1880E+14	4.1605E+13	6.3891E+13
24	6.3123E+11	5.7041E+09	1.4963E+10	4.7903E+10	7.8433E+09
25	7.2627E+14	3.3544E+12	1.1640E+13	1.4761E+13	4.4063E+11
26	1.2578E+15	6.1626E+12	2.1814E+13	3.1003E+13	9.0966E+11
27	9.5478E+14	4.6480E+12	1.0890E+13	1.9628E+13	1.0813E+12
28	9.4676E+14	4.4026E+12	1.8493E+13	2.4412E+13	8.1587E+11
29	1.1900E+15	5.5816E+12	2.6053E+13	3.2413E+13	1.5826E+12
30	2.2510E+15	1.0496E+13	7.8918E+13	6.3922E+13	1.1732E+12
31	1.2510E+15	1.0496E+13	7.8918E+13	6.3922E+13	1.1732E+12
32	7.1827E+15	3.9114E+13	1.0265E+14	8.5530E+14	1.6509E+12
33	1.2961E+16	6.0021E+13	1.2891E+14	3.0674E+14	4.5294E+12
34	9.5903E+15	4.5862E+13	1.0536E+14	3.0737E+14	6.6504E+12
35	6.7331E+15	3.0450E+13	6.1131E+13	4.7915E+14	1.1830E+13
36	9.8057E+12	1.7664E+11	7.8376E+13	2.4062E+13	3.8823E+12

(N) NEUTRON SPECTRUM FOR ZONE 25

ENERGY GROUP	UPPER ENERGY (eV)	LOWER ENERGY (eV)	GROUP MIDPOINT (eV)	FLUX	NORMALIZED FLUX PER EV
1	1.4910E+07	1.3490E+07	1.4200E+07	9.3217E+13	7.2470E-09
2	1.3490E+07	1.2214E+07	1.2852E+07	1.1331E+13	8.8400E-09
3	1.2214E+07	1.1825E+07	1.2019E+07	3.1113E+13	2.4192E-09
4	1.1825E+07	1.0000E+07	1.0912E+07	3.9997E+13	4.8572E-09
5	1.0000E+07	9.0490E+06	9.5245E+06	4.1291E+13	5.0470E-09
6	9.0490E+06	7.4852E+06	8.2671E+06	7.8460E+12	9.5900E-09
7	7.4852E+06	6.0530E+06	6.7691E+06	6.4541E+12	7.9139E-09
8	6.0530E+06	4.4590E+06	5.2560E+06	6.4541E+12	7.9139E-09
9	4.4590E+06	4.0657E+06	4.2623E+06	6.8200E+12	9.1779E-09
10	4.0657E+06	3.3570E+06	3.7113E+06	6.8200E+12	8.0956E-09
11	3.3570E+06	2.7579E+06	3.0574E+06	8.7617E+12	1.0825E-08
12	2.7579E+06	2.2130E+06	2.4854E+06	8.7617E+12	2.1458E-08
13	2.2130E+06	1.8260E+06	2.0195E+06	1.0790E+13	3.2297E-08
14	1.8260E+06	1.0000E+06	1.4140E+06	4.3310E+13	6.3904E-08
15	1.0000E+06	5.5816E+05	7.7918E+05	4.3310E+13	1.0760E-07
16	5.5816E+05	2.6053E+05	4.0934E+05	7.2884E+13	2.7708E-07
17	2.6053E+05	4.0960E+04	1.2644E+05	1.0811E+14	8.0964E-07
18	4.0960E+04	3.3544E+03	2.2111E+04	1.1494E+14	3.7014E-06
19	3.3544E+03	2.7579E+02	1.8119E+03	9.0139E+13	3.9419E-06
20	2.7579E+02	5.7041E+01	1.6890E+02	7.4471E+13	3.2643E-06
21	5.7041E+01	1.8540E+00	1.2292E+01	5.8058E+13	3.3857E-03
22	1.8540E+00	4.1400E-01	1.1347E+00	2.1841E+13	1.8340E-02
23	4.1400E-01	1.0000E-04	2.0705E-01	2.0705E+13	6.6474E-02

(G) GAMMA SPECTRUM FOR ZONE 25

ENERGY GROUP	UPPER ENERGY (eV)	LOWER ENERGY (eV)	GROUP MIDPOINT (eV)	FLUX	NORMALIZED FLUX PER EV
1	1.4000E+07	1.2000E+07	1.3000E+07	2.7841E+09	6.1450E-12
2	1.2000E+07	8.0000E+06	1.0000E+07	3.3947E+13	2.8119E-09
3	8.0000E+06	7.0000E+06	7.5000E+06	2.1626E+13	2.8012E-09
4	7.0000E+06	6.0000E+06	6.5000E+06	4.9450E+13	2.8643E-09
5	6.0000E+06	5.0000E+06	5.5000E+06	4.4869E+13	2.8031E-09
6	5.0000E+06	4.0000E+06	4.5000E+06	5.5016E+13	2.7191E-09
7	4.0000E+06	3.0000E+06	3.5000E+06	1.0492E+13	2.7132E-09
8	3.0000E+06	2.0000E+06	2.5000E+06	1.6024E+13	7.2038E-09
9	2.0000E+06	1.0000E+06	1.5000E+06	3.2916E+13	1.4940E-07
10	1.0000E+06	4.0000E+05	7.0000E+05	6.8821E+13	4.9471E-07
11	4.0000E+05	2.0000E+05	3.0000E+05	9.5852E+13	1.0423E-06
12	2.0000E+05	1.0000E+05	1.5000E+05	3.0450E+13	1.3841E-06
13	1.0000E+05	1.0000E+04	5.5000E+04	1.7664E+11	8.9213E-09

Figure 2. (Continued)

Figure 3. Heating rate plot for the ACTIVE sample problem.

Figure 4. Plots of isotopic contributions to neutron heating rate for the sample problem.

Figure 5. Plots of isotopic contributions to gamma heating rate for the sample problem.

Figure 6. Plot of the tritium breeding rate for the sample problem.

Figure 7. Plot of the volume-integrated tritium breeding rate for the sample problem.

Figure 8. Plot of the total capture rate for the sample problem.

LI-6 Capture Rate

Figure 9. Plot of the lithium-6 capture rate for the sample problem.

Neutron spectrum for zone 2

Figure 10. Histogram plot of the neutron spectrum for zone 2 of the sample problem.

Gamma spectrum for zone 2

Figure 11. Histogram plot of the gamma spectrum for zone 2 of the sample problem.

Neutron spectrum for zone 2

Figure 12. Smooth curve plot of the neutron spectrum for zone 2 of the sample problem.

APPENDIX A

FIDO Input

A.1 Fixed Form Format

Each card is divided into six 12-digit data fields which are in turn divided into 3 subfields as shown in Figure A-1. The first subfield is a two-digit integer; the second subfield contains either a \$, *, R, I, T, S, J, W, F, A, E, Z, Q, L, N, M, U V, +, -, or a blank. The third subfield contains either a fixed or floating point number. The contents of the first two subfields will define the operation to be performed on the third field.

(6 (I2, A1, F9.0))

Figure A-1

Blank fields are ignored. One can use any or all fields on a card. For example, a box of blank cards sandwiched anywhere in a data array would be completely ignored.

Each data array is identified by a two-digit integer in a first subfield. There are both fixed and floating point arrays; a fixed point array is designated by a \$ in the second subfield, a floating point array by an *.

The second subfield contains an operator which specifies the type of operation to be performed on the data. The possible operators are listed in Section A.2.

A.2 Array Operators

- \$ indicates the beginning of an integer array. The first subfield contains a one-or two-digit number identifying the array (in free form use \$\$).
- * indicates the beginning of a floating point array. The first subfield identifies the array (in free form use **).
- R indicates that the entry in the third subfield is to be repeated the number of times specified in the first subfield (in free form e.g., 6R2.0 gives 2.0 2.0 2.0 2.0 2.0 2.0).
- J indicates that the entries for the array begin on the next card and appear in 10A6 format.
- I indicates linear interpolation between the entry in the third subfield and the entry in the third subfield of the next data field. The number in the first subfield gives the number of points to be placed equally spaced in the specified range (in free form, e.g., 4I1 6 gives 1 2 3 4 5 6).
- T indicates termination of data reading for a block. A block can contain any number of arrays. Data on a card after a T will be ignored.
- S indicates skip. The first subfield defines the number of entries to be skipped. The third field can contain the first entry following the skips. A blank third subfield would be ignored (in free form, e.g., 9\$\$ 1 2 3 5S 9 10 indicates that five entries in the ten entry 9\$\$ array were skipped).

- F is used to fill the remainder of an array with the item given in the third subfield (in free form F8 fills the array with 8's).
- A is used to address a particular location in an array. This location is specified in the third subfield: the first subfield is blank (in free form, e. g., 4\$\$ A6 12 implies that entry 6 in the 4\$\$ array is replaced by 12 and all other entries are left to default values).
- E may be used to end specifying data for an array. This option is particularly useful when it is desired to replace only some items in particular array. The items in question are replaced, and the use of an E prevents having to count and skip to the end of the array (in free form, e. g., 1\$\$ 1 2 3 4 E implies that after 4 the rest of the array is left to default values).
- Z indicates that a zero is repeated the number of times specified in the first subfield (in free form, e.g., 60** 100Z indicates that zero is repeated 100 times in the 60** array).
- Q is used to repeat sequences of numbers. The length of the sequence is defined in the third subfield. The number of times to repeat the sequence is given in the first subfield (in free form, e. g., 11\$\$ 1 64 7 6 7 6 7 6 7 6 4 can be written 11\$\$ 1 64 7 6 3Q2 4).
- L is similar to I except that a logarithmic interpolation is performed between the entry points. This option is particularly useful for defining energy structures equally spaced in lethargy.
- N is used to repeat a sequence of numbers in reverse order. The length of the sequence is defined in the third subfield (in free form, e.g., 6** 1.0 2.0 3.0 3.0 2.0 1.0 can be written 6** 1.0 2.0 3.0 3N).

M is used to negate and repeat an inverted sequence. The length of the sequence is given in the third subfield (in free form, e. g., 7\$\$ 1.0 2.0 3.0 -3.0 -2.0 -1.0 can be written 7\$\$\$ 1.0 2.0 3.0 3M).

W indicates that the entries for the array begin on the next card and appear in 7A10 format.

U is used to replace the ANISN input format for an array. The array number is given in the first subfield. The format, written in normal FORTRAN, is specified on the card immediately following the card containing a U. The parenthesis normally encapsulating a format should be included.

+ or - indicates exponentiation. The + may be either a 12 punch or a 12-8-6 punch. The data in the third file is multiplied by 10^{+N} , where N is an integer in the first subfield. This option allows one to specify a number in up to nine significant digits.

Integer data in the third subfield must be right adjusted. Floating point data may be written with or without an exponent. If the decimal is omitted, it is assumed to be immediately to the left of the exponent field. If there is no exponent, the decimal point is assumed to be to the extreme right of the nine column subfield.

A.3 Input Restrictions

The following restrictions must be observed when using the FIDO input format:

- (1) Blank data fields are ignored.
- (2) If the interpolation option (I) is used, the next data field may not be either blank or an A entry.

- (3) The third subfield of a data field containing a \$ or an * may contain an integer, N. The next data entry is assumed to be the (N+1)th member of the array. Normally the third subfield is blank and is ignored.
- (4) All data arrays must be filled with the correct number of entries. A data array is ended by either starting a new data array or by ending a data block.

A.4 Free Form Format

The transferral of input data to input forms or punched cards for a code requiring significant amounts of input is always a time consuming, distasteful and error-prone process. The original ANISN formats were designed to help reduce these difficulties. The options are convenience features. The usefulness of the "F" option which fills an array is obvious, but it is somewhat harder to see the practical uses for some of the more obscure ones like N, M, and Q; however, frequent use will turn up situations where these options are invaluable. For example, the S_n cosines are negated and reflected about 90° , a fact which suggests the use of the M option.

There are justifiable complaints with the input formats; one being that data, where convenience options are not applicable, can be hard to write because of the manner in which the data fields are spread on the card. This is especially true of integer arrays, where the data are right adjusted in 12-column fields. The FIDO input forms help to some extent, but the actual keypunching is still troublesome for the layman.

The awkwardness of the input format described in the preceeding paragraph has been eliminated by Ward Engle who has designed and im-

implemented an all-FORTRAN free-form FIDO input scheme which has data items separated by blanks (as others do), but still allows all of the important convenience features of the earlier formats. The restrictions on the use of this input are essentially that the user write the data in a form that he can interpret within the context of the FIDO options. Data is easily written and keypunched, since there is no worry about which type character falls in which column or how many blanks are left between entries.

The free-form input can be interspersed with the fixed form input. To select free-form, an array is identified as either a \$\$ or an ** array, for integer and floating point arrays, respectively.

The restrictions are:

- (1) Any third subfield (data entry) must be followed by one or more blanks. This is an obvious restriction, otherwise data interpretation would be impossible.
- (2) Only columns 1-72 are used.
- (3) Numbers with exponents must not have imbedded blanks; e.g., use 1.0E+4, not 1. E+4 or 1.0E + 04.
- (4) The old + or - options (2nd subfield) are not operational. Significance requirements which led to the development of this option can be had directly.
- (5) Never enter more than 9 digits in a number. The exponent is not counted; e.g., 9234+09, 923400000 + 1 will work, 9234000000 will not work.
- (6) Do not use a blank between items which fall in the first and second subfields with the old format, e.g., 24R, not 24 R. Note that the 99 restriction on the number of repeats, interpolations, etc., has been eliminated.

- (7) The Z-entry must be entered as 738Z, not Z 738. The old format allowed either.
- (8) The Q, M, N entries must be specified as Q4, not 4Q. The old format allows either. An entry like 3Q4 accomplishes the same as Q4 Q4 Q4. This is now true for either format.

Any character other than the digits 0 through 9, +, -, ., A, C, E, F, N, M, O, Q, T, or blank in column 1 of a card will cause the contents of the card to be listed as comments, while the data is read in. Column 2 should contain the proper carriage control character, e.g., blank, 0, 1, 2, etc. This card is ignored as a data card. This option is also available with the old formats.

Some examples of the new format are given below:

```
1$$_25R1_0_4_3Q3_2$$_3R42_E_T_
```

The first 25 entries of the 1\$ array are 1's followed by 0 and 4 and then the sequence 1 0 4 is repeated three times. The 2\$ array has three 42's and then data input to the array ends. The T terminates a data block,

```
42**_0.0_0.1666667_0.3333333_N2
```

```
43**_-1.0_-0.8819171_-0.3333333_M2
```

This example puts 0.0, 0.1666667, 0.3333333, 0.3333333, 0.1666667 in the 42* array and -1.0, -0.8819171, -0.3333333, 0.3333333, 0.8819171 in the 43* array.

APPENDIX B

ACTIVE LIBRARIES

ACTIVE calculations can use up to three libraries at a time, the kerma and tritium production factor library, the absorption and fission cross section library, and the reaction cross section library. These libraries are all in card image and their formats are given in Table B-1, B-2 and B-3. Table B-4 lists the ACTIVE libraries available that correspond to existing ANISN libraries.

The library ID numbers do not have to be in numerical order in the ACTIVE input. ACTIVE searches the input ID's to see if a library material is required. If ACTIVE does not find an input ID on the library, all data for that ID are set to zero in the ACTIVE problem.

ACTIVE libraries containing reaction cross sections must be generated from one source; usually MACKLIB-IV using the MACKR code. These libraries will probably be problem dependent as far as the reactions desired are concerned.

The capture cross sections used by ACTIVE are calculated in ACTIVE by subtracting the fission cross section from the absorption cross section.

TABLE B-1. FORMAT OF THE ACTIVE LIBRARY CONTAINING KERMA AND TRITIUM PRODUCTION FACTORS

The following cards are present for each material on the library:

Card 1.	Material ID
format:	37X,I4
Card(s) 2.	Neutron Kerma Factors (NG^a Values)
format:	6E12.5
Card(s) 3.	Gamma Kerma Factors (NG^a Values)
format:	6E12.5
Card(s) 4.	Tritium Production Factors (NG^a Values)
format:	6E12.5

a. NG = number of neutron groups + number of gamma groups

TABLE B-2. FORMAT FOR THE ACTIVE LIBRARY CONTAINING ABSORPTION AND FISSION CROSS SECTIONS

The following cards are present for each material on the library:

Card 1.	Material ID
format:	I5
Card(s) 2.	Neutron Absorption Cross Sections (NNG^a Values)
format:	6E12.5
Card(s) 3.	Neutron Fission Cross Section (NNG^a Values)
format:	6E12.5

a. NNG = number of neutron groups

TABLE B-3. FORMAT FOR THE ACTIVE LIBRARY CONTAINING REACTION CROSS SECTIONS

The following cards are present for each material on the library:

Card 1. Material ID

format: I5

Card(s) 2. Neutron Reaction Cross Sections (NNG^a values)

format: 6E12.5

Card type two appears IXS^b times for each material.

a. NNG = number of neutron groups

b. IXS = number of neutron reaction types

TABLE B-4. AVAILABLE ACTIVE LIBRARIES

<u>ANISN Library</u>	<u>Neutron Groups</u>	<u>Gamma Groups</u>	<u>ACTIVE KERMA Library</u>	<u>ACTIVE Absorption and Fission Library</u>
EPR ^a	100	21	yes	yes
BUGLE ^b	45	16	yes	no
FLUNG ^c	35	21	yes	no
EGG ^d	23	13	yes	yes

a. DLC-37F

b. DLC-47

c. DLC-86

d. collapsed version of DLC-37F

APPENDIX C

DESCRIPTION OF THE DISSPLA PLOTTING PROCEDURE

A procedure is available on the CDC system that allows the user to divert plot information to various output devices such as microfilm, paper, or permanent file. This procedure processes DISSPLA generated data and is called DISPLAY. The procedure DISPLAY resides on the file JLJPROC, and is accessed using the following control cards:

```
ATTACH,JLJPROC,ID=JLJ,MR=1.
```

```
BEGIN,DISPLAY,JLJPROC,options.
```

User options for the procedure DISPLAY are given in Table C-1. Sample jobs using DISPLAY are shown in Figure C-1. This procedure can be used with absolute load modules or binaries.

TABLE C-1. PROCEDURE DISPLAY USER OPTIONS

BEGIN,DISPLAY,JLJPROC,UID=,PFN=,IABS=,IENV=,IDIS=,LGO=,I=

UID = User ID (default = JLJ)

PFN = Name for permanent file (default = PLFILE)

I = output form flag

-1, versatec plots (paper)
 0, permanent file only (default)
 1, permanent file and microfilm
 2, microfilm only
 3, no plot output

IABS = library flag

0, attach libraries needed (default)
 1, do not attach libraries

IENV = INEL environmental library flag

0, do not attach (default)
 1, attach the dynamic version (ENVRL176D,ID=RJW)
 2, attach the static version (ENVRL176S,ID=RJW)

IDIS = DISSPLA library flag

0, attach the dynamic version (default)
 1, attach the static version

LGO - name of local file to execute (default=LGO)

Sample 1.

JOB CARD.
ACCOUNT CARD.
FTN.
ATTACH,JLJPROC, ID=JLJ,MR=1.
BEGIN,DISPLAY,JLJPROC,UID=JLJ,I=-1,IENV=2,IDIS=1.
7/8/9
FORTRAN source deck

7/8/9
input data

6/7/8/9

Sample 2.

JOB CARD.
ACCOUNT CARD

ATTACH,ACTIVE,ACTIVE5, ID=RPB
ATTACH,TAPE1,HEATL7B, ID=RPB.
ATTACH,JLJPROC, ID=JLJ,MR=1.
BEGIN,DISPLAY,JLJPROC,UID=JLJ,I=1,IABS=1,PFN=PLOTS,LGO=ACTIVE.
7/8/9
input data
6/7/8/9

Figure C-1. Sample uses of the procedure DISPLAY.

APPENDIX D

ACTIVE FORTRAN SOURCE LISTING

```

PROGRAM ACTIVE(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE1,
1 PLFILE,TAPE2,TAPE3,TAPE4,TAPE7)

CJLJ
CJLJ      PROGRAM ACTIVE CALCULATES HEATING RATES DUE TO NEUTRONS AND
CJLJ      GAMMAS AND TRITIUM BREEDING FOR FUSION BLANKET DESIGNS.
CJLJ      FLUXES FROM AN ANISN CALCULATION ARE INPUT ALONG WITH
CJLJ      MESH INTERVAL DATA, ISOTOPE IDS AND NUMBER DENSITIES
CJLJ      ACTIVE READS A HEATLIB FILE ON TAPE1 THAT IS GENERATED FROM
CJLJ      MACKLIB-IV DATA.
CJLJ      ACTIVE ALSO PROVIDES ZONE EDITS SIMILAR TO ANISN EDITS FOR
CJLJ      HEATING RATES AND TRITIUM BREEDING.
CJLJ
CJLJ      ACTIVE V04 ALSO CALCULATES FISSION AND CAPTURE RATES IN
CJLJ      THE USERS MODEL, BY READING IN A SET OF FISSION AND
CJLJ      ABSORPTION CROSS SECTIONS ON TAPE3.
CJLJ      ACTIVE V04 WILL CALCULATE NEUTRON AND GAMMA SPECTRA AT
CJLJ      USER SPECIFIED ZONES AND INTERVALS

COMMON A(1)
DIMENSION IA(1),TITLE(8)
COMMON /CONTROL/ NINT,NNGRP,NGGRP,NZONES,NZ1,NZ2,NISO,IGELM,ANORM,
1 FNORM,IFISS,ISPEC1,ISPECZ,NMAT,IHEAT,ITRIT,JPLOT,INORM,IDIVID
EQUIVALENCE (A(1),IA(1))
READ(5,1)TITLE
IF(EOF(5).NE.0) GO TO 4000
1 FORMAT(8A10)

CJLJ
CJLJ      INPUT PARAMETERS ARE DESCRIBED IN THE 2 FORMAT STATEMENT.
CJLJ

READ(5,*)NINT,NNGRP,NGGRP,NZONES,NZ1,NZ2,NISO,NMAT,IGELM,JPLOT,
1 IHEAT,ITRIT,IFISS,IXS,ISPEC1,ISPECZ,INORM,IDIVID,ANORM,FNORM
WRITE(6,2)TITLE,NINT,NNGRP,NGGRP,NZONES,NZ1,NZ2,NISO,NMAT,IGELM,
1 JPLOT,IHEAT,ITRIT,IFISS,IXS
WRITE(6,3)ISPEC1,ISPECZ,INORM,IDIVID,ANORM,FNORM
2 FORMAT(1H1,75X,8A10,71H0,
+/10X,*NUMBER OF SPATIAL INTERVALS *,15,
+/10X,*NUMBER OF NEUTRON ENERGY GROUPS *,15,
+/10X,*NUMBER OF GAMMA ENERGY GROUPS *,15,
+/10X,*NUMBER OF ZONES IN THE PROBLEM *,15,
+/10X,*FIRST INTERVAL FOR CALCULATIONS *,15,
+/10X,*LAST INTERVAL FOR CALCULATIONS *,15,
+/10X,*NUMBER OF ISOTOPE IN THE PROBLEM *,15,
+/10X,*NUMBER OF MACRO MATERIALS IN THE PROBLEM *,15,
+/10X,*GEOMETRY, 0/1/2, SLAB/CYL/SPHERE *,15,
+/10X,*PLOT DATA, 0/1, NO/YES *,15,
+/10X,*CALCULATE HEATING RATES, 0/1, NO/YES *,15,
+/10X,*CALCULATE TRITIUM BREEDING, 0/1, NO/YES *,15,
+/10X,*CALCULATE FISSION RATES, 0/1, NO/YES *,15,
+/10X,*CALCULATE REACTION RATES, 0/N, NO/N REACTIONS *,15)
3 FORMAT(10X,
+ *CALCULATE SPECTRA BY INTERVALS, 0/N, NO/N INTERVALS *,15,
+/10X,*CALCULATE SPECTRA BY ZONES, 0/N, NO/N ZONES *,15,
+/10X,*SPECTRA NORMALIZATION AND PLOTTING FLAG *,
+/10X,*PLOT AS SMOOTH CURVE, UNNORMALIZED/NORMALIZED, 0/1 *,
+/10X,*PLOT AS HISTOGRAM, UNNORMALIZED/NORMALIZED, 2/3 *,15,
+/10X,*SPECTRA CALCULATED PER EV/PER UNIT LETHARGY, 0/1 *,15,
+/10X,*CONVERSION FACTOR TO W/C *,1PE12.5
+/10X,*FLUX NORMALIZATION FACTOR *,
+1PE12.5)

CJLJ
CJLJ      THE NEXT STATEMENTS EVALUATE THE CORE REQUIREMENTS FOR ACTIVE
CJLJ      AND SET THE FIELD LENGTH TO ACCOMODATE THIS PROBLEM
CJLJ

MAXLENG = 131000
NG = NNGRP + NGGRP
N1 = NINT + 1
NN = NZ2 - NZ1 + 1
IF(NN.LT.0) NN = 0

```

```

NNGRPI = NNGRP + 1
NGGRPI = NGGRP + 1
NEPLOT = MAXO(NNGRP,NGGRP)
NALLXS = IXS * NISO * NNGRP + (NISO+1) * IXS * NN + IXS
NN10 = MAXO(NN*10,(NISO+1)*IXS)
ISPEC = 0
IHP = 0
IALL = 0
IF(ISPECI.GT.0.OR.ISPECZ.GT.0) ISPEC = 1
IF(IHEAT.GT.0.OR.IFISS.GT.0.OR.IXS.GT.0) IHP = 1
IF(IHEAT.GT.0.OR.IFISS.GT.0.OR.ITRIT.GT.0.OR.IXS.GT.0) IALL = 1
NIZ = 1
NIM = NIZ + NINT
NJI = NIM + IALL * NZONES
NJF = NJI + IALL * NISO
NBI = NJF + IALL * NISO
NX = NBI + IALL * NISO * NMAT
NXM = NX + N1
NXP = NXM + NINT
NFL = NXP + IALL * NN
NFZ = NFL + NINT * NG
NH = NFZ + NZONES * NG
NHN = NH + IHEAT * NN
NHG = NHN + IHEAT * NN
NNI = NHG + IHEAT * NN
NGI = NNI + IHEAT * NISO * NN
NKE = NGI + IHEAT * NISO * NN
NKD = NKE + IHEAT * NISO * NG
NHP = NKD + IALL * NG
NTF = NHP + IHP * NN10
NTR = NTF + ITRIT * NISO * NG
NTI = NTR + ITRIT * NN
NBR = NTI + ITRIT * NN * NISO
NRI = NBR + ITRIT * NN
NSF = NRI + ITRIT * NISO
NSC = NSF + IFISS * NISO * NNGRP
NFT = NSC + IFISS * NNGRP * NISO
NFI = NFT + IFISS * NN
NCT = NFI + IFISS * NISO
NCI = NCT + IFISS * NN
NSN = NCI + IFISS * NISO * NN
NSG = NSN + ISPEC * NNGRP
NIS = NSG + ISPEC * NGGRP
NSZ = NIS + ISPEC * ISPECI
NEN = NSZ + ISPEC * ISPECZ
NEG = NEN + ISPEC * (NNGRP + 1)
NNM = NEG + ISPEC * (NGGRP + 1)
NGM = NNM + ISPEC * NNGRP
NEP = NGM + ISPEC * NGGRP
NXS = NEP + ISPEC * JPLOT * NEPLOT
NTOT = NXS + NALLXS
NTOT = NTOT + 100
JEND = LOCF(A(1))
MXSTOR = JEND + NTOT
WRITE(6,1000)TITLE,JEND,NTOT,MXSTOR

```

```

1000 FORMAT(1H1,10X,* CORE REQUIREMENTS FOR CASE TITLED *,8A10,
1 /20X,*PROGRAM LENGTH = *,16,
2 /20X,*REQUIRED STORAGE FOR THIS CASE = *,16,
3 /20X,*TOTAL CORE SPACE REQUIRED FOR THIS CASE = *,16,////1H0)
IF(MXSTOR.GT.MAXLENG) GO TO 2000
CALL FTBMEM(MXSTOR,0)
CJLJ ZERO OUT THE BLANK COMMON
CALL ZERO(A,NTOT)

```

```

CJLJ
CJLJ SET THE INDICES FOR THE VARIOUS DATA TO USED IN S.R. MAIN
CJLJ

```

```

WRITE(6,3000)NIZ,NIM,NJI,NJF,NBI,
1 NX,NXM,NXP,NFL,NFZ,NH,NHN,NHG,NNI,NGI,NKE,NKD,NHP,NTF,NTR,NTI,
2 NBR,NRI,NSF,NSC,NFT,NF,NFI,NCT,NC,NCI,NSN,NSG,NIS,NSZ,NEN,
3 NEG,NNM,NGM,NEP,NXS
3000 FORMAT(1H1,
3 /6X,*NIZ = *,I5,/6X,*NIM = *,I5,/6X,*NJI = *,I5,
4 /6X,*NJF = *,I5,/6X,*NBI = *,I5,/6X,*NX = *,I5,
5 /6X,*NXM = *,I5,/6X,*NXP = *,I5,/6X,*NFL = *,I5,
6 /6X,*NFZ = *,I5,/6X,*NH = *,I5,/6X,*NHN = *,I5,
7 /6X,*NHG = *,I5,/6X,*NNI = *,I5,/6X,*NGI = *,I5,
8 /6X,*NKE = *,I5,/6X,*NKD = *,I5,/6X,*NHP = *,I5,
9 /6X,*NTF = *,I5,/6X,*NTR = *,I5,/6X,*NTI = *,I5,
A /6X,*NBR = *,I5,/6X,*NRI = *,I5,/6X,*NSF = *,I5,
B /6X,*NSC = *,I5,/6X,*NFT = *,I5,/6X,*NF = *,I5,
C /6X,*NFI = *,I5,/6X,*NCT = *,I5,/6X,*NC = *,I5,
D /6X,*NCI = *,I5,/6X,*NSN = *,I5,/6X,*NSG = *,I5,
E /6X,*NIS = *,I5,/6X,*NSZ = *,I5,/6X,*NEN = *,I5,
F /6X,*NEG = *,I5,/6X,*NNM = *,I5,/6X,*NGM = *,I5,
G /6X,*NEP = *,I5,/6X,*NXP = *,I5)

CJLJ
CJLJ S.R. MAIN CALCULATES THE HEATING RATES AND TRITIUM BREEDING
CJLJ AND CONTROLS THE EDITING OF DATA AND THE PLOT PROCEDURES
CJLJ
CALL MAIN(NINT,NISO,NG,NZONES,N1,NN,NMAT,NNGRP,NGGRP,NNGRP1,
+ NGGRP1,ISPECI,ISPECZ,NN10,
1 A(NIZ),A(NIM),A(NJI),A(NJF),A(NBI),A(NX),A(NXM),A(NXP),
2 A(NFL),A(NFZ),A(NH),A(NHN),A(NHG),A(NNI),A(NGI),A(NKE),A(NKD),
3 A(NHP),A(NTF),A(NTR),A(NTI),A(NBR),A(NRI),A(NSF),A(NSC),
4 A(NFT),A(NF),A(NFI),A(NCT),A(NC),A(NCI),A(NSN),A(NSG),A(NIS),
5 A(NSZ),A(NEN),A(NEG),A(NNM),A(NGM),A(NEP),A(NXS),
6 NEPLOT,NALLXS,IXS,TITLE)
STOP
2000 WRITE(6,2001)MXSTOR,MAXLENG
2001 FORMAT(1HC,132(1H*),/1HC,10X,
1 *REQUESTED CORE IS GREATER THAN MAXIMUM AVAILABLE*,
2 /1HO,15X,*REQUESTED CORE = *,I7,
3 /1HO,15X,*MAXIMUM AVAILABLE CORE = *,I7,
4 /1HO,132(1H*))
4000 CONTINUE
STOP
END
SUBROUTINE READKF(M,N,A,B,J,JF,AA)

CJLJ
CJLJ S.R. READKF READS IN THE KERMA AND TRITIUM BREEDING FACTORS OF
CJLJ ALL NEEDED ISOTOPES FROM THE HEATLIB FILE ON TAPE1
CJLJ
COMMON /CONTROL/ NINT,NNGRP,NGGRP,NZONES,NZ1,NZ2,NISO,IGEOM,ANORM
1 ,FNORM,IFISS,ISPECI,ISPECZ,NMAT,IHEAT,ITRIT,JPLOT
DIMENSION A(M,N),B(M,N),J(M),JF(M)
DIMENSION AA(N)
REWIND 1

CJLJ
CJLJ READ IN ID NUMBERS
CJLJ
12 READ(1,2) I
IF(EOF(1).NE.0) GO TO 1000
2 FORMAT(37X,I4)

CJLJ
CJLJ LOOP TO SEE IF ISOTOPE ID I HAS BEEN REQUESTED
CJLJ
DO 10 K=1,M
10 IF(I.EQ.J(K)) GO TO 100
DO 11 K=1,3
11 READ(1,101)(AA(L),L=1,N)
GO TO 12
100 CONTINUE
READ(1,101)(AA(L),L=1,N)
IF(IHEAT.EQ.0) GO TO 21

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DO 20 JJ=1,N
20 A(K,JJ) = AA(JJ)
21 CONTINUE
  READ(1,101) (AA(L),L=1,N)
  IF(IHEAT.EQ.0) GO TO 23
  N1 = NNGRP + 1
  DO 22 JJ=N1,N
22 A(K,JJ) = AA(JJ)
23 CONTINUE
  READ(1,101) (AA(L),L=1,N)
  IF(ITRIT.EQ.0) GO TO 25
  DO 24 JJ=1,N
24 B(K,JJ) = AA(JJ)
25 CONTINUE
  GO TO 12
101 FORMAT(6E12.5)
1000 CONTINUE
  RETURN
  END
  SUBROUTINE ZERO(A,N)
CJLJ
CJLJ      S.R. ZERO ZEROS OUT THE BLANK COMMON FOR THE PROBLEM
CJLJ
  DIMENSION A(1)
  DO 1 I=1,N
1 A(I) = 0.0
  RETURN
  END
  SUBROUTINE MAIN(N,N1,NG,NZ,N1,NN,NM,NNG,NGG,NGG1,NGG1,ISI,ISZ,
+ NN10,
1 IZONE,IMAT,JISO,JFLAG,BISO,X,XMID,XP,FLUX,FLXZONE,
2 HEAT,HEATN,HEATG,HEATIN,HEATIG,KERMA,KDUM,HPLOT,TBRFAC,
3 TRITBR,TRITBRI,BRINT,BRINTI,SIGF,SIGC,FISTOT,FIS,FISI,
4 CAPTOT,CAP,CAP1,SPECN,SPECG,ISINT,ISZONE,ENERN,ENERG,
5 ENMID,EGMID,EPLOT,XS,NEPLOT,NALLXS,IXS,TITLE)
  DIMENSION EPLOT(NEPLOT),XS(NALLXS)
CJLJ
CJLJ      S.R. MAIN CALCULATES HEATING RATES AND TRITIUM BREEDING
CJLJ
  COMMON /CONTROL/ NINT,NNGRP,NNGRP,NZONES,NZ1,NZ2,NISO,IGEOM,ANORM,
1 FNCRM,IFISS,ISPEC1,ISPEC2,NMAT,IHEAT,ITRIT,JPLOT,INORM,IDIVID
  DIMENSION HEAT(NN),HEATN(NN),HEATG(NN),HEATIN(NI,NN),HEATIG(NI,NN)
+ ,KERMA(NI,NG),TBRFAC(NI,NG),TRITBR(NN),TRITBRI(NI,NN),IZONE(N)
+ ,BISO(NI,NM),JISO(NI),X(N1),XMID(N),XP(NN),FLUX(N,NG),
+ JFLAG(NI),BRINT(NN),TITLE(8),SIGF(NI,NNG),FISTOT(NN),FIS(N1,NN),
+ SIGC(NI,NNG),CAPTOT(NN),CAP(NI,NN),SPECN(NNG),SPECG(NGG),
+ ISINT(ISI),ISZONE(ISZ),ENERN(NNG1),ENERG(NGG1),IMAT(NZ),
+ HPLOT(NN10),CAP1(NI),FISI(NI),BRINTI(NI),ENMID(NNG),EGMID(NGG),
+ KDUM(NG),FLXZONE(NZ,NG)
  DIMENSION XTITLE(6)
CJLJ
CJLJ      HEAT      = TOTAL HEATING RATE
CJLJ      HEATN     = NEUTRON HEATING RATE
CJLJ      HEATG     = GAMMA HEATING RATE
CJLJ      HEATIN    = ISOTOPIC NEUTRON HEATING RATES
CJLJ      HEATIG    = ISOTOPIC GAMMA HEATING RATES
CJLJ      HPLOT     = PLOTTING ARRAY FOR HEATING RATE FRACTIONS
CJLJ      TRITBRI   = ISOTOPIC TRITIUM BREEDING
CJLJ      TRITBR    = TRITIUM BREEDING
CJLJ      KERMA     = ISOTOPIC KERMA FACTORS
CJLJ      KDUM      = DUMMY ARRAY FOR KERMA FACTORS
CJLJ      TBRFAC    = ISOTOPIC TRITIUM PRODUCTION FACTORS
CJLJ      BISO      = ISOTOPIC NUMBER DENSITIES BY MACRO MATERIAL
CJLJ      IZONE     = ZONE NUMBER BY INTERVAL
CJLJ      JISO      = ISOTOPE ID NUMBER ON HEATLIB
CJLJ      IMAT      = MACRO MATERIAL BY ZONE
CJLJ      X         = SPATIAL INTERVAL DATA
CJLJ      XMID      = SPATIAL INTERVAL MIDPOINTS

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CJLJ      XP      = SPATIAL INTERVAL DATA FOR PLOTTING
CJLJ      JFLAG    = ISOTOPE ALPHANUMERIC LABEL FROM HEATLIB
CJLJ      FLUX     = SPACE AND ENERGY DEPENDENT FLUX FROM ANISN
CJLJ      BRINT    = VOLUME INTEGRATED TRITIUM BREEDING BY SPATIAL INTERVAL
CJLJ      BRINT1   = ISOTOPIC TRITIUM BREEDING OVER VOLUME
CJLJ      SIGF     = FISSION CROSS SECTIONS
CJLJ      FISTOT   = TOTAL FISSION RATE
CJLJ      FIS      = ISOTOPIC FISSION RATES
CJLJ      FISI     = ISOTOPIC VOLUME-INTEGRATED FISSION RATES
CJLJ      SIGC     = CAPTURE CROSS SECTIONS
CJLJ      CAPTOT   = TOTAL CAPTURE RATE
CJLJ      CAP      = ISOTOPIC CAPTURE RATES
CJLJ      CAPI     = ISOTOPIC VOLUME-INTEGRATED CAPTURE RATES
CJLJ      SPECN    = NEUTRON ENERGY SPECTRUM
CJLJ      SPECG    = GAMMA ENERGY SPECTRUM
CJLJ      ENERN    = NEUTRON ENERGY GROUP BOUNDARIES
CJLJ      ENERG    = GAMMA ENERGY GROUP BOUNDARIES
CJLJ      ISINT    = INTERVALS FOR WHICH SPECTRA ARE DESIRED
CJLJ      ISZONE   = ZONES FOR WHICH SPECTRA ARE DESIRED
CJLJ      ENMID    = ENERGY MIDPOINTS FOR NEUTRON GROUP STRUCTURE
CJLJ      EGMID    = ENERGY MIDPOINTS FOR GAMMA GROUP STRUCTURE
CJLJ
CJLJ      REAL KERMA
CJLJ
CJLJ      CALL FIDO TO READ IN DATA
CJLJ
      I PLOT = 1
      I ALL = 0
      IF (IHEAT.GT.0.OR.IFISS.GT.0.OR.ITRIT.GT.0.OR.IXS.GT.0) IALL = 1
      IF (JPLOT.GT.0.AND.IALL.GT.0) READ(5,100)XTITLE
100  FORMAT(6A10)
      IF (IALL.GT.0) CALL FIDO(5,6,N1,JISO,JISO)
      IF (IALL.GT.0) CALL FIDO(5,6,N1,JFLAG,JFLAG)
      IF (IALL.GT.0) CALL FIDO(5,6,N1*NM,BISO,BISO)
      CALL FIDO(5,6,N,IZONE,IZONE)
      IF (IALL.GT.0) CALL FIDO(5,6,N2,IMAT,IMAT)
      IF (ISI.GT.0.OR.ISZ.GT.0) CALL FIDO(5,6,NNG1,ENERN,ENERN)
      IF (ISI.GT.0.OR.ISZ.GT.0) CALL FIDO(5,6,NNG1,ENERG,ENERG)
      IF (ISI.GT.0) CALL FIDO(5,6,ISI,ISINT,ISINT)
      IF (ISZ.GT.0) CALL FIDO(5,6,ISZ,ISZONE,ISZONE)
      IF (IXS.GT.0) CALL FIDO(5,6,IXS,XS,XS)
      CALL FIDO(5,6,N1,X,X)
      CALL FIDO(5,6,N*NG,FLUX,FLUX)
CJLJ
CJLJ      S.R. XOUT CALCULATES XMID AND PRINTS OUT INTERVAL DATA
CJLJ
      CALL XOUT(X,XMID,N1,N,IZONE,TITLE,IGEOM,IMAT,NZONES,IALL)
CJLJ
CJLJ      S.R. READKF READS IN KERMA, TRITIUM PRODUCTION FACTORS
CJLJ      AND ISOTOPE FLAGS
CJLJ
      IF (ITRIT.GT.0.OR.IHEAT.GT.0) CALL READKF(NI,NG,KERMA,
1 TBRFAC,JISO,JFLAG,KDUM)
CJLJ
CJLJ      S.R. ISO PRINTS OUT ISOTOPE NUMBER DENSITIES BY ZONE
CJLJ
      IF (IALL.NE.0) CALL ISO(NI,NMAT,JISO,
1 BISO,JFLAG,TITLE)
CJLJ
CJLJ      S.R. WRITEKF WRITES OUT KERMA AND BREEDING FACTORS
CJLJ
      IF (IHEAT.GT.0.OR.ITRIT.GT.0) CALL WRITEKF(NI,NG,JFLAG,
1 KERMA,TBRFAC,TITLE,IHEAT,ITRIT)
      NP = NZ2 - NZ1 + 1
      IF (IFISS.EQ.1) CALL FISSIN(NI,NNGRP,SIGF,SIGC,JISO,KDUM)
      IF (IFISS.EQ.1) CALL FISSOUT(NI,NNGRP,JFLAG,SIGF,SIGC,TITLE)
CJLJ
      IF (IXS.GT.0) CALL READXS(XS(IXS+1),IXS,NNGRP,NISO,JISO,KDUM)

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      IF(IXS.GT.0) CALL WRITXS(XS(1),XS(IXS+1),IXS,NNGRP,NISO,JFLAG,
1  TITLE)
CJLJ
      IF(IALLEQ.0.OR.NN.LE.0) GO TO 200
      DO 1 I=1,N
      IF( 1.LT. NZ1 ) GO TO 1
      IF( 1.GT. NZ2 ) GO TO 1
      I1 = I - NZ1 + 1
      XP(I1) = XMID(I) - X(NZ1)
1  CONTINUE
200 CONTINUE
      IF(IHEAT.GT.0) CALL CALHEAT(NP,NINT,NG,NISO,NMAT,NZONES,
1  ANORM,FNORM,HEAT,HEATN,HEATG,HEATIN,HEATIG,KERMA,BISO,
2  FLUX,IZONE,IMAT,NZ1,NZ2,NNGRP)
      IF(ITRIT.GT.0) CALL CALTRIT(NP,NINT,NNGRP,NG,NISO,NMAT,NZONES,
1  TRITBR,TRITBRI,TBRFAC,BISO,FLUX,IZONE,IMAT,NZ1,NZ2)
      IF(IFISS.GT.0) CALL CALFISS(NP,NINT,NNGRP,NG,NISO,NMAT,
1  NZONES,FNORM,FISTOT,FIS,SIGF,CAPTOT,CAP,SIGC,BISO,
2  FLUX,IZONE,IMAT,NZ1,NZ2)
      IF(IHEAT.GT.0.OR.ITRIT.GT.0.OR.IFISS.GT.0) CALL DATAOUT(NP,
1  HEAT,HEATN,HEATG,TRITBR,FISTOT,CAPTOT,TITLE,
2  IFISS,IHEAT,ITRIT,XP)
      NX1 = IXS + 1
      NX2 = NX1 + IXS * NISO * NNGRP
      NX3 = NX2 + IXS * NN
      IF(IXS.GT.0) CALL REACRAT(XS(1),XS(NX1),XS(NX2),XS(NX3),IXS,
1  NISO,NNGRP,NN,JFLAG,NG,NMAT,NZONES,BISO,FLUX,IMAT,NINT,IZONE,
2  NZ1,NZ2,FNORM)
CJLJ
CJLJ      S.R. HEATOUT AND TRITOUT WRITE OUT ISOTOPIC CONTRIBUTIONS
CJLJ      TO HEATING RATES AND TRITIUM BREEDING
CJLJ
      IF(IHEAT.GT.0) CALL HEATOUT(NP,NI,JFLAG,HEATIN,HEATN,HEATIG,
1  HEATG,TITLE,KDUM,NG)
      IF(ITRIT.GT.0) CALL TRITOUT(NP,NI,JFLAG,TRITBRI,TRITBR,TITLE,
1  KDUM,NG)
      IF(IFISS.GT.0) CALL FRATOUT(NP,NI,JFLAG,FIS,FISTOT,CAP,CAPTOT,
1  TITLE,KDUM,NG)
      IF(IXS.GT.0) CALL REACOUT(XS(1),XS(NX2),XS(NX3),IXS,NISO,
1  NN,JFLAG,KDUM,NG,TITLE)
CJLJ
CJLJ      S.R. INTBR CALCULATES THE VOLUME-INTEGRATED TRITIUM BREEDING
CJLJ
      IF(ITRIT.GT.0) CALL INTBR(NP,N1,NZ1,NZ2,IGEOM,X,XP,TRITBR,JFLAG,
1  BRINT,NISO,
1  TRITBRI,BRINTI,TITLE)
      IF(IFISS.EQ.1) CALL INTRATE(NP,X,N1,NI,IGEOM,NZ1,NZ2,JFLAG,
1  TITLE,FIS,CAP,FISI,CAPI,FNORM)
CJLJ
CJLJ      S.R. ZONESUM PERFORMS ZONAL EDITS OF DATA
CJLJ
      IF(JPLOT.GT.0) CALL COMPRS
      IF(IHEAT.GT.0.OR.ITRIT.GT.0.OR.IFISS.GT.0) CALL ZONESUM(HEAT,
1  HEATIN,HEATG,TRITBR,X,XP,NP,N1,IGEOM,NZ1,NZ2,IZONE,
2  TITLE,FISTOT,CAPTOT,IFISS,IHEAT,ITRIT)
      CALL FLXSUM(FLUX,NINT,NG,IGEOM,X,N1,TITLE,IZONE,FLXZONE,NZ,FNORM)
      IF(IXS.GT.0) CALL INTREAC(X,N1,NINT,IGEOM,IZONE,NZ1,NZ2,
1  IXS,NP,XS(1),XS(NX2),XS(NX3),NISO,JFLAG,HPLT,NN10,TITLE)
      IF(ISPEC1.GT.0.OR.ISPEC2.GT.0) CALL SPECTRA(FLXZONE,FLUX,
1  NZ,NINT,NG,NNGRP,NNGRP,ENERG,SPECN,
2  SPECG,ISINT,ISZONE,ISI,ISZ,NGG1,NGG1,ENMID,
3  EGMID,EPLT,NEPLT,IPLT,JPLT,INORM,IDIVID)
CJLJ
CJLJ      THE NEXT S.R. CALLS PERFORM THE PLOTTING OF DATA
CJLJ      PLOTACT PLOTS THE HEATING RATES
CJLJ      FRACF PLOTS THE FRACTIONAL CONTRIBUTIONS OF VARIOUS
CJLJ      ISOTOPES
CJLJ      PLOTBR PLOTS THE TRITIUM BREEDING RESULTS

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CJLJ

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IF(JPLOT.EQ.0) GO TO 9999
IF(IHEAT.GT.0) CALL PLOTACT(NP,XP,HEATN,HEATG,HEAT,X,N1,
1 IZONE,NZ1,NZ2,NINT,IPLOT,XTITLE)
IPLOT = IPLOT + 1
NP1 = NP + 1
NP2 = NP1 + NP
NP3 = NP2 + NP
NP4 = NP3 + NP
NP5 = NP4 + NP
NN5 = 5 * NP
IF(IHEAT.GT.0) CALL FRACT(NP,XP,HEATN,HEATG,HEATIN,HEATIG,
1 N1,NI,NINT,X,IZONE,JFLAG,NZ1,NZ2,IPLOT,HPLLOT(1),HPLLOT(NP1),
2 HPLLOT(NP2),HPLLOT(NP3),HPLLOT(NP4),HPLLOT(NP5),NN5,KDUM,NG,XTITLE)
IF(ITRIT.GT.0) CALL PLOTBR(NP,XP,TRITBR,BRINT,X,N1,
1 IZONE,NZ1,NZ2,NINT,IPLOT,XTITLE)
IF(IFISS.GT.0.AND.JPLOT.GT.0) CALL FISSPLT(NP,XP,
1 NISQ,JFLAG,FIS,FISTOT,CAP,
2 CAPTOT,HPLLOT,X,N1,IZONE,NZ1,NZ2,NINT,IPLOT,XTITLE)
IF(IXS.GT.0) CALL PLCTRAT(NP,XP,NISQ,JFLAG,X,N1,IZONE,NZ1,NZ2,
1 NINT,IPLOT,XTITLE,XS(1),XS(NXS2),XS(NXS3),IXS,HPLLOT)
CALL DONEPL
9999 CONTINUE
RETURN
END
SUBROUTINE XOUT(X1,X2,N1,N2,IZ,TITLE,IGEOM,IMAT,NZ,IALL)
DIMENSION X1(N1),X2(N2),IZ(N2),TITLE(8)
DIMENSION IMAT(NZ)

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CJLJ
CJLJ
CJLJ
CJLJ
CJLJ
CJLJ
CJLJ

S.R. XOUT CALCULATES THE INTERVAL MIDPOINT VALUES
AND EDITS ALL THE INTERVAL DATA
X1 = INTERVAL DATA
X2 = INTERVAL MIDPOINT
IZ = ZONE NUMBERS BY INTERVAL

```

WRITE(6,1) TITLE
1 FORMAT(1H1,10X,8A10,
1 //6X,14X,*INSIDE*,10X,*OUTSIDE*,10X,*INTERVAL*,
2 9X,*INTERVAL*,9X,*ZONE*,3X,*MATERIAL*,
+6X,*INTERVAL*,6X,*RADIUS*,11X,*RADIUS*,10X,*MIDPOINT*,8X,
3 2X,*VOLUME*,9X,*NUMBER*,3X,*NUMBER*,/1X)
2 FORMAT(8X,14,4(5X,1PE12.5),5X,15,6X,14)
DO 10 I=1,N2
I1=I+1
VOLI = VOL(IGEOM,X1,I)
X2(I)=(X1(I)+X1(I1))/2.0
IZI = IZ(I)
IM = 0
IF(IALL.GT.0) IM = IMAT(IZI)
10 WRITE(6,2)I,X1(I),X1(I1),X2(I),VOLI,IZI,IM
RETURN
END

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CRUA

C

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SUBROUTINE FIDO (N5,N6,NCOUNN,D,LDTK)
DIMENSION IN(37),K(37),V(37),LDTK(1),FMT(3),VMT(18),D(1)
DIMENSION PRT(3)
EQUIVALENCE (BB,LBB)
DISPLAY OFF
DATA LDL,LS,LR1,LI,LT,LSS/"$ ","* ","R ","I ","T ","
1 "S "/
DATA FMT(1),E1,E2,E3,E4/"(1X,","10E1","2.5)","10I1","2) "/"
DATA LF,LA,LAP,LPL,LMI/"F ","A ","+ ","+ ","- "/"
DATA LZ,LV,LU,BB/"Z ","V ","U "," " "/"
DATA LQ,LM,LN/"Q ","M ","N ","/","E/"E ","/","L","L "/"
DATA LKI/"K "/"
DATA LO,LC,PRT(1),PRT(2),PRT(3),IPRTRG/"D ","C ","OFF ",
1 "PRT ","ON ","-1/
DATA LJ,LW/"J ","W "/"

```

```

J=0
J3=0
I11=0
IVMT=0
NCOUNT=0
1 CALL FFREAD(IN,K,V,NF,N5,N6,IPRTRG)
DO 27 I=1,NF
IF(K(I).NE.LPL .AND. K(I).NE.LAP .AND. K(I).NE.LMI)GO TO 27
C *** EXPONENTIATION (+,+,-)
L=IN(I)
IF(L.EQ.0)GO TO 27
E=10.0**L
IF(K(I).EQ.LMI)GO TO 28
V(I)=V(I)*E
GO TO 27
28 V(I)=V(I)/E
27 CONTINUE
10 FORMAT(6(I2,A1,F9.0),T5,2A4,5(4X2A4))
1002 DO 2 I=1,NF
IF(I11.EQ.0)GO TO 4
IF(I11-2)3,44,46
4 I11=0
IF(K(I).EQ.LBB)GO TO 14
IF(K(I).EQ.LCL)GO TO 5
IF(K(I).EQ.LS )GO TO 6
IF(K(I).EQ.LR1)GO TO 7
IF(K(I).EQ.LI )GO TO 8
IF(K(I).EQ.LT )GO TO 9
IF(K(I).EQ.LSS)GO TO 11
IF(K(I).EQ.LF)GO TO 23
IF(K(I).EQ.LA)GO TO 26
IF(K(I).EQ.L2)GO TO 31
IF(K(I).EQ.LE)GO TO 39
IF(K(I).EQ.LQ)GO TO 35
IF(K(I).EQ.LM .OR. K(I).EQ.LN)GO TO 36
IF(K(I).EQ.LU)GO TO 33
IF(K(I).EQ.LV)GO TO 34
IF(K(I).EQ.LJ .OR. K(I).EQ.LW) GO TO 34
IF(K(I).EQ.LL1)GO TO 42
IF(K(I).EQ.LK1)GO TO 46
IF(K(I).EQ.LO)GO TO 55
IF(K(I).EQ.LC)GO TO 56
GO TO 14
C *** TERMINATE (T)
9 J2=C
ITEST=IN(I)
IF(J.EQ.0)GO TO 16
GO TO 12
C *** VARIABLE FORMAT CONTROL (U,V)
33 READ(N5,80)VMT
34 IVMT=1
C *** BEGIN NEW ARRAY (*,$)
6 KKK=0
GO TO 13
5 KKK=1
13 IF(NCOUNT+J .EQ. 0)GO TO 15
J2=1
12 WRITE (N6,20) LL,LB,J
IF(J.EQ.NCOUNT)GO TO 16
IMAX=J1 + J - 1
FMT(2)=E1
FMT(3)=E2
IF(KK.NE.1)GO TO 22
FMT(2)=E3
FMT(3)=E4
22 WRITE (N6,FMT) (D(II),II=J1,IMAX)
J3=J3 + 1
WRITE (N6,30) NCOUNT,LL,LB

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16 IF(J2.NE.C)GO TO 15
WRITE(N6,50)IN(I),LT
RETURN
15 LL=IN(I)
KK=KKK
LB=K(I)
J1 = 1
NCOUNT = NCOUNN
41 J=0
IF(IVMT.EQ.0)GO TO 2
C *** VARIABLE FORMAT CONTROL (U,V)
32 IF(NCOUNT.EQ.0)GO TO 1
J=NCOUNT
NCC=J1 + NCOUNT - 1
IF(K(I).NE.LJ.AND.K(I).NE.LW) READ(N5,VMT) (D(J2),J2=J1,NCC)
IF(K(I).EQ.LW) READ(N5,201) (D(J2),J2=J1,NCC)
201 FORMAT(7A10)
IF(K(I).EQ.LJ) READ(N5,200) (D(J2),J2=J1,NCC)
200 FORMAT(10A6)
IVMT=0
GO TO 1
C *** FILL ARRAY (F)
23 IF(J.GE.NCOUNT)GO TO 25
NCC=J+1
DO 24 II=NCC,NCOUNT
J2=J1 + II -1
D(J2)=V(I)
24 IF(KK.NE.0)LDTK(J2)=V(I)
J=NCOUNT
GO TO 2
25 WRITE (N6,60) LL,LB
GO TO 2
C *** END ARRAY (E)
39 IF(J.LE.NCOUNT)J=NCOUNT
GO TO 2
C *** ADDRESS MODIFICATION (A)
26 J=V(I)
IF(J.GT.NCOUNT .OR. J.LE.0)WRITE(N6,70)J,LL,LB
J=J-1
GO TO 2
C *** SKIP (S)
11 J=J + IN(I)
GO TO 2
C *** TURN PRINT TRIGGER ON/OFF
55 IPTRG=-IPTRG
WRITE(N6,110)PRT(2),PRT(IPTRG+2),IN(I),LO
110 FORMAT(" ",T53,2A4,I7,A1)
GO TO 2
C *** PRINT COUNT IN CURRENT ARRAY
56 WRITE(N6,90)LL,LB,J,IN(I),LC
GO TO 2
90 FORMAT(T90,I5,A1," ARRAY",I7," ENTRIES READ AT",I4,A1)
C *** NO MODIFICATION
14 CONTINUE
17 J2=J1 + J
D(J2)=V(I)
IF(KK.NE.0)LDTK(J2)=V(I)
J=J + 1
GO TO 2
C *** ZERO (Z)
31 IN(I)=V(.) + IN(I)
V(I)=0.0
C *** REPEAT (R)
7 L=IN(I)
DO 18 I1=1,L
J2=J1 + J
D(J2)=V(I)
IF(KK.NE.0)LDTK(J2)=V(I)

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18 J=J + 1
GO TO 2
C *** SEQUENCE REPEAT (Q)
35 L=V(I) + IN(I)
LSEQ=1
IF(V(I).EQ.0.0 .OR. IN(I).EQ.0)GO TO 51
L=V(I)
LSEQ=IN(I)
51 DO 52 LSQ=1,LSEQ
DO 37 I1=1,L
J2=J1 + J
J4=J2 - L
D(J2)=D(J4)
37 J=J + 1
52 CONTINUE
GO TO 2
C *** INVERTED SEQUENCE REPEAT (N)
36 L=V(I) + IN(I)
LSEQ=1
IF(V(I).EQ.0.0 .OR. IN(I).EQ.0)GO TO 53
L=V(I)
LSEQ=IN(I)
53 DO 54 LSQ=1,LSEQ
DO 38 I1=1,L
J2=J1 + J
J4=J2 - I1 - I1 + 1
D(J2)=D(J4)
C *** REVERSED SIGN INVERTED SEQUENCE REPEAT (M)
IF(K(I).EQ.LM)D(J2)=-D(J2)
38 J=J + 1
54 CONTINUE
GO TO 2
C *** LOGARITHMIC INTERPOLATION (L)
42 I=IN(I) + 1
VV=V(I)
I11=2
GO TO 2
44 DEL=EXP(ALOG(V(I)/VV)/L)
J2=J1 + J
D(J2)=VV
J=J + 1
DO 45 I1=2,L
J2=J1 + J
D(J2)=DEL*D(J2-1)
45 J=J + 1
IF(I11.NE.0)GO TO 4
GO TO 2
C *** FIXED 10 LOG INTERP. (K)
46 L=IN(I) + 1
VV=V(I)
I11=3
GO TO 2
48 DIF=(V(I)-VV)*.1111111
D11=EXP(2.302585/L)
J2=J1 + J
D(J2)=VV
VV=VV-DIF
J=J+1
DO 49 I1=2,L
J2=J1 + J
DIF=DIF*DEL
D(J2)=VV + DIF
49 J=J+1
IF(I11.NE.0)GO TO 4
GO TO 2
C *** INTERPOLATE (I)
8 IF(KK.NE.0)WRITE (N6,40) LL,LB
L=IN(I) + 1

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```

VV=V(I)
I11=1
GO TO 2
3 DEL=(V(I)-VV)/FLOAT(L)
DO 21 I1=1,L
J2=J1 + J
DELT=DEL*FLOAT(I1-1) + VV
D(J2)=DELT
IF(KK.NE.0)LDTK(J2)=DELT
21 J=J + 1
IF(I11.NE.0)GO TO 4
GO TO 2
2 CONTINUE
GO TO 1
20 FORMAT(1H0,15,A1,6H ARRAY,17,13H ENTRIES READ)
30 FORMAT(14H0***** ERROR 17,20H ENTRIES REQUIRED IN I3,A1,6H ARRAY/
121H0 DATA EDIT CONTINUES)
40 FORMAT(39H0***** WARNING INTERPOLATION USED IN I2,A1,14H INTEGER
1 ARRAY/21H0 DATA EDIT CONTINUES)
50 FORMAT(1HC,15,A1)
60 FORMAT(31H0***** FILL OPTION IGNORED IN I2,A1,6H ARRAY)
70 FORMAT(24H0***** WARNING ADDRESS17,20H IS BEYOND LIMITS OF I3,A1,
1 6H ARRAY)
80 FORMAT(18A4)
END
CRUA FUS
SUBROUTINE FFREAD(IN,K,V,NF,N5,N6,IPRTRG)
DIMENSION NY(80),IN(37),K(37),V(37),N(10)
C DISPLAY OFF
DATA NT,NBB,NDP,NPL,NPA,NMI/4HT ,4H ,4H ,4H+ ,4H+ ,
1 4H- ,NSS/4HS /
DATA NDL,NS,NE/4H$ ,4H* ,4HE /
DATA NQ,NM,NN/4HQ ,4HM ,4HN /
DATA NR,NI,NFF,NA,NL,NK/4HR ,4HI ,4HF ,4HA ,4HL ,4HK /
DATA IFREE,N/O,1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9/
DATA NSL/17520040100B/
C DATA NCST2,NCST1/-264224705,-113229759/ ,IFREE/O/
C DATA NT,NBB,NDP,NPL,NPA,NMI/1HT,1H ,1H.,1H+,1H-,1H-/
C DATA NSS/1HS/
C DATA NDL,NS,NE/1H$,1H*,1HE/
C DATA NQ,NM,NN/1HQ,1HM,1HN/
C DATA NR,NI,NFF,NA,NL,NK/1HR,1HI,1HF,1HA,1HL,1HK/
C DATA NSL/1H'/
1998 DO 1 I=1,37
IN(I)=0
V(I)=0.0
1 K(I)=NBB
IEXP=0
NSCL=0
NDPN=0
LEX=0
NLM=0
ISGN=1
IBLNK=0
NF=1
NCC=1
IFC=0
IDS=0
112 READ (5,10) NY
IF(NY(1).NE.NSL)GO TO 111
WRITE(6,10)(NY(I),I=2,80)
GO TO 112
10 FORMAT(80A1)
111 NYNCC=NY(NCC)
NYDUM=0
C CALL CHMOVE(1,1,NYNCC,10,NYDUM)
C IF(IFREE.EQ.C)GO TO 122
IFC=IFC+1

```

```

IF(IFC.GT.12)IFC=1
IF(IFC.EQ.3)GO TO 124
IF(IFC.EQ.11 .AND. IEX.NE.0 .AND. NYNCC.EQ.NBB)GO TO 106
122 IF(NYNCC.EQ.NE .AND. IFC.GT.4)GO TO 203
IF(NYNCC.EQ.NBB)GO TO 101
IF(NYNCC.EQ.NPL .OR. NYNCC.EQ.NPA)GO TO 103
IF(NYNCC.EQ.NMI)GO TO 104
IF(NYNCC.EQ.NE .AND. IBLNK.EQ.1)GO TO 203
IBLNK=1
IF(NYNCC.EQ.NDP)GO TO 102
124 DO 1024 I=1,10
IF(NYNCC.NE.N(I))GO TO 1024
NUMM=1-1
IF(IEX.NE.0)GO TO 107
GO TO 105
1024 CONTINUE
C IF(NYNCC.LT.NCST1 .AND. NYNCC.GT.NCST2)GO TO 105
C IF(NYDUM.GT.32B .AND. NYDUM.LT.45B) GO TO 105
121 IF(K(NF).NE.NBB .AND. NYNCC.EQ.NBB)GO TO 101
K(NF)=NYNCC
IN(NF)=NUM
NUM=0
IBLNK=0
IF(NYNCC.EQ.NBB)GO TO 106
IF(K(NF).NE.NCL .AND. K(NF).NE.NS)GO TO 113
IFREE=0
IDS=1
IF(NF.EQ.1)GO TO 108
IF(K(NF).NE.K(NF-1))GO TO 108
IDS=0
K(NF)=NBB
GO TO 106
113 IF(IFREE.EQ.0 .AND.
1 NYNCC.NE.NR .AND. NYNCC.NE.N1 .AND. NYNCC.NE.NFF .AND.
2 NYNCC.NE.NA .AND. NYNCC.NE.NL .AND. NYNCC.NE.NK .AND.
3 NYNCC.NE.NG .AND. NYNCC.NE.NM .AND. NYNCC.NE.NN )GO TO 108
IF(IFREE.EQ.1 .AND. NYNCC.EQ.NSS)GO TO 108
IF(NCC.EQ.72)WRITE(6,20)NY
20 FORMAT(63H0 ***** INCOMPLETE FIELD AT END OF CARD, SOME DATA MAY
1BE LOST/27H CARD IMAGE FOLLOWS/IH,80A1)
GO TO 106
C 105 NUMM=10 - ((IABS(NYNCC) - 96452540)/16777216)
C 105 NUMM=NYDUM-338
105 NUM=NUM*10 + NUMM
NSCL=NSCL + NDPN
GO TO 206
102 NDPN=-1
GO TO 206
C 107 NUMM=10 - ((IABS(NYNCC) - 96452540)/16777216)
C 107 NUMM=NYDUM-338
107 IEXP=1EXP*10 + IEX*NUMM
206 IF(IFC.EQ.12)GO TO 301
GO TO 106
103 IF(NUM.NE.0)GO TO 203
ISGN=1
GO TO 106
203 IEX=1
GO TO 106
104 IF(NUM.NE.0)GO TO 204
ISGN=-1
GO TO 106
204 IEX=-1
GO TO 106
123 IFREE=1
IDS=0
GO TO 109
101 IF(IDS.EQ.1)GO TO 123
IF(IFREE.EQ.1 .AND. IFC.EQ.12 .AND. K(NF).NE.NBB)GO TO 301

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```

      IF( IBLNK.EQ.0)GO TO 106
      IF( IFREE.EQ.1 .AND. IFC.NE.12)GO TO 106
301  VNUM=ISGN*NUM
      V(NF)=VNUM*10.0** (IEXP+NSCL)
      NDPN=0
      IEX=0
      IEXP=0
      NSCL=0
      IBLNK=0
      NUM=0
      ISGN=1
108  CONTINUE
      NF=NF + 1
      IF( NYNCC.EQ.NSS)GO TO 106
109  IFC=0
      IF( IFREE.EQ.1)NCC=((NCC+11)/12)*12
      IF( K(NF-1).EQ.NT)GO TO 999
106  IF( NCC.EQ.73)GO TO 999
      NCC=NCC+1
      IF( NCC.LE.72)GO TO 111
      GO TO 101
999  NF=NF-1
      IF( NF.LE.0)GO TO 1998
      RETURN
      END
      SUBROUTINE MAX(N,X,XMAX,XMIN)
      DIMENSION X(N)
CJLJ      S.R. MAX CALCULATES THE MIN AND MAX VALUES OF AN ARRAY
CJLJ      AND THEN DETERMINES THE POWERS OF TEN THAT BRACKET
CJLJ      THE DATA
CJLJ
      XMAX = -1.0E+99
      XMIN = 1.0E+99
      DO 1 I=1,N
      XMAX = AMAX1 ( XMAX , X(I) )
1  XMIN = AMIN1 ( XMIN , X(I) )
      IF(XMAX.EQ.0.0.AND.XMIN.EQ.0.0) RETURN
      IF(XMIN.NE. 0.0) GO TO 30
      XMIN = XMAX / 1.0E+10
      DO 4 I=1,N
4  IF(X(I).EQ. 0.0) X(I) = XMIN
30  CONTINUE
      AM1 = ALOG10(XMIN)
      AMA = ALOG10(XMAX)
      DO 2 J=1,100
      AJ = FLOAT(J-50)
      IF( AJ .LT. AM1 ) GO TO 10
      IF( AJ .GT. AMA ) GO TO 20
      GO TO 2
10  XMIN = 10.0 ** AJ
2  CONTINUE
20  XMAX = 10.0 ** AJ
      RETURN
      END
      SUBROUTINE ISO(M,N,JN,B,JF,TITLE)
      DIMENSION JN(M),B(M,N),JF(M),TITLE(8)
CJLJ      S.R. ISO PRINTS OUT ISOTOPIC DATA BY ZONE
CJLJ
      WRITE(6,1) TITLE
1  FORMAT(1H1,10X,8A10,
2  //4X,*MATERIAL*,16X,*ID*,/5X,*NUMBER*,4X,*ISOTOPE*,
2  4X,*NUMBER*,4X,*CONCENTRATION*,/1H0)
      DO 2 I=1,N
      ICHK = 0
      DO 3 J=1,M
      IF(B(J,I).NE. 0.0 .AND. ICHK.EQ. 0) WRITE(6,4)I,JF(J),

```

```

1 JN(J),B(J,I)
  IF(B(J,I).NE. 0.0 .AND. 1CHK .GT. 0) WRITE(6,5)JF(J),
1 JN(J),B(J,I)
  IF(B(J,I).NE. 0.0) 1CHK = 1CHK + 1
3 CONTINUE
  WRITE(6,6)
2 CONTINUE
4 FORMAT(5X,I5,5X,A6,5X,I5,5X,1PE12.5)
5 FORMAT(15X,A6,5X,I5,5X,1PE12.5)
6 FORMAT(1H0)
  RETURN
  END
  SUBROUTINE WRITEKF(M,N,JF,KF,BF,T,IHEAT,ITRIT)

```

CJLJ
CJLJ
CJLJ S.R. WRITEKF WRITES THE KERMA AND TRITIUM PRODUCTION FACTORS

```

  REAL KF
  DIMENSION JF(M),KF(M,N),BF(M,N),T(8)
  IF(IHEAT.EQ.0) GO TO 100
  KFLAG = 6HKERMA
  DO 1 I=1,M,6
  I5 = I + 5
  IF(I5.GT.M) I5 = M
  WRITE(6,11)T,(JF(J),J=1,I5)
  WRITE(6,12)(KFLAG,J=1,I5)
  WRITE(6,13)
11 FORMAT(1H1,10X,8A10,///5X,*ENERGY*,9X,A6,5(11X,A6))
12 FORMAT(5X,*GROUP*,10X,A6,5(11X,A6))
13 FORMAT(1H0)
  DO 2 K=1,N
  2 WRITE(6,3)K,(KF(J,K),J=1,I5)
  3 FORMAT(6X,I3,2X,6(5X,1PE12.5))
  1 CONTINUE
100 CONTINUE
  IF(ITRIT.EQ.0) GO TO 200
  KFLAG = 8HTRITIUM
  LFLAG = 10HPRDUCTION
  MFLAG = 8HFACTOR
  DO 20 I=1,M,6
  I5 = I + 5
  IF(I5.GT.M) I5 = M
  WRITE(6,21)T,(JF(J),J=1,I5)
  WRITE(6,22)(KFLAG,J=1,I5)
  WRITE(6,23)(LFLAG,J=1,I5)
  WRITE(6,24)(MFLAG,J=1,I5)
21 FORMAT(1H1,10X,8A10,///5X,*ENERGY*,8X,A6,5(11X,A6))
22 FORMAT(5X,*GROUP*,8X,A8,5(9X,A8))
23 FORMAT(17X,A10,5(7X,A10))
  WRITE(6,13)
24 FORMAT(18X,A8,5(9X,A8))
  DO 30 K=1,N
  30 WRITE(6,3)K,(BF(J,K),J=1,I5)
  20 CONTINUE
200 CONTINUE
  RETURN
  END
  SUBROUTINE INTBR(N,N1,NZ1,NZ2,IGEDM,X,XP,BR,JFLAG,BRINT,NI,BRI,
1 BRINT1,TITLE)
  DIMENSION X(N1),XP(N),BR(N),BRINT(N),BRI(NI,N),BRINT1(NI)
  DIMENSION TITLE(8),JFLAG(NI)

```

CJLJ
CJLJ
CJLJ
CJLJ S.R. INTBR VOLUME INTEGRATES THE TRITIUM PRODUCTION RATES
 TO GET THE TRITIUM BREEDING

```

  BRTOT = 0.0
  DO 10 J=1,NI
10 BRINT1(J) = 0.0
  DO 1 I=NZ1,NZ2

```

```

VOLI = VOL(IGEDM,X,I)
II = I - NZ1 + 1
BRIGT = BRIGT + BR(II) * VOLI
BRINT(II) = BRIGT
DO 11 J=1,N1
BRINTI(J) = BRINTI(J) + BR(J,II) * VOLI
11 CONTINUE
1 CONTINUE
WRITE(6,2) TITLE
2 FORMAT(1H1,10X,8A10,///3X,*INTERVAL*,8X,*X*,13X,*TRITIUM*,9X,
1 *INTEGRATED*,/33X,*BREEDING*,9X,*TRITIUM*,/35X,*RATE*,11X,
2 *BREEDING*,/1H0)
DO 3 I=1,N
3 WRITE(6,4) I,XP(I),BR(I),BRINT(I)
WRITE(6,20) TITLE
20 FORMAT(1H1,10X,8A10,///11X,*INTEGRATED TRITIUM BREEDING DATA*,
1 /1H0,16X,*INTEGRATED*,/18X,*TRITIUM*,/4X,*ISOTOPE*,7X,*BREEDING*,
2 10X,*FRACTION*,/1H0)
DO 21 J=1,N1
IF(BRINTI(J).EQ.0.0) GO TO 21
FRAC = BRINTI(J) / BRINT(N)
WRITE(6,22) JFLAG(J),BRINTI(J),FRAC
21 CONTINUE
22 FORMAT(5X,A6,5X,1PE12.5,5X,1PE12.5)
4 FORMAT(5X,I4,3(5X,1PE12.5))
RETURN
END
SUBROUTINE PLOTACT(N1,X1,HN1,HG1,H1,X,NX,IZ,NZ1,NZ2,N,IPL0T,XT)
DIMENSION XT(6)

```

CJLJ
CJLJ
CJLJ

S.R. PLOTACT PLOTS THE HEAT, HEATN, AND HEATG DATA

```

DIMENSION X1(N1),HN1(N1),HG1(N1),H1(N1),IZ(N),X(NX)
DIMENSION XL(2),YL(2)
DIMENSION IPKRAY(400)
XMIN=-10.0
CALL ZMAX(N1,H1,HMAX,HMIN)
CALL ZMAX(N1,HN1,HNMAX,HNMIN)
CALL ZMAX(N1,HG1,HGMAX,HGMIN)
YL(1) = AMIN1(HMIN,HNMIN,HGMIN)
YL(2) = AMAX1(HMAX,HNMAX,HGMAX)
IF(YL(1).EQ.0.0.AND.YL(2).EQ.0.0) GO TO 1
CALL COMPLX
CALL BGNPL(IPL0T)
CALL MX1ALF("L/CSTD","")
CALL MX2ALF("STANDARD","")
CALL MX3ALF("INSTRUCTION","+")
CALL LINES("(T)OTAL$",IPKRAY,1)
CALL LINES("(N)EUTRONS$",IPKRAY,2)
CALL LINES("(G)AMMA$",IPKRAY,3)
CALL TITLE("$",
1 -100,XT,100,
2 "(H)EATING RATE ((W/CC)$",100,8.0,6.0)
CALL STEPSIZ(XMIN,X1(N1),XSTEP,YL(1),YL(2),YSTEP,1,0)
CALL YLOG(XMIN,XSTEP,YL(1),YSTEP)
CALL FRAME
CALL CURVE(X1,H1,1,-1)
CALL CURVE(X1,HN1,1,-1)
CALL CURVE(X1,HG1,1,-1)
CALL ZCURVE(X1,H1,N1,0)
CALL ZCURVE(X1,HN1,N1,1)
CALL ZCURVE(X1,HG1,N1,2)
CALL LEGEND(IPKRAY,3,6.5,6.1)
CALL ZONELIN(NZ1,NZ2,IZ,N,X,NX,YL)
CALL ENDPL(IPL0T)
1 CONTINUE
RETURN
END

```

```

SUBROUTINE FRACT(N,X,HN,HG,HIN,HIG,N1,N1,NN,X1,IZ,JF,NZ1,NZ2,
1 IPLUT,HPLOT1,HPLOT2,HPLOT3,HPLOT4,HPLOT5,ADUM,NALL,ICOUNT,NC,XT)
CJLJ
CJLJ      S.R. FRACT CALCULATES THE FRACTIONAL CONTRIBUTION OF EACH
CJLJ      ISOTOPE TO NEUTRON AND GAMMA HEATING AND CALLS
CJLJ      PLOTFRG TO PLOT THE DATA
C
DIMENSION X(N),HN(N),HG(N),HIN(N1,N),HIG(N1,N),X1(N1),ADUM(NALL)
DIMENSION IZ(NN),JF(N1)
DIMENSION HPLOT1(N),HPLOT2(N),HPLOT3(N),HPLOT4(N),HPLOT5(N)
DIMENSION ICOUNT(NC),XT(6)
NEUTRON LOOP
NN1 = N + 1
NN2 = NN1 + N
NN3 = NN2 + N
NN4 = NN3 + N
CALL ZCHECK(N,N1,HIN,ICOUNT,NC,NUM)
DO 1 I=1,NUM,5
I5 = I + 4
IF(I5.GT.NUM) I5 = NUM
ICLK = I5 - 1 + 1
I1 = I + 1
I2 = I + 2
I3 = I + 3
I4 = I + 4
DO 2 K=1,N
GO TO (100,200,300,400,500),ICLK
500 J5 = JF(ICOUNT(I4))
HPLOT5(K) = HIN(ICOUNT(I4),K)
400 J4 = JF(ICOUNT(I3))
HPLOT4(K) = HIN(ICOUNT(I3),K)
300 J3 = JF(ICOUNT(I2))
HPLOT3(K) = HIN(ICOUNT(I2),K)
200 J2 = JF(ICOUNT(I1))
HPLOT2(K) = HIN(ICOUNT(I1),K)
100 J1 = JF(ICOUNT(I))
HPLOT1(K) = HIN(ICOUNT(I),K)
2 CONTINUE
CALL PLOTFRG(IPLUT,ICLK,N,X,HN,HPLOT1,HPLOT2,HPLOT3,HPLOT4,HPLOT5,
1 N1,X1,IZ,J1,J2,J3,J4,J5,1,NZ1,NZ2,ADUM(1),ADUM(NN1),ADUM(NN2),
2 ADUM(NN3),ADUM(NN4),XT)
IPLUT = IPLUT + 1
1 CONTINUE
CALL ZCHECK(N,N1,HIG,ICOUNT,NC,NUM)
DO 3 I=1,NUM,5
I5 = I + 4
IF(I5.GT.NUM) I5 = NUM
ICLK = I5 - 1 + 1
I1 = I + 1
I2 = I + 2
I3 = I + 3
I4 = I + 4
DO 4 K=1,N
GO TO (111,211,311,411,511),ICLK
511 J5 = JF(ICOUNT(I4))
HPLOT5(K) = HIG(ICOUNT(I4),K)
411 J4 = JF(ICOUNT(I3))
HPLOT4(K) = HIG(ICOUNT(I3),K)
311 J3 = JF(ICOUNT(I2))
HPLOT3(K) = HIG(ICOUNT(I2),K)
211 J2 = JF(ICOUNT(I1))
HPLOT2(K) = HIG(ICOUNT(I1),K)
111 J1 = JF(ICOUNT(I))
HPLOT1(K) = HIG(ICOUNT(I),K)
4 CONTINUE
CALL PLOTFRG(IPLUT,ICLK,N,X,HG,HPLOT1,HPLOT2,HPLOT3,HPLOT4,HPLOT5,
1 N1,X1,IZ,J1,J2,J3,J4,J5,2,NZ1,NZ2,ADUM(1),ADUM(NN1),ADUM(NN2),
2 ADUM(NN3),ADUM(NN4),XT)

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      IPLOT = IPLOT + 1
3    CONTINUE
      RETURN
      END
      SUBROUTINE PLOTFRFC(IPLOT, INUM, N, X1, H, H1, H2, H3, H4, H5, N1, X, IZ,
1    A1, A2, A3, A4, A5, ITYPE, NZ1, NZ2, F1, F2, F3, F4, F5, XT)
      DIMENSION XT(6)
CJLJ
CJLJ      S.R. PLOTFRFC PLOTS THE ISOTOPIC FRACTIONS OF HEATING
CJLJ
      DIMENSION X1(N), H(N), H1(N), H2(N), H3(N), H4(N), H5(N)
      DIMENSION XL(2), YL(2), F1(N), F2(N), F3(N), F4(N), F5(N)
      DIMENSION IPKRAY(600), X(N1), IZ(N)
      DIMENSION AT1(6), AT2(6), AT3(6), AT4(6), AT5(6)
      DO 1 I=1, N
        F1(I) = H1(I) / H(I)
        IF(INUM.GE.2) F2(I) = H2(I) / H(I)
        IF(INUM.GE.3) F3(I) = H3(I) / H(I)
        IF(INUM.GE.4) F4(I) = H4(I) / H(I)
        IF(INUM.GE.5) F5(I) = H5(I) / H(I)
1    CONTINUE
      CALL COMPLX
      CALL BGNPL(IPLOT)
      CALL MX1ALF("L/CSTD", "")
      CALL MX2ALF("STANDARD", "(")
      CALL MX3ALF("INSTRUCTION", "+")
      IF(INUM.EQ.5) GO TO 105
      IF(INUM.EQ.4) GO TO 104
      IF(INUM.EQ.3) GO TO 103
      IF(INUM.EQ.2) GO TO 102
      IF(INUM.EQ.1) GO TO 101
105  REWIND 2
      WRITE(2,12)A5
      REWIND 2
      READ(2,13)(AT5(J),J=1,6)
      ENCODE(10,10,T5)(AT5(J),J=1,6)
104  REWIND 2
      WRITE(2,12)A4
      REWIND 2
      READ(2,13)(AT4(J),J=1,6)
      ENCODE(10,10,T4)(AT4(J),J=1,6)
103  REWIND 2
      WRITE(2,12)A3
      REWIND 2
      READ(2,13)(AT3(J),J=1,6)
      ENCODE(10,10,T3)(AT3(J),J=1,6)
102  REWIND 2
      WRITE(2,12)A2
      REWIND 2
      READ(2,13)(AT2(J),J=1,6)
      ENCODE(10,10,T2)(AT2(J),J=1,6)
101  REWIND 2
      WRITE(2,12)A1
      REWIND 2
      READ(2,13)(AT1(J),J=1,6)
      ENCODE(10,10,T1)(AT1(J),J=1,6)
12  FORMAT(A6)
13  FORMAT(6A1)
10  FORMAT(1H(,6A1,3H)$ )
      WRITE(6,11)T1
      IF(INUM.GE.2) WRITE(6,11)T2
      IF(INUM.GE.3) WRITE(6,11)T3
      IF(INUM.GE.4) WRITE(6,11)T4
      IF(INUM.GE.5) WRITE(6,11)T5
11  FORMAT(5X,A10)
      CALL LINES(T1,IPKRAY,1)
      IF(INUM.GE.2) CALL LINES(T2,IPKRAY,2)
      IF(INUM.GE.3) CALL LINES(T3,IPKRAY,3)

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IF(INUM.GE.4) CALL LINES(T4,IPKRAY,4)
IF(INUM.GE.5) CALL LINES(T5,IPKRAY,5)
IF(ITYPE.EQ.1) CALL TITLE("$",
1 -100,XT,100,
2 "(F)RACTION OF TOTAL NEUTRON HEATINGS$",100,8.0,6.0)
IF(ITYPE.EQ.2) CALL TITLE("$",
1 -100,XT,100,
2 "(F)RACTION OF TOTAL GAMMA HEATINGS$",100,8.0,6.0)
YL(1)=0.0
CALL MAXI(N,INUM,YL(2),F1,F2,F3,F4,F5)
CALL STEPSIZ(-10.0,X1(N),XSTEP,YL(1),YL(2),YSTEP,0,0)
YL(2) = YL(1) + 6.0 * YSTEP
CALL GRAPH(-10.0,XSTEP,YL(1),YSTEP)
CALL FRAME
CALL CURVE(X1,F1,N,-2)
IF(INUM.GE.2) CALL CURVE(X1,F2,N,-2)
IF(INUM.GE.3) CALL CURVE(X1,F3,N,-2)
IF(INUM.GE.4) CALL CURVE(X1,F4,N,-2)
IF(INUM.GE.5) CALL CURVE(X1,F5,N,-2)
CALL LEGEND(IPKRAY,INUM,6.5,6.1)
CALL ZONELIN(NZ1,NZ2,IZ,N,X,N1,YL)
CALL ENDPL(IPLT)
RETURN
END
SUBROUTINE PLOTBR(N1,X1,B1,B2,X,NX,IZ,NZ1,NZ2,N,IPLT,XT)
DIMENSION XT(6)

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S.R. PLOTBR PLOTS THE TRITIUM PRODUCTION RATE, B1, AND THE
TRITIUM BREEDING, B2.

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DIMENSION X1(N1),B1(N1),B2(N1),IZ(N),X(NX)
DIMENSION YL(2)
XMIN=-10.0
CALL ZMAX(N1,B1,BMAX,BMIN)
IF(BMIN.EQ.C.C.AND.BMAX.EQ.0.0) GO TO 10
CALL BGNPL(IPLT)
CALL COMPLX
CALL MX1ALF("L/CSTD","")
CALL MX2ALF("STANDARD","")
CALL MX3ALF("INSTRUCTION","+")
CALL TITLE("$",
1 -100,"(D)ISTANCE FROM EDGE OF FIRST WALL (( )CM)$",100,
2 "(B)REEDING RATE $",100,8.0,6.0)
YL(1) = BMIN
YL(2) = BMAX
CALL STEPSIZ(XMIN,X1(N1),XSTEP,BMIN,BMAX,YSTEP,1,0)
CALL YLOG(XMIN,XSTEP,YL(1),YSTEP)
CALL FRAME
CALL ZCURVE(X1,B1,N1,0)
CALL ZONELIN(NZ1,NZ2,IZ,N,X,NX,YL)
CALL ENDPL(IPLT)
IPLT = IPLT + 1
CALL BGNPL(IPLT)
CALL COMPLX
CALL MX1ALF("L/CSTD","")
CALL MX2ALF("STANDARD","")
CALL MX3ALF("INSTRUCTION","+")
DO 100 I=1,N1
X1(I) = X(NZ1 + I) - X(NZ1)
100 CONTINUE
CALL TITLE("$",-100,XT,
1 100,"(I)NTEGRATED BREEDING RATE $",100,8.0,6.0)
XORIG = -10.0
YORIG = 0.0
YMAX = B2(N1)
CALL STEPSIZ(XORIG,X1(N1),XS,YORIG,YMAX,YS,0,0)
CALL GRAPH(XORIG,XS,YORIG,YS)
CALL FRAME

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CALL CURVE(X1,B2,N1,-2)
YL(1) = YORIG
YL(2) = YORIG + YS * 6.0
CALL ZONELIN(NZ1,NZ2,IZ,N,X,NX,YL)
CALL ENDPL(IPLOT)
IPLOT = IPLOT + 1
10 CONTINUE
RETURN
END
SUBROUTINE ZONESUM(H,HN,HG,BR,X,XP,NP,N1,IGEOM,NZ1,NZ2,IZ,T,
1 FT,CT,IFISS,IHEAT,ITRIT)
CJLJ      S.R. ZONESUM INTEGRATES DATA OVER THE ZONE AND EDITS
CJLJ      OUT THE DATA IN ZONE FORMAT
CJLJ
      DIMENSION H(NP),HN(NP),HG(NP),BR(NP),XP(NP),X(N1)
      DIMENSION IZ(N1),FT(NP),CT(NP),T(8)
      IZP = IZ(NZ1)
      TOT H = 0.0
      TOT HN = 0.0
      TOT HG = 0.0
      TOT BR = 0.0
      TOT VOL = 0.0
      TOT CAP = 0.0
      TOT FIS = 0.0
      IF(IFISS.GT.0.AND.IHEAT.GT.0.AND.ITRIT.GT.0) GO TO 1
      IF(IFISS.EQ.0.AND.IHEAT.GT.0.AND.ITRIT.GT.0) GO TO 2
      IF(IFISS.EQ.0.AND.IHEAT.EQ.0.AND.ITRIT.GT.0) GO TO 3
      IF(ITRIT.EQ.0.AND.IFIS.SGT.0.AND.IHEAT.GT.0) GO TO 4
      IF(IHEAT.EQ.0.AND.IFIS.SGT.0.AND.ITRIT.GT.0) GO TO 5
      IF(IHEAT.EQ.0.AND.IFIS.SGT.0.AND.ITRIT.EQ.0) GO TO 6
      IF(ITRIT.EQ.0.AND.IFIS.EQ.0.AND.IHEAT.GT.0) GO TO 7
      RETURN
1 CONTINUE
      WRITE(6,11)T
      DO 12 I=NZ1,NZ2
      I1 = I - NZ1 + 1
      IF(IZ(I).EQ.IZP) GO TO 13
14 CONTINUE
      WRITE(6,100)IZP,TOTVOL,TOTH,TOTHN,TOT HG,TOTBR,TOTFIS,TOTCAP
      IZP = IZ(I)
      TOTVOL = 0.0
      TOTH = 0.0
      TOT HN = 0.0
      TOT HG = 0.0
      TOTBR = 0.0
      TOTFIS = 0.0
      TOTCAP = 0.0
      IF(I.EQ.NZ2) GO TO 1000
13 CONTINUE
      VOLI = VOL(IGEOM,X,I)
      TOTVOL = TOTVOL + VOLI
      TOTH = TOTH + H(I1) * VOLI
      TOT HN = TOT HN + HN(I1) * VOLI
      TOT HG = TOT HG + HG(I1) * VOLI
      TOTBR = TOTBR + BR(I1) * VOLI
      TOTFIS = TOTFIS + FT(I1) * VOLI
      TOTCAP = TOTCAP + CT(I1) * VOLI
      IF(I.EQ.NZ2.AND.IZ(I+1).NE.IZP) GO TO 14
12 CONTINUE
      RETURN
2 CONTINUE
      WRITE(6,21)T
      DO 22 I=NZ1,NZ2
      I1 = I - NZ1 + 1
      IF(IZ(I).EQ.IZP) GO TO 23
24 CONTINUE
      WRITE(6,100)IZP,TOTVOL,TOTH,TOT HN,TOT HG,TOTBR

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IZP = IZ(1)
TOTVOL = 0.0
TOTH = 0.0
TOTHN = 0.0
TOTHG = 0.0
TOTBR = 0.0
IF(I.EQ.NZ2) GO TO 1000
23 CONTINUE
VOLI = VOL(IGEOM,X,I)
TOTVOL = TOTVOL + VOLI
TOTH = TOTH + H(II) * VOLI
TOTHN = TOTHN + HN(II) * VOLI
TOTHG = TOTHG + HG(II) * VOLI
TOTBR = TOTBR + BR(II) * VOLI
IF(I.EQ.NZ2.AND.IZ(I+1).NE.IZP) GO TO 24
22 CONTINUE
RETURN
3 CONTINUE
WRITE(6,31)I
DO 32 I=NZ1,NZ2
II = I - NZ1 + 1
IF(IZ(I).EQ.IZP) GO TO 33
34 CONTINUE
WRITE(6,100)IZP,TOTVOL,TOTBR
IZP = IZ(I)
TOTVOL = 0.0
TOTBR = 0.0
IF(I.EQ.NZ2) GO TO 1000
33 CONTINUE
VOLI = VOL(IGEOM,X,I)
TOTVOL = TOTVOL + VOLI
TOTBR = TOTBR + BR(II) * VOLI
IF(I.EQ.NZ2.AND.IZ(I+1).NE.IZP) GO TO 34
32 CONTINUE
RETURN
4 CONTINUE
WRITE(6,41)I
DO 42 I=NZ1,NZ2
II = I - NZ1 + 1
IF(IZ(I).EQ.IZP) GO TO 43
44 CONTINUE
WRITE(6,100)IZP,TOTVOL,TOTH,TOTHN,TOTHG,TOTFIS,TOTCAP
IZP = IZ(I)
TOTVOL = 0.0
TOTH = 0.0
TOTHN = 0.0
TOTHG = 0.0
TOTFIS = 0.0
TOTCAP = 0.0
IF(I.EQ.NZ2) GO TO 1000
43 CONTINUE
VOLI = VOL(IGEOM,X,I)
TOTVOL = TOTVOL + VOLI
TOTH = TOTH + H(II) * VOLI
TOTHN = TOTHN + HN(II) * VOLI
TOTHG = TOTHG + HG(II) * VOLI
TOTFIS = TOTFIS + FI(II) * VOLI
TOTCAP = TOTCAP + CT(II) * VOLI
IF(I.EQ.NZ2.AND.IZ(I+1).NE.IZP) GO TO 44
42 CONTINUE
RETURN
5 CONTINUE
WRITE(6,51)I
DO 52 I=NZ1,NZ2
II = I - NZ1 + 1
IF(IZ(I).EQ.IZP) GO TO 53
54 CONTINUE
WRITE(6,100)IZP,TOTVOL,TOTBR,TOTFIS,TOTCAP

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      IZP = IZ(1)
      TOTVOL = 0.0
      TOTBR = 0.0
      TOTFIS = 0.0
      TOTCAP = 0.0
      IF(I.EQ.NZ2) GO TO 1000
53  CONTINUE
      VOLI = VOL(IGEOM,X,I)
      TOTVOL = TOTVOL + VOLI
      TOTBR = TOTBR + BR(II) * VOLI
      TOTFIS = TOTFIS + FT(II) * VOLI
      TOTCAP = TOTCAP + CT(II) * VOLI
      IF(I.EQ.NZ2.AND.IZ(I+1).NE.IZP) GO TO 54
52  CONTINUE
      RETURN
6  CONTINUE
      WRITE(6,61)T
      DO 62 I=NZ1,NZ2
      II = I - NZ1 + 1
      IF(IZ(1).EQ.IZP) GO TO 63
64  CONTINUE
      WRITE(6,100)IZP,TOTVOL,TOTFIS,TOTCAP
      IZP = IZ(1)
      TOTVOL = 0.0
      TOTFIS = 0.0
      TOTCAP = 0.0
      IF(I.EQ.NZ2) GO TO 1000
63  CONTINUE
      VOLI = VOL(IGEOM,X,I)
      TOTVOL = TOTVOL + VOLI
      TOTH = TOTH + H(II) * VOLI
      TOTCAP = TOTCAP + CT(II) * VOLI
      IF(I.EQ.NZ2.AND.IZ(I+1).NE.IZP) GO TO 64
62  CONTINUE
      RETURN
7  CONTINUE
      WRITE(6,71)T
      DO 72 I=NZ1,NZ2
      II = I - NZ1 + 1
      IF(IZ(1).EQ.IZP) GO TO 73
74  CONTINUE
      WRITE(6,100)IZP,TOTVOL,TOTH,TOTHN,TOTHG
      IZP = IZ(1)
      TOTVOL = 0.0
      TOTH = 0.0
      TOTHN = 0.0
      TOTHG = 0.0
      IF(I.EQ.NZ2) GO TO 1000
73  CONTINUE
      VOLI = VOL(IGEOM,X,I)
      TOTVOL = TOTVOL + VOLI
      TOTH = TOTH + H(II) * VOLI
      TOTHN = TOTHN + HN(II) * VOLI
      TOTHG = TOTHG + HG(II) * VOLI
      IF(I.EQ.NZ2.AND.IZ(I+1).NE.IZP) GO TO 74
72  CONTINUE
      RETURN
100 FORMAT(5X,I5,7(5X,1PE12.5),/1X)
11  FORMAT(1H1,10X,8A10,///5X,*ZONE*,10X,*ZONE*,12X,*TOTAL*,
1  11X,*NEUTRON*,11X,*GAMMA*,11X,*TRITIUM*,11X,*TOTAL*,12X,
2  *TOTAL*,/4X,*NUMBER*,8X,*VOLUME*,10X,*HEATING*,10X,
3  *HEATING*,10X,*HEATING*,10X,*BREEDING*,9X,*FISSIONS*,9X,
4  *CAPTURES*,/1X)
21  FORMAT(1H1,10X,8A10,///5X,*ZONE*,10X,*ZONE*,12X,*TOTAL*,
1  11X,*NEUTRON*,11X,*GAMMA*,11X,*TRITIUM*,/4X,*NUMBER*,
2  6X,*VOLUME*,3(10X,*HEATING*),10X,*BREEDING*,/1X)
31  FORMAT(1H1,10X,8A10,///5X,*ZONE*,10X,*ZONE*,11X,*TRITIUM*,
1  /4X,*NUMBER*,6X,*VOLUME*,10X,*BREEDING*,/1X)

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41 FORMAT(1H1,10X,8A10,///5X,*ZONE*,10X,*ZONE*,12X,*TOTAL*,
1 11X,*NEUTRON*,11X,*GAMMA*,12X,*TOTAL*,12X,*TOTAL*,/4X,
2 *NUMBER*,8X,*VOLUME*,3(10X,*HEATING*),10X,*FISSIONS*,
3 9X,*CAPTURES*,/1X)
51 FORMAT(1H1,10X,8A10,///5X,*ZONE*,10X,*ZONE*,11X,*TRITIUM*,
1 11X,*TOTAL*,12X,*TOTAL*,/4X,*NUMBER*,8X,*VOLUME*,10X,
2 *BREEDING*,9X,*FISSIONS*,9X,*CAPTURES*,/1X)
61 FORMAT(1H1,10X,8A10,///5X,*ZONE*,10X,*ZONE*,12X,*TOTAL*,
1 12X,*TOTAL*,/4X,*NUMBER*,8X,*VOLUME*,10X,*FISSIONS*,
2 9X,*CAPTURES*,/1X)
71 FORMAT(1H1,10X,8A10,///5X,*ZONE*,10X,*ZONE*,12X,*TOTAL*,
1 11X,*NEUTRON*,11X,*GAMMA*,/4X,*NUMBER*,8X,*VOLUME*,
2 3(10X,*HEATING*),/1X)
1000 CONTINUE
      RETURN
      END
      FUNCTION VOL(IGEOM,X,I)
      DIMENSION X(1)
      IF(IGEOM.EQ.0) VOL = X(I+1) - X(I)
      IF(IGEOM.EQ.1) VOL = 3.14159 * (X(I+1) * X(I+1) - X(I) * X(I))
      IF(IGEOM.EQ.2) VOL = (4.0 * 3.14159 / 3.0) *
1 (X(I+1) * X(I+1) * X(I+1) - X(I) * X(I) * X(I))
      RETURN
      END
      SUBROUTINE FLUXSUM(FLUX,N,NG,IGEOM,X,NX,TITLE,IZ,FSUM,NZ,
1 FNRM)
CJLJ      S.R. FLUXSUM INTEGRATES THE INPUT FLUX OVER THE ZONE VOLUMES
CJLJ
CJLJ      DIMENSION FLUX(N,NG),X(NX),IZ(N),TITLE(8),FSUM(NZ,NG)
      DO 1 J=1,NG
      DO 1 I=1,NZ
1 FSUM(I,J) = 0.0
      DO 10 I=1,N
      IZP = IZ(I)
      VOLI = VOL(IGEOM,X,I)
      DO 11 J=1,NG
      FSUM(IZP,J) = FSUM(IZP,J) + FLUX(I,J) * VOLI * FNRM
11 CONTINUE
10 CONTINUE
      ID = 5HZONE
      DO 20 I=1,NZ,6
      I6 = 1 + 5
      IF (I6 .GT. NZ) I6 = NZ
      WRITE(6,2)TITLE
      2 FORMAT(1H1,10X,8A10,///15X,*VOLUME INTEGRATED FLUXES BY ZONE*,/1H0)
      WRITE(6,21)(ID,J,J=1,I6)
21 FORMAT(5X,*GROUP*,7X,A5,I2,5(10X,A5,I2))
24 FORMAT(1H0)
      WRITE(6,24)
      DO 22 K=1,NG
      WRITE(6,23) K,(FSUM(J,K),J=1,I6)
22 CONTINUE
20 CONTINUE
23 FORMAT(5X,15,6(5X,1PE12.5))
      RETURN
      END
      SUBROUTINE STEPSIZ(XMIN,XMAX,XSTEP,YMIN,YMAX,YSTEP,LOGY,LOGX)
CJLJ      S.R. STEPSIZ CALCULATES THE STEP SIZES FOR USE BY DISSPLA
CJLJ      IN THE PLOTTING ROUTINES
CJLJ
CJLJ      IF(LOGX.EQ.1) GO TO 10
      XSTEP = 5.0
      XS = (XMAX - XMIN) / 8.0
      IF(XS .GT. 5.0 .AND. XS .LE. 10.0) XSTEP = 10.0
      IF(XS .GT. 10.0 .AND. XS .LE. 15.0) XSTEP = 15.0
      IF(XS .GT. 15.0 .AND. XS .LE. 20.0) XSTEP = 20.0

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      IF(XS .GT. 20.0 .AND. XS .LE. 25.0) XSTEP = 25.0
      IF(XS .GT. 25.0 .AND. XS .LE. 30.0) XSTEP = 30.0
      IF(XS .GT. 30.0 .AND. XS .LE. 40.0) XSTEP = 40.0
      IF(XS .GT. 40.0) XSTEP = 50.0
      GO TO 11
10  CONTINUE
      IMI = IFIX(ALOG10(XMIN)+0.01)
      IMA = IFIX(ALOG10(XMAX)+0.01)
      IF(XMAX.LT.1.0) IMA = IFIX(ALOG10(XMAX) - 0.01)
      IF(XMIN.LT.1.0) IMI = IFIX(ALOG10(XMIN) - 0.01)
      NCY = IMA - IMI
      XSTEP = 8.0 / FLOAT(NCY)
11  IF(LOGY.EQ.1) GO TO 1
      YSTEP = 0.1
      YS = (YMAX - YMIN) / 6.0
      IF(YS .GT. 0.1 .AND. YS .LE. 0.2) YSTEP = 0.2
      IF(YS .GT. 0.2 .AND. YS .LE. 0.25) YSTEP = 0.25
      IF(YS .GT. 0.25 .AND. YS .LE. 0.50) YSTEP = 0.5
      IF(YS .GT. 0.5 .AND. YS .LE. 1.0) YSTEP = 1.0
      IF(YS .GT. 1.0 .AND. YS .LE. 1.5) YSTEP = 1.5
      IF(YS .GT. 1.5 .AND. YS .LE. 2.0) YSTEP = 2.0
      IF(YS .GT. 2.0) YSTEP = 5.0
      RETURN
1  CONTINUE
      IMI = IFIX(ALOG10(YMIN)+0.01)
      IMA = IFIX(ALOG10(YMAX)+0.01)
      IF(YMAX.LT.1.0) IMA = IFIX(ALOG10(YMAX) - 0.01)
      IF(YMIN.LT.1.0) IMI = IFIX(ALOG10(YMIN) - 0.01)
      NCYCLES = IMA - IMI
      YSTEP = 6.0 / FLOAT(NCYCLES)
      RETURN
      END
      SUBROUTINE HEATOUT(NP,NI,JFLAG,HEATIN,HEATN,HEATIG,HEATG,
1  T,ICOUNT,NC)

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CJLJ S.R. HEATOUT EDITS OUT THE ISOTOPIC HEATING RATES AND THEIR
 CJLJ FRACTION OF THE TOTAL HEATING RATE
 CJLJ

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      DIMENSION JFLAG(NI),HEATIN(NI,NP),HEATN(NP),HEATIG(NI,NP)
      DIMENSION ICOUNT(NC),T(8),HEATG(NP)
      ID1 = 7HNEUTRON
      ID2 = 8HHEATING
      CALL ZCHECK(NP,NI,HEATIN,ICOUNT,NC,NUM)
      IF(NUM.EQ.0) GO TO 3
      CALL OUT(T,NP,NI,JFLAG,HEATIN,HEATN,ICOUNT,NC,NUM,ID1,ID2)
      IF(NUM.EQ.NI) GO TO 30
3  CONTINUE
      WRITE(6,1)
      DO 20 I=1,NI
      IF(NUM.EQ.0) GO TO 5
      DO 21 J=1,NUM
21  IF(I.EQ.ICOUNT(J)) GO TO 20
5  CONTINUE
      WRITE(6,2)ID1,JFLAG(I)
20  CONTINUE
      WRITE(6,40)
40  FORMAT(1H0,132(1H*))
30  CONTINUE
      ID1 = 7H GAMMA
      CALL ZCHECK(NP,NI,HEATIG,ICOUNT,NC,NUM)
      IF(NUM.EQ.0) GO TO 4
      CALL OUT(T,NP,NI,JFLAG,HEATIG,HEATG,ICOUNT,NC,NUM,ID1,ID2)
      IF(NUM.EQ.NI) RETURN
4  CONTINUE
      WRITE(6,1)
1  FORMAT(1H1,132(1H*))
      DO 10 I=1,NI
      IF(NUM.EQ.0) GO TO 6

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      DO 11 J=1,NUM
11  IF(I.EQ.ICOUNT(J)) GO TO 10
      6  CONTINUE
      WRITE(6,2)ID1,JFLAG(I)
10  CONTINUE
      2  FORMAT(1H0,5X,*CALCULATED *,A7,* HEATING RATES FOR *,A6,
      1  * ARE ZERO*)
      WRITE(6,40)
      RETURN
      END
      SUBROUTINE TRITOUT(NP,NI,JFLAG,TRITBRI,TRITBR,T,ICOUNT,NC)
CJLJ
CJLJ      S.R. TRITOUT EDITS THE ISOTOPIC TRITIUM BREEDING RATES AND
CJLJ      THEIR FRACTION OF TOTAL TRITIUM BREEDING
CJLJ
      DIMENSION ICOUNT(NC),JFLAG(NI),TRITBRI(NI,NP),TRITBR(NP),T(8)
      ID1 = 7HTRITIUM
      ID2 = 8HBREEDING
      CALL ZCHECK(NF,NI,TRITBRI,ICOUNT,NC,NUM)
      IF(NUM.EQ.0) GO TO 3
      CALL OUT(T,NP,NI,JFLAG,TRITBRI,TRITBR,ICOUNT,NC,NUM,ID1,ID2)
      IF(NUM.EQ.NI) RETURN
      3  CONTINUE
      WRITE(6,1)
      1  FORMAT(1H1,132(1H*))
      DO 10 I=1,NI
      IF(NUM.EQ.0) GO TO 4
      DO 11 J=1,NUM
11  IF(I.EQ.ICOUNT(J)) GO TO 10
      4  CONTINUE
      WRITE(6,2)JFLAG(I)
10  CONTINUE
      2  FORMAT(1H0,5X,*CALCULATED TRITIUM BREEDING RATES FOR *,A6,
      1  * ARE ZERO*)
      WRITE(6,40)
40  FORMAT(1H0,132(1H*))
      RETURN
      END
      SUBROUTINE FISSIN(NI,N,SF,SC,JI,A)
      DIMENSION JI(NI),SF(NI,N),SC(NI,N),A(N)
CJLJ
CJLJ      S.R. FISSIN READS IN FISSION AND ABSORPTION CROSS SECTIONS
CJLJ      AND CALCULATES CAPTURE CROSS SECTIONS
CJLJ
      REWIND 3
12  READ(3,1)1
      IF(EOF(3).NE.C) GO TO 1000
      1  FORMAT(I5)
      DO 10 K=1,NI
10  IF(I.EQ.JI(K)) GO TO 100
      READ(3,101)(A(IK),IK=1,N)
      READ(3,101)(A(IK),IK=1,N)
      GO TO 12
100 READ(3,101)(SC(K,L),L=1,N)
      READ(3,101)(SF(K,L),L=1,N)
101  FORMAT(6E12.5)
      GO TO 12
1000 CONTINUE
      DO 1001 J=1,NI
      DO 1001 K=1,N
      SC(J,K) = SC(J,K) - SF(J,K)
1001 CONTINUE
      RETURN
      END
      SUBROUTINE FISSOUT(NI,N,JF,SF,SC,T)
CJLJ
CJLJ      S.R. FISSOUT WRITES OUT THE FISSION AND CAPTURE CROSS SECTIONS
CJLJ

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        DIMENSION JF(NI),SF(NI,N),SC(NI,N),T(8)
        KF1 = 6HCRUSS
        KF2 = 7HSECTION
        LFLAG = 7HFISSION
        ICOUNT = 0
100    DO 1 I=1,NI,6
        I5 = I + 5
        IF(I5.GT.NI) I5 = NI
        WRITE(6,11)T,(JF(J),J=1,I5)
        WRITE(6,12)(LFLAG,J=1,I5)
        WRITE(6,13)(KF1,KF2,J=1,I5)
11    FORMAT(1H1,10X,8A10,///19X,A6,5(11X,A6))
12    FORMAT(5X,*ENERGY*,8X,A7,5(10X,A7))
13    FORMAT(5X,*GROUP*,5X,A6,A7,5(4X,A6,A7))
14    FORMAT(1H0)
        WRITE(6,14)
        IF(ICOUNT.EQ.1) GO TO 4
        DO 2 K=1,N
2    WRITE(6,3)K,(SF(J,K),J=1,I5)
3    FORMAT(6X,13,2X,6(5X,1PE12.5))
4    IF(ICOUNT.EQ.0) GO TO 1
        DO 5 K=1,N
5    WRITE(6,3)K,(SC(J,K),J=1,I5)
1    CONTINUE
        LFLAG = 7HCAPTURE
        ICOUNT = ICOUNT + 1
        IF(ICOUNT.EQ.1) GO TO 100
        RETURN
    END
    SUBROUTINE FRATOUT(NP,NI,JFLAG,FIS,FISTOT,CAP,CAPTOT,T,ICOUNT,NC)

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S.R. FRATOUT EDITS OUT THE ISOTOPIC REACTION RATES
 AND THEIR FRACTION OF THE TOTAL REACTION RATE

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        DIMENSION JFLAG(NI),FIS(NI,NP),FISTOT(NP),CAP(NI,NP),CAPTOT(NP)
        DIMENSION ICOUNT(NC)
        ID1 = 7HFISSION
        ID2 = 8H RATE
        CALL ZCHECK(NP,NI,FIS,ICOUNT,NC,NUM)
        IF(NUM.EQ.0) GO TO 3
        CALL OUT(T,NP,NI,JFLAG,FIS,FISTOT,ICOUNT,NC,NUM,ID1,ID2)
        IF(NUM.EQ.NI) GO TO 30
3    CONTINUE
        WRITE(6,1)
1    FORMAT(1H1,132(1H*))
        DO 10 I=1,NI
        IF(NUM.EQ.0) GO TO 5
        DO 11 J=1,NUM
11    IF(I.EQ.ICOUNT(J)) GO TO 10
5    CONTINUE
        WRITE(6,2)ID1,JFLAG(I)
10    CONTINUE
        WRITE(6,40)
30    CONTINUE
        ID1 = 7HCAPTURE
        CALL ZCHECK(NP,NI,CAP,ICOUNT,NC,NUM)
        IF(NUM.EQ.0) GO TO 4
40    FORMAT(1H0,132(1H*))
        CALL OUT(T,NP,NI,JFLAG,CAP,CAPTOT,ICOUNT,NC,NUM,ID1,ID2)
        IF(NUM.EQ.NI) RETURN
4    CONTINUE
        WRITE(6,1)
        DO 20 I=1,NI
        IF(NUM.EQ.0) GO TO 6
        DO 21 J=1,NUM
21    IF(I.EQ.ICOUNT(J)) GO TO 20
6    CONTINUE
        WRITE(6,2)ID1,JFLAG(I)

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20 CONTINUE
2  FORMAT(1H0,5X,*CALCULATED *,A7,* RATES FOR *,A6,* ARE ZERO*)
   WRITE(6,40)
   RETURN
   END
   SUBROUTINE INTRATE(NP,X,N1,NI,IGEOM,NZ1,NZ2,JFLAG,TITLE,FIS,CAP,
1  FISI,CAP1,FNORM)
CJLJ
CJLJ      S.R. INTRATE CALCULATES THE VOLUME INTEGRATED ISOTOPIC
CJLJ      FISSION AND CAPTURE RATES
CJLJ
   DIMENSION X(N1),JFLAG(NI),FIS(NI,NP),CAP(NI,NP),CAP1(NI),FISI(NI)
   DIMENSION TITLE(8)
   FISTOT = 0.0
   CAPTOT = 0.0
   DO 1 J=1,NI
   FISI(J) = 0.0
   CAP1(J) = 0.0
1  CONTINUE
   DO 10 I=NZ1,NZ2
   VOLI = VOL(IGEOM,X,I)
   I1 = I - NZ1 + 1
   DO 11 J=1,NI
   FISI(J) = FISI(J) + FIS(J,I1) * VOLI / FNORM
   CAP1(J) = CAP1(J) + CAP(J,I1) * VOLI / FNORM
   FISTOT = FISTOT + FIS(J,I1) * VOLI / FNORM
   CAPTOT = CAPTOT + CAP(J,I1) * VOLI / FNORM
11 CONTINUE
10 CONTINUE
   TOT = FISTOT + CAPTOT
   F1 = 1.0
   F2 = 1.0
   F3 = 1.0
   F4 = 1.0
   IF(TOT.EQ.0.0) GO TO 30
   F3 = FISTOT / TOT
   F4 = CAPTOT / TOT
30 CONTINUE
   WRITE(6,20)TITLE,FISTOT,F1,F3,CAPTOT,F2,F4
   IF(TOT.EQ.0.0) RETURN
20  FORMAT(1H1,10X,8A10,///11X,
1  *INTEGRATED FISSION AND CAPTURE RATES PER *,
2  *SOURCE NEUTRON*,/1H0,15X,*FISSIONS PER*,5X,*FRACTION OF*,
3  6X,*FRACTION OF*,6X,*CAPTURES PER*,5X,*FRACTION OF*,6X,
4  *FRACTION OF*,/4X,*ISOTOPE*,4X,*SOURCE NEUTRON*,6X,
5  *FISSIONS*,5X,*TOTAL REACTIONS*,3X,*SOURCE NEUTRON*,6X,
6  *CAPTURES*,5X,*TOTAL REACTIONS*,/1H0,4X,*TOTAL*,6(5X,1PE12.5))
   DO 21 J=1,NI
   F1 = 0.0
   F2 = 0.0
   F3 = 0.0
   F4 = 0.0
   IF(FISI(J).EQ.0.0.AND.CAP1(J).EQ.0.0) GO TO 21
   IF(FISTOT.NE.0.0) F1 = FISI(J) / FISTOT
   IF(CAPTOT.NE.0.0) F2 = CAP1(J) / CAPTOT
   F3 = FISI(J) / TOT
   F4 = CAP1(J) / TOT
   WRITE(6,22)JFLAG(J),FISI(J),F1,F3,CAP1(J),F2,F4
21 CONTINUE
22  FORMAT(5X,A6,6(5X,1PE12.5))
   RETURN
   END
   SUBROUTINE SPECTRA(FLXZONE,FLUX,NZONES,NINT,NG,NNG,NGG,EN,EG,
1  SN,SG,ISINT,ISZONE,ISI,ISZ,NNG1,NGG1,ENMID,EGMID,EPLT,
2  NEPLT,IPLT,JPLT,INORM,IDIVID)
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CJLJ      S.R. SPECTRA CALCULATES THE NEUTRON AND GAMMA ENERGY
CJLJ      SPECTRA FOR SPECIFIED ZONES AND INTERVALS

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DIMENSION EPLUT(NEPLOT)
DIMENSION FLXZONE(NZONES,NG),FLUX(NINT,NG),EN(NNG1),EG(NGG1)
DIMENSION SN(NNG),SG(NGG),ISINT(ISI),ISZONE(ISZ),TITLE(4)
DIMENSION ENMID(NNG),EGMID(NGG)
DIMENSION TITLE2(4)
FLUXTOT = 1.0
DO 1 I=1,NNG
1 ENMID(I) = (EN(I) + EN(I+1)) / 2.0
DO 2 I=1,NGG
2 EGMID(I) = (EG(I) + EG(I+1)) / 2.0
IF(ISZ.EQ.0) GO TO 200
DO 10 I=1,ISZ
IZ = ISZONE(I)
FLUXTOT = 1.0
IF(INORM.EQ.0.OR.INORM.EQ.2) GO TO 15
FLUXTOT = 0.0
DO 11 J=1,NNG
11 FLUXTOT = FLUXTOT + FLXZONE(IZ,J)
15 CONTINUE
DO 12 K=1,NNG
DELU = DELTA(IDIVID,EN,K)
SN(K) = FLXZONE(IZ,K) / (FLUXTOT * DELU)
12 CONTINUE
FLUXTOT = 1.0
IF(INORM.EQ.0.OR.INORM.EQ.2) GO TO 16
FLUXTOT = 0.0
DO 13 J=1,NGG
13 FLUXTOT = FLUXTOT + FLXZONE(IZ,NNG+J)
16 CONTINUE
DO 14 K=1,NGG
DELU = DELTA(IDIVID,EG,K)
SG(K) = FLXZONE(IZ,NNG+K) / (FLUXTOT * DELU)
14 CONTINUE
ENCODE(40,3,TITLE)IZ
ENCODE(40,4,TITLE2)IZ
IF(INORM.GE.2.AND.JPLOT.GT.0) CALL HISTGRM(TITLE,TITLE2,SN,SG,
1 EN,EG,EPLUT,NNG,NNG1,NGG,NGG1,NEPLOT,IPLOT,INORM,IDIVID)
CALL SPECOUT(SN,EN,NNG,NNG1,TITLE,ENMID,FLXZONE,NZONES,NG,
1 IZ,1,IDIVID,INORM)
IF(INORM.LT.2.AND.JPLOT.GT.0) CALL SPECPLT(SN,ENMID,NNG,EPLUT,
1 NEPLOT,TITLE,IPLOT,IDIVID,INORM)
ENCODE(40,4,TITLE)IZ
CALL SPECOUT(SG,EG,NGG,NGG1,TITLE,EGMID,FLXZONE,NZONES,NG,
1 IZ,NNG1,IDIVID,INORM)
IF(INORM.LT.2.AND.JPLOT.GT.0) CALL SPECPLT(SG,EGMID,NGG,EPLUT,
1 NEPLOT,TITLE,IPLOT,IDIVID,INORM)
3 FORMAT(*(N)EUTRON SPECTRUM FOR ZONE *,I3,*,8X)
4 FORMAT(*(G)AMMA SPECTRUM FOR ZONE *,I3,*,10X)
10 CONTINUE
200 IF(ISI.EQ.0) GO TO 300
DO 210 I=1,ISI
II = ISINT(I)
FLUXTOT = 1.0
IF(INORM.EQ.0.OR.INORM.EQ.2) GO TO 215
FLUXTOT = 0.0
DO 211 J=1,NNG
211 FLUXTOT = FLUXTOT + FLUX(II,J)
215 CONTINUE
DO 212 K=1,NNG
DELU = DELTA(IDIVID,EN,K)
SN(K) = FLUX(II,K) / (FLUXTOT * DELU)
212 CONTINUE
FLUXTOT = 1.0
IF(INORM.EQ.0.OR.INORM.EQ.2) GO TO 216
FLUXTOT = 0.0
DO 213 J=1,NGG
213 FLUXTOT = FLUXTOT + FLUX(II,NNG+J)

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216 CONTINUE
  DO 214 K=1,NGG
    DELU = DELTA(IDIVID,EG,K)
    SG(K) = FLUX(II,NNG+K) / (FLUXTOT * DELU)
214 CONTINUE
  ENCODE(40,5,TITLE)II
  ENCODE(40,6,TITLE2)II
  IF(INORM.GE.2.AND.JPLOT.GT.0) CALL HISTGRM(TITLE,TITLE2,SN,SG,
1 EN,EG,EPLT,NNG,NNG1,NGG,NGG1,NEPLOT,IPLT,INORM,IDIVID)
  CALL SPECOUT(SN,EN,NNG,NNG1,TITLE,ENMID,FLUX,NINT,NG,II,1,
1 IDIVID,INORM)
  IF(INORM.LT.2.AND.JPLOT.GT.0) CALL SPECPLT(SN,ENMID,NNG,EPLT,
1 NEPLOT,TITLE,IPLT,IDIVID,INORM)
  ENCODE(40,6,TITLE)II
  CALL SPECOUT(SG,EG,NGG,NGG1,TITLE,EGMID,FLUX,NINT,NG,II,NNG1,
1 IDIVID,INORM)
  IF(INORM.LT.2.AND.JPLOT.GT.0) CALL SPECPLT(SG,EGMID,NGG,EPLT,
1 NEPLOT,TITLE,IPLT,IDIVID,INORM)
5 FORMAT(* (N) NEUTRON SPECTRUM FOR INTERVAL *,I3,*,*,4X)
6 FORMAT(* (G) GAMMA SPECTRUM FOR INTERVAL *,I3,*,*,6X)
210 CONTINUE
300 CONTINUE
  RETURN
  END
  SUBROUTINE SPECPLT(S,E,N,EP,NP,T,IPLT,IDIVID,INORM)

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S.R. SPECPLT PLOTS NEUTRON AND GAMMA ENERGY SPECTRA

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  DIMENSION EP(NP)
  DIMENSION S(N),E(N),T(4)
  NGO = N
  CALL SPCZERO(S,E,N,NGO,EP,NP)
  CALL COMPLX
  CALL BGNPL(IPLT)
  CALL MX1ALF("L/CSTD","")
  CALL MX2ALF("STANDARD","")
  CALL MX3ALF("INSTRUCTION","+")
  IF(INORM.EQ.1.AND.IDIVID.EQ.1) CALL TITLE(T,-100,
1 "(E)ENERGY ((E(V)))$",100,"(R)RELATIVE FLUX PER UNIT LETHARGY$",
2 100,8.0,6.0)
  IF(INORM.EQ.0.AND.IDIVID.EQ.0) CALL TITLE(T,-100,
1 "(E)ENERGY ((E(V)))$",
2 100,"(F)FLUX PER E(V)",100,8.0,6.0)
  IF(INORM.EQ.0.AND.IDIVID.EQ.1) CALL TITLE(T,-100,
1 "(E)ENERGY ((E(V)))$",
2 100,"(F)FLUX PER UNIT LETHARGY$",100,8.0,6.0)
  IF(INORM.EQ.1.AND.IDIVID.EQ.0) CALL TITLE(T,-100,
1 "(E)ENERGY ((E(V)))$",
2 100,"(R)RELATIVE FLUX PER E(V)",100,8.0,6.0)
  CALL MAX(NGO,S,SMAX,SMIN)
  CALL MAX(NGO,EP,EMAX,EMIN)
  CALL STEPSIZ(EMIN,EMAX,ESTEP,SMIN,SMAX,SSTEP,1,1)
  CALL LOGLOG(EMIN,ESTEP,SMIN,SSTEP)
  CALL FRAME
  CALL CURVE(EP,S,NGO,0)
  CALL ENDPL(IPLT)
  IPLT = IPLT + 1
  RETURN
  END
  SUBROUTINE SPECOUT(S,E,N,N1,T,EMID,F,NZ,NG,IZ,ISTART,IDIVID,INORM)

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S.R. SPECOUT PRINTS OUT NEUTRON AND GAMMA ENERGY SPECTRA

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  DIMENSION S(N),E(N1),EMID(N),T(4)
  DIMENSION F(NZ,NG)
  IF(IDIVID.EQ.0) GO TO 20
  IF(INORM.EQ.0.OR.INORM.EQ.2) WRITE(6,13)T
  IF(INORM.EQ.1.OR.INORM.EQ.3) WRITE(6,12)T

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        GC TO 21
20 CONTINUE
    IF(INORM.EQ.0.OR.INORM.EQ.2) WRITE(6,1)T
    IF(INORM.EQ.1.OR.INORM.EQ.3) WRITE(6,11)T
21 CONTINUE
1  FORMAT(1H1,20X,4A10,///16X,*UPPER*,12X,*LOWER*,12X,*GROUP*,26X,
2  /3X,*ENERGY*,7X,*ENERGY*,11X,*ENERGY*,10X,*MIDPOINT*,24X,
3  4X,*FLUX*,
4  /4X,*GROUP*,8X,*(EV)*,2(13X,*(EV)*),13X,*FLUX*,9X,
5  3X,*PER EV*,/1X)
11 FORMAT(1H1,20X,4A10,///16X,*UPPER*,12X,*LOWER*,12X,*GROUP*,26X,
1  1X,*NORMALIZED*,
2  /3X,*ENERGY*,7X,*ENERGY*,11X,*ENERGY*,10X,*MIDPOINT*,24X,
3  4X,*FLUX*,
4  /4X,*GROUP*,8X,*(EV)*,2(13X,*(EV)*),13X,*FLUX*,9X,
5  3X,*PER EV*,/1X)
12 FORMAT(1H1,20X,4A10,///16X,*UPPER*,12X,*LOWER*,12X,*GROUP*,26X,
1  1X,*NORMALIZED*,
2  /3X,*ENERGY*,7X,*ENERGY*,11X,*ENERGY*,10X,*MIDPOINT*,24X,
3  2X,*FLUX PER*,
4  /4X,*GROUP*,8X,*(EV)*,2(13X,*(EV)*),13X,*FLUX*,9X,
5  *UNIT LETHARGY*,/1X)
13 FORMAT(1H1,20X,4A10,///16X,*UPPER*,12X,*LOWER*,12X,*GROUP*,26X,
1  4X,*FLUX*,
2  /3X,*ENERGY*,7X,*ENERGY*,11X,*ENERGY*,10X,*MIDPOINT*,24X,
3  4X,*PER*,
4  /4X,*GROUP*,8X,*(EV)*,2(13X,*(EV)*),13X,*FLUX*,9X,
5  *UNIT LETHARGY*,/1X)
2  FORMAT(5X,I3,5(5X,1PE12.5))
    DO 3 I=1,N
    IX = ISTART - 1 + I
    3  WRITE(6,2)I,E(I),E(I+1),EMID(I),F(IZ,IX),S(I)
    RETURN
    END
    SUBROUTINE CALHEAT(NP,NINT,NG,NISO,NMAT,NZONES,ANORM,FNORM,
1  HEAT,HEATN,HEATG,HEATIN,HEATIG,KERMA,BISO,FLUX,IZONE,
2  IMAT,NZ1,NZ2,NNGRP)

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S.R. CALHEAT CALCULATES THE ISOTOPIC NEUTRON AND GAMMA
HEATING RATES BY INTERVAL

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    DIMENSION FLUX(NINT,NG),KERMA(NISO,NG),BISO(NISO,NMAT)
    DIMENSION HEAT(NP),HEATN(NP),HEATG(NP),HEATIN(NISO,NP)
    DIMENSION HEATIG(NISO,NP),IZONE(NINT)
    DIMENSION IMAT(NZONES)
    REAL KERMA
    DO 1 I=NZ1,NZ2
    IZ = IZONE(I)
    II = 1 - NZ1 + 1
    IM = IMAT(IZ)
    DO 2 J=1,NISO
    IF(BISO(J,IM).EQ.0.0) GO TO 2
    DO 3 K=1,NG
    IF(K.GT.NNGRP) GO TO 4
    HEATIN(J,II) = HEATIN(J,II) + FLUX(I,K) * KERMA(J,K)
    GO TO 3
4  CONTINUE
    HEATIG(J,II) = HEATIG(J,II) + FLUX(I,K) * KERMA(J,K)
3  CONTINUE
    HEATIN(J,II) = HEATIN(J,II) * BISO(J,IM) * ANORM * FNORM
    HEATIG(J,II) = HEATIG(J,II) * BISO(J,IM) * ANORM * FNORM
    HEATN(II) = HEATN(II) + HEATIN(J,II)
    HEATG(II) = HEATG(II) + HEATIG(J,II)
2  CONTINUE
    HEAT(II) = HEATN(II) + HEATG(II)
1  CONTINUE
    RETURN
    END

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SUBROUTINE CALTBR(NP,NINT,NNGRP,NG,NISO,NMAT,NZONES,
1 TRITBR,TRITBRI,TBRFAC,BISO,FLUX,IZONE,IMAT,NZ1,NZ2)
CJLJ
CJLJ      S.F. CALTBR CALCULATES THE ISOTOPIC TRITIUM PRODUCTION
CJLJ      BY INTERVAL
CJLJ
      DIMENSION FLUX(NINT,NG),BISO(NISO,NMAT),IZONE(NINT),IMAT(NZONES)
      DIMENSION TBRFAC(NISO,NG),TRITBR(NP),TRITBRI(NISO,NP)
      DO 1 I=NZ1,NZ2
      IZ = IZONE(I)
      II = I - NZ1 + 1
      IM = IMAT(IZ)
      DO 2 J=1,NISO
      IF(BISO(J,IM).EQ.0.0) GO TO 2
      DO 3 K=1,NNGRP
      FB = FLUX(I,K) * BISO(J,IM)
      TRITBRI(J,II) = TRITBRI(J,II) + FB * TBRFAC(J,K)
3 CONTINUE
      TRITBR(II) = TRITBR(II) + TRITBRI(J,II)
2 CONTINUE
1 CONTINUE
      RETURN
      END
      SUBROUTINE CALFISS(NP,NINT,NNGRP,NG,NISO,NMAT,NZONES,FNORM,
1 FISTOT,FIS,SIGF,CAPTOT,CAP,SIGC,BISO,FLUX,IZONE,IMAT,
2 NZ1,NZ2)

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CJLJ
CJLJ      S.R. CALFISS CALCULATES THE ISOTOPIC FISSION AND CAPTURE
CJLJ      RATES BY INTERVAL
CJLJ
      DIMENSION FLUX(NINT,NG),FISTOT(NP),FIS(NISO,NP),SIGF(NISO,NNGRP)
      DIMENSION CAPTOT(NP),CAP(NISO,NP),SIGC(NISO,NNGRP),IZONE(NINT)
      DIMENSION BISO(NISO,NMAT),IMAT(NZONES)
      DO 1 I=NZ1,NZ2
      IZ = IZONE(I)
      II = I - NZ1 + 1
      IM = IMAT(IZ)
      DO 2 J=1,NISO
      IF(BISO(J,IM).EQ.0.0) GO TO 2
      DO 3 K=1,NNGRP
      FB = FLUX(I,K) * BISO(J,IM) * FNORM
      FIS(J,II) = FIS(J,II) + FB * SIGF(J,K)
      CAP(J,II) = CAP(J,II) + FB * SIGC(J,K)
3 CONTINUE
      FISTOT(II) = FISTOT(II) + FIS(J,II)
      CAPTOT(II) = CAPTOT(II) + CAP(J,II)
2 CONTINUE
1 CONTINUE
      RETURN
      END
      SUBROUTINE DATAOUT(NP,HEAT,HEATN,HEATG,TRITBR,FISTOT,CAPTOT,
1 T,IFISS,IHEAT,ITRIT,XP)

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CJLJ
CJLJ      S.R. DATAOUT PRINTS OUT THE TOTAL HEATING, TRITIUM PRODUCTION,
CJLJ      FISSION, AND CAPTURE RATES BY INTERVAL
CJLJ
      DIMENSION T(8),XP(NP)
      DIMENSION HEAT(NP),HEATN(NP),HEATG(NP),TRITBR(NP)
      DIMENSION FISTOT(NP),CAPTOT(NP)
      IF(IFISS.GT.0.AND.IHEAT.GT.0.AND.ITRIT.GT.0) GO TO 1
      IF(IFISS.EQ.0.AND.IHEAT.GT.0.AND.ITRIT.GT.0) GO TO 2
      IF(IFISS.EQ.0.AND.IHEAT.EQ.0.AND.ITRIT.GT.0) GO TO 3
      IF(ITRIT.EQ.0.AND.IFISS.GT.0.AND.IHEAT.GT.0) GO TO 4
      IF(IHEAT.EQ.0.AND.IFISS.GT.0.AND.ITRIT.GT.0) GO TO 5
      IF(IHEAT.EQ.0.AND.IFISS.GT.0.AND.ITRIT.EQ.0) GO TO 6
      IF(ITRIT.EQ.0.AND.IFISS.EQ.0.AND.IHEAT.GT.0) GO TO 7
      RETURN
1 CONTINUE

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WRITE(6,11)T
DO 12 J=1,NP
WRITE(6,101)J,XP(J),HEAT(J),HEATN(J),HEATG(J),TRITBR(J),
1 FISTOT(J),CAPTOT(J)
12 CONTINUE
RETURN
2 CONTINUE
WRITE(6,21)T
DO 22 J=1,NP
WRITE(6,102)J,XP(J),HEAT(J),HEATN(J),HEATG(J),TRITBR(J)
22 CONTINUE
RETURN
3 CONTINUE
WRITE(6,31)T
DO 32 J=1,NP
WRITE(6,103)J,XP(J),TRITBR(J)
32 CONTINUE
RETURN
4 CONTINUE
WRITE(6,41)T
DO 42 J=1,NP
WRITE(6,104)J,XP(J),HEAT(J),HEATN(J),HEATG(J),
1 FISTOT(J),CAPTOT(J)
42 CONTINUE
RETURN
5 CONTINUE
WRITE(6,51)T
DO 52 J=1,NP
WRITE(6,105)J,XP(J),TRITBR(J),FISTOT(J),CAPTOT(J)
52 CONTINUE
RETURN
6 CONTINUE
WRITE(6,61)T
DO 62 J=1,NP
WRITE(6,106)J,XP(J),FISTOT(J),CAPTOT(J)
62 CONTINUE
RETURN
7 CONTINUE
WRITE(6,71)T
DO 72 J=1,NP
WRITE(6,107)J,XP(J),HEAT(J),HEATN(J),HEATG(J)
72 CONTINUE
RETURN
101 FORMAT(5X,I5,7(5X,1PE12.5))
102 FORMAT(5X,I5,5(5X,1PE12.5))
103 FORMAT(5X,I5,2(5X,1PE12.5))
104 FORMAT(5X,I5,6(5X,1PE12.5))
105 FORMAT(5X,I5,4(5X,1PE12.5))
106 FORMAT(5X,I5,3(5X,1PE12.5))
107 FORMAT(5X,I5,4(5X,1PE12.5))
11 FORMAT(1H1,10X,8A10,///35X,*TOTAL*,11X,*NEUTRON*,11X,*GAMMA*,
1 11X,*TRITIUM*,10X,*FISSION*,10X,*CAPTURE*,/3X,*INTERVAL*,
2 6X,*DISTANCE*,9X,*HEATING*,10X,*HEATING*,10X,*HEATING*,10X,
3 *BREEDING*,11X,*RATE*,13X,*RATE*,/1X)
21 FORMAT(1H1,10X,8A10,///35X,*TOTAL*,11X,*NEUTRON*,11X,*GAMMA*,
1 11X,*TRITIUM*,/3X,*INTERVAL*,6X,*DISTANCE*,9X,*HEATING*,
2 10X,*HEATING*,10X,*HEATING*,10X,*BREEDING*,/1X)
31 FORMAT(1H1,10X,8A10,///34X,*TRITIUM*,/3X,*INTERVAL*,6X,
1 *DISTANCE*,9X,*BREEDING*,/1X)
41 FORMAT(1H1,10X,8A10,///35X,*TOTAL*,11X,*NEUTRON*,11X,*GAMMA*,
1 11X,*FISSION*,10X,*CAPTURE*,/3X,*INTERVAL*,6X,*DISTANCE*,
2 9X,*HEATING*,10X,*HEATING*,10X,*HEATING*,12X,*RATE*,
3 13X,*RATE*,/1X)
51 FORMAT(1H1,10X,8A10,///34X,*TRITIUM*,10X,*FISSION*,
1 10X,*CAPTURE*,/3X,*INTERVAL*,6X,*DISTANCE*,9X,
2 *BREEDING*,11X,*RATE*,13X,*RATE*,/1X)
61 FORMAT(1H1,10X,8A10,///34X,*FISSION*,10X,*CAPTURE*,/3X,
1 *INTERVAL*,6X,*DISTANCE*,11X,*RATE*,13X,*RATE*,/1X)

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71 FORMAT(1H1,10X,8A10,///35X,*TOTAL*,11X,*NEUTRON*,11X,*GAMMA*,
1 /3X,*INTERVAL*,6X,*DISTANCE*,9X,*HEATING*,10X,*HEATING*,
2 10X,*HEATING*,/1X)
END
FUNCTION DELTA(1,E,K)
CJLJ
CJLJ     FUNCTION DELTA CALCULATES THE ENERGY OR LETHARGY WIDTHS
CJLJ     GIVEN AN ENERGY GROUP STRUCTURE
CJLJ
    DIMENSION E(1)
    EZERO = 1.0E+07
    IF(I.EQ.1) GO TO 1
    DELTA = E(K) - E(K+1)
    RETURN
1 CONTINUE
    DELTA = ALOG(LZERO/E(K+1)) - ALOG(EZERO/E(K))
    RETURN
END
SUBROUTINE SPCZERO(S,E,N,J,EP,NP)
CJLJ
CJLJ     S.R. SPCZERO REMOVES ZEROS FROM CALCULATED SPECTRA FOR PLOTTING
CJLJ
    DIMENSION S(N),E(N),EP(NP)
    I = 0
    J = 0
1   I = I + 1
    IF(S(I).EQ.0.0) GO TO 2
    J = J + 1
    S(J) = S(I)
    EP(J) = E(I)
2   IF(I.EQ.N) RETURN
    GO TO 1
END
SUBROUTINE FISSPLT(NP,XP,NI,JF,F,FT,C,CT,HPLOT,X,N,IZ,N1,N2,
1 NINT,1PLOT,XT)
CJLJ
CJLJ     S.R. FISSPLT PLOTS ISOTOPIC FISSION AND CAPTURE RATES
CJLJ     BY INTERVAL
CJLJ
    DIMENSION XT(6)
    DIMENSION XF(NP),F(NI,NP),FT(NP),C(NI,NP),CT(NP),JF(NI)
    DIMENSION X(N),IZ(NINT),T(3),HPLOT(NP),YL(2)
    DATA TOTAL /6H TOTAL/
    XMIN = -10.0
    CALL COMPLX
    ENCODE(30,10,1)TOTAL
10  FORMAT(1H1,A6,1H),1X,"(F)FISSION (R)ATE $  ")
    CALL ZMAX(NP,FT,YL(2),YL(1))
    ISTEP = 1
    IF(YL(2).EQ.0.0.AND.YL(1).EQ.0.0) GO TO 1000
    CALL BGNPL(1PLOT)
    CALL MX1ALF("L/CSTD","")
    CALL MX2ALF("STANDARD","")
    CALL TITLE(1,-100,XT,
1 100,"(F)FISSION RATE ((F)FISSIONS/CC-SEC)$",100,8.0,6.0)
    CALL STEPSIZ(XMIN,XP(NP),XSTEP,YL(1),YL(2),YSTEP,1,0)
    CALL YLOG(XMIN,XSTEP,YL(1),YSTEP)
    CALL FRAME
    CALL ZCURVE(XP,FT,NP,0)
    CALL ZONELIN(N1,N2,IZ,NINT,X,N,YL)
    CALL ENDPL(1PLOT)
    1PLOT = 1PLOT + 1
1010 CONTINUE
    ENCODE(30,20,1)TOTAL
20  FORMAT(1H1,A6,1H),1X,"(C)CAPTURE (R)ATE $  ")
    CALL ZMAX(NP,CT,YL(2),YL(1))
    ISTEP = 2
    IF(YL(2).EQ.0.0.AND.YL(1).EQ.0.0) GO TO 1000

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CALL BGNPL(IPLLOT)
CALL MX1ALF("L/CSTD","")
CALL MX2ALF("STANDARD","")
CALL TITLE(T,-100,XT,
1 100,"(C)CAPTURE RATE ((CAPTURES/CC-SEC)$",100,8.0,6.0)
CALL STEPSIZ(XMIN,XP(NP),XSTEP,YL(1),YL(2),YSTEP,1,0)
CALL YLOG(XMIN,XSTEP,YL(1),YSTEP)
CALL FRAME
CALL ZCURVE(XP,CT,NP,0)
CALL ZONELIN(N1,N2,IZ,NINT,X,N,YL)
CALL ENDPL(IPLLOT)
IPLLOT = IPLLOT + 1
1020 CONTINUE
DO 100 I=1,NI
ENCODE(30,10,T)JF(I)
DO 22 J=1,NP
22 HPLLOT(J) = F(I,J)
CALL ZMAX(NP,HPLLOT,YL(2),YL(1))
ISTEP = 3
IF(YL(2).EQ.0.0.AND.YL(1).EQ.0.0) GO TO 1005
CALL BGNPL(IPLLOT)
CALL MX1ALF("L/CSTD","")
CALL MX2ALF("STANDARD","")
CALL TITLE(T,-100,XT,
1 100,"(F)FISSION RATE ((FISSIONS/CC-SEC)$",100,8.0,6.0)
CALL STEPSIZ(XMIN,XP(NP),XSTEP,YL(1),YL(2),YSTEP,1,0)
CALL YLOG(XMIN,XSTEP,YL(1),YSTEP)
CALL FRAME
CALL ZCURVE(XP,HPLLOT,NP,0)
CALL ZONELIN(N1,N2,IZ,NINT,X,N,YL)
CALL ENDPL(IPLLOT)
IPLLOT = IPLLOT + 1
1030 CONTINUE
ENCODE(30,20,T)JF(1)
DO 25 J=1,NP
25 HPLLOT(J) = C(I,J)
CALL ZMAX(NP,HPLLOT,YL(2),YL(1))
ISTEP = 4
IF(YL(2).EQ.0.0.AND.YL(1).EQ.0.0) GO TO 1005
CALL BGNPL(IPLLOT)
CALL MX1ALF("L/CSTD","")
CALL MX2ALF("STANDARD","")
CALL TITLE(T,-100,XT,
1 100,"(C)CAPTURE RATE ((CAPTURES/CC-SEC)$",100,8.0,6.0)
CALL STEPSIZ(XMIN,XP(NP),XSTEP,YL(1),YL(2),YSTEP,1,0)
CALL YLOG(XMIN,XSTEP,YL(1),YSTEP)
CALL FRAME
CALL ZCURVE(XP,HPLLOT,NP,0)
CALL ZONELIN(N1,N2,IZ,NINT,X,N,YL)
CALL ENDPL(IPLLOT)
IPLLOT = IPLLOT + 1
1040 CONTINUE
GO TO 100
1005 CONTINUE
WRITE(6,1001)T
GO TO (1010,1020,1030,1040)ISTEP
100 CONTINUE
RETURN
1000 CONTINUE
WRITE(6,1001)T
1001 FORMAT(1H0,132(1H*),/10X,*ALL DATA FOR *,3A10,
1 * ARE ZERO, PLOT NOT DRAWN*,/132(1H*))
IF(ISTEP.EQ.1)1010,1020
END
SUBROUTINE ZCHECK(NP,NI,X,ICOUNT,NC,NUM)
CJLJ
CJLJ      S.R. ZCHECK CALCULATES THE NUMBER OF COLUMNS FILLED WITH ZEROS
CJLJ      IN A 2-D ARRAY

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CJLJ
      DIMENSION X(N1,NP),ICOUNT(NC)
      NUM = 0
      DO 1 I=1,N1
        XMIN = 1.0E+99
        XMAX = -1.0E+99
        DO 2 K=1,NP
          XMIN = AMIN1(XMIN,X(I,K))
          XMAX = AMAX1(XMAX,X(I,K))
2      IF(XMIN.EQ.0.0.AND.XMAX.EQ.0.0) GO TO 1
        NUM = NUM + 1
        ICOUNT(NUM) = I
1      CONTINUE
      RETURN
      END
      SUBROUTINE OUT(T,NP,N1,JF,X,XT,IC,NC,NUM,ID1,ID2)

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CJLJ
CJLJ
CJLJ
      S.R. OUT PRINTS OUT 2-D ARRAYS OF DATA
      DIMENSION X(N1,NP),XT(NP),JF(N1),IC(NC),T(8),F(3)
      ID = 6H/TOTAL
      IDO = 8H/REACTION
      DO 20 I=1,NUM,3
        I3 = I + 2
        IF(I3.GT.NUM) I3 = NUM
        WRITE(6,1)T,(JF(IC(K)),JF(IC(K)),ID,K=I,I3)
        WRITE(6,2)(ID1,ID1,K=I,I3)
        WRITE(6,3)(ID2,IDO,K=I,I3)
        WRITE(6,5)
        DO 22 KK=1,NP
        DO 23 II=1,I3
          F(II-I+1) = 0.0
          IF(XT(KK).EQ.0.0) GO TO 23
          F(II-I+1) = X(IC(II),KK) / XT(KK)
23      CONTINUE
22      WRITE(6,4)KK,(X(IC(II),KK),F(II-I+1),II=I,I3)
20      CONTINUE
1      FORMAT(1H1,10X,8A10,///18X,A6,8X,2A6,2(8X,A6,8X,2A6))
2      FORMAT(17X,A7,5(10X,A7))
3      FORMAT(17X,A6,5(9X,A8))
5      FORMAT(1H0)
4      FORMAT(5X,15,6(5X,1PE12.5))
      RETURN
      END
      SUBROUTINE MAXI(N,INUM,FMAX,F1,F2,F3,F4,F5)

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CJLJ
CJLJ
CJLJ
      S.R. MAXI CALCULATES THE MAXIMUM OF INUM INPUT 1-D ARRAYS
      DIMENSION F1(N),F2(N),F3(N),F4(N),F5(N)
      FMAX = 0.0
      GO TO (1,2,3,4,5),INUM
1      DO 11 I=1,N
        FMAX = AMAX1(FMAX,F1(I))
      RETURN
2      DO 22 I=1,N
        FMAX = AMAX1(FMAX,F1(I),F2(I))
      RETURN
3      DO 33 I=1,N
        FMAX = AMAX1(FMAX,F1(I),F2(I),F3(I))
      RETURN
4      DO 44 I=1,N
        FMAX = AMAX1(FMAX,F1(I),F2(I),F3(I),F4(I))
      RETURN
5      DO 55 I=1,N
        FMAX = AMAX1(FMAX,F1(I),F2(I),F3(I),F4(I),F5(I))
      RETURN
      END
      SUBROUTINE ZCNELIN(NZ1,NZ2,IZ,N,X,NX,YL)

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CJLJ
CJLJ      S.R. ZONELIN DRAWS ZONE BOUNDARIES ON PLOTS
          DIMENSION IZ(N),X(NX),XL(2),YL(2)
          IZP = 0
          DO 1 I=NZ1,NZ2
          IF(IZ(I).EQ.1ZP) GO TO 1
          IZP = IZ(I)
          XL(1) = X(I) - X(NZ1)
          XL(2) = XL(1)
          CALL CURVE(XL,YL,2,0)
1 CONTINUE
          RETURN
          END
          SUBROUTINE READXS(XS,IXS,NNG,NISO,JISO,A)

CJLJ
CJLJ      S.R. READXS READS IN REACTION RATE CROSS SECTION DATA ON TAPE4
CJLJ
          DIMENSION JISO(NISO),XS(IXS,NISO,NNG),A(NNG)
          REWIND 4
10 READ(4,1) IF
          IF(EOF(4).NE.0) GO TO 1000
          1 FORMAT(I5)
          DO 20 J=1,NISO
          20 IF(IF.EQ.JISO(J)) GO TO 100
          DO 30 I=1,IXS
          30 READ(4,2)(A(IK),IK=1,NNG)
          GO TO 10
100 DO 101 I=1,IXS
101 READ(4,2)(XS(I,J,K),K=1,NNG)
          GO TO 10
1000 CONTINUE
          2 FORMAT(6E12.5)
          RETURN
          END
          SUBROUTINE REACRAT(TYPE,XS,TOTRAT,RATISO,IXS,NI,NNG,N,JF,NG,
+ NM,NZ,BISO,FLUX,IM,NINT,IZ,NZ1,NZ2,FNORM)

CJLJ
CJLJ      S.R. REACRAT CALCULATES ISOTOPIC REACTION RATES BY INTERVAL
CJLJ
          DIMENSION TYPE(IXS),XS(IXS,NI,NNG),TOTRAT(IXS,N)
          DIMENSION RATISO(IXS,NI,N),JF(NI),IM(NZ),FLUX(NINT,NG)
          DIMENSION BISO(NI,NM),IZ(NINT)
          DO 1 I=NZ1,NZ2
          JZ = IZ(I)
          II = 1 - NZ1 + 1
          JM = IM(JZ)
          DO 1 J=1,NI
          IF(BISO(J,JM).EQ.0.0) GO TO 2
          DO 3 L=1,IXS
          DO 4 K=1,NNG
          FB = FLUX(I,K) * BISO(J,JM) * FNORM
          RATISO(L,J,II) = RATISO(L,J,II) + FB * XS(L,J,K)
          4 CONTINUE
          TOTRAT(L,II) = TOTRAT(L,II) + RATISO(L,J,II)
          3 CONTINUE
          2 CONTINUE
          1 CONTINUE
          RETURN
          END
          SUBROUTINE WRITXS(TYPE,XS,IXS,NNG,NI,JF,T)

CJLJ
CJLJ      S.R. WRITXS WRITES OUT REACTION RATE CROSS SECTIONS
CJLJ
          DIMENSION I(8),TYPE(IXS),XS(IXS,NI,NNG),JF(NI)
          KF1 = 6HCROSS
          KF2 = 7HSECTION
          DO 1 I=1,IXS
          DO 2 J=1,NI,6

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      J5 = J + 5
      IF (J5.GT.NI) J5 = NI
      WRITE(6,11)T,(JF(K),K=J,J5)
      WRITE(6,12)(TYPE(I),K=J,J5)
      WRITE(6,13)(KF1,KF2,K=J,J5)
      WRITE(6,14)
11  FORMAT(1H1,10X,8A10,///19X,A6,5(11X,A6))
12  FORMAT(5X,*ENERGY*,6X,A10,5(7X,A10))
13  FORMAT(5X,*GROUP*,5X,A6,A7,5(4X,A6,A7))
14  FORMAT(1HC)
      DO 3 K=1,NNG
      3  WRITE(6,4)K,(XS(I,L,K),L=J,J5)
      4  FORMAT(6X,I3,2X,6(5X,1PE12.5))
      2  CONTINUE
      1  CONTINUE
      RETURN
      END
      SUBROUTINE REACOUT(TYPE,TOTRAT,RATISO,IXS,NI,NN,JF,ICOUNT,NC,T)
CJLJ
CJLJ      S.R. REACOUT PRINTS OUT REACTION RATES BY ISOTOPE AND INTERVAL
CJLJ
      DIMENSION T(8),JF(NI),TYPE(IXS),TOTRAT(IXS,NN)
      DIMENSION RATISO(IXS,NI,NN),ICOUNT(NC)
      ID2 = 8H RATE
      CALL REACSUM(TYPE,TOTRAT,IXS,NN,T)
      DO 1 I=1,IXS
      CALL ZCHECK3(RATISO,IXS,I,NI,NN,ICOUNT,NC,NUM)
      IF(NUM.EQ.0) GO TO 7
      CALL OUT3(T,NN,NI,JF,RATISO,TOTRAT,ICOUNT,NC,NUM,
+ TYPE(I),ID2,IXS,I)
      IF(NUM.EQ.NI) GO TO 10
7  CONTINUE
      WRITE(6,2)
      2  FORMAT(1H1,132(1H*))
      DO 3 J=1,NI
      IF(NUM.EQ.0) GO TO 6
      DO 4 K=1,NUM
      4  IF(J.EQ.ICOUNT(K)) GO TO 3
      8  CONTINUE
      WRITE(6,5)TYPE(I),JF(J)
      3  CONTINUE
      WRITE(6,6)
      6  FORMAT(1HC,132(1H*))
      5  FORMAT(1H0,5X,*CALCULATED *,A10,* RATES FOR *,A6,* ARE ZERO*)
10  CONTINUE
      1  CONTINUE
      RETURN
      END
      SUBROUTINE REACSUM(TYPE,TOTRAT,IXS,N,T)
CJLJ
CJLJ      S.R. REACSUM PRINTS OUT THE TOTAL REACTION RATES BY INTERVAL
CJLJ
      DIMENSION TYPE(IXS),TOTRAT(IXS,N),T(8)
      IC2 = 8H RATE
      ID0 = 7H TOTAL
      ID1 = 8HREACTION
      DO 1 I=1,IXS,6
      15 = I + 5
      IF(I5.GT.IXS) 15 = IXS
      WRITE(6,10)T,(ID0,IK=I,15)
      WRITE(6,11)(TYPE(IK),IK=I,15)
      WRITE(6,12)(ID1,IK=I,15)
      WRITE(6,12)(ID2,IK=I,15)
      WRITE(6,13)
      DO 20 J=1,N
      20  WRITE(6,21)J,(TOTRAT(IK,J),IK=I,15)
      1  CONTINUE
      21  FORMAT(5X,I5,6(5X,1PE12.5))

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10 FORMAT(1H1,10X,8A10,///17X,A7,5(10X,A7))
11 FORMAT(16X,A10,5(7X,A10))
12 FORMAT(17X,A8,5(9X,A8))
13 FORMAT(1H0)
RETURN
END
SUBROUTINE INTREAC(X,NX,N,IGEOM,IZ,NZ1,NZ2,IXS,NN,TYPE,TOTRAT,
+ RATISO,NI,JF,SUMX,NSUM,T)
CJLJ
CJLJ
CJLJ
      S.R. INTREAC VOLUME INTEGRATES TOTAL REACTION RATES BY ZONE
      DIMENSION X(NX),IZ(N),TYPE(IXS),TOTRAT(IXS,NN),RATISO(IXS,NI,NN)
      DIMENSION JF(NI),SUMX(NSUM),T(8)
      ID = 5HTOTAL
      ID1 = 9HREACTIONS
      ID2 = 4H/SEC
      IZP = IZ(NZ1)
      DO 1 I=1,IXS
1 SUMX(I) = 0.0
      TOTVOL = 0.0
      DO 100 I=1,IXS,5
      I5 = I + 4
      IF(I5.GT.IXS) I5 = IXS
      WRITE(6,10)I,(ID,IK=I,I5)
10 FORMAT(1H1,10X,8A10,///35X,A5,4(12X,A5))
11 FORMAT(5X,*ZONE*,10X,*ZONE*,10X,A10,4(7X,A10))
12 FORMAT(4X,*NUMBER*,8X,*VOLUME*,7X,A9,A4,4(4X,A9,A4))
14 FORMAT(1H0)
      WRITE(6,11)(TYPE(IK),IK=I,I5)
      WRITE(6,12)(ID1,ID2,IK=I,I5)
      WRITE(6,14)
      DO 20 K=NZ1,NZ2
      KK = K - NZ1 + 1
      IF(IZ(K).EQ.IZP) GO TO 21
22 CONTINUE
      WRITE(6,13)IZP,TOTVOL,(SUMX(IK),IK=I,I5)
      IZP = IZ(K)
      TOTVOL = 0.0
      DO 23 J=1,I5
23 SUMX(J) = 0.0
      IF(K.EQ.NZ2) GO TO 1000
21 CONTINUE
      VOLI = VOL(IGEOM,X,K)
      TOTVOL = TOTVOL + VOLI
      DO 24 J=1,I5
24 SUMX(J) = SUMX(J) + TOTRAT(J,KK) * VOLI
      IF(K.EQ.NZ2.AND.IZ(K+1).NE.IZP) GO TO 22
20 CONTINUE
100 CONTINUE
13 FORMAT(5X,I5,6(5X,1PE12.5),/1X)
1000 CONTINUE
      CALL REACISC(SUMX(1),SUMX(IXS+1),X,NX,IGEOM,NZ1,NZ2,JF,NN,NI,
+ TYPE,IXS,TOTRAT,RATISO,T)
      RETURN
      END
SUBROUTINE REACISO(SUMT,SUMI,X,NX,IGEOM,N1,N2,JF,N,NI,TYPE,
+ IXS,TOT,RISO,T)
CJLJ
CJLJ
CJLJ
      S.R. REACISO VOLUME INTEGRATES ISOTOPIC REACTION RATES
      DIMENSION T(8),SUMT(IXS),SUMI(IXS,NI),JF(NI),X(NX),TYPE(IXS)
      DIMENSION TOT(IXS,N),RISO(IXS,NI,N)
      TO = 6HTOTAL
      DO 1 I=1,IXS
      SUMT(I) = 0.0
      DO 1 J=1,NI
1 SUMI(I,J) = 0.0
      DO 2 I=1,IXS

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DO 3 J=N1,N2
JJ = J - N1 + 1
VOLI = VOL(IGEOM,X,J)
DO 4 K=1,NI
4 SUMI(I,K) = SUMI(I,K) + RISO(I,K,JJ) * VOLI
3 SUMT(I) = SUMT(I) + TOT(I,JJ) * VOLI
2 CONTINUE
ID1 = 9HREACTIONS
ID2 = 4H/SEC
DO 10 I=1,IXS,6
I5 = I + 5
IF(I5.GT.IXS) I5 = IXS
WRITE(6,11)I,(TYPE(K),K=I,I5)
WRITE(6,12)(IL1,ID2,K=I,I5)
WRITE(6,14)
WRITE(6,13)TO,(SUMT(K),K=I,I5)
DO 20 J=1,N1
20 WRITE(6,13)JF(J),(SUMI(K,J),K=I,I5)
10 CONTINUE
11 FORMAT(1H1,10X,8A10,///17X,A10,5(7X,A10))
12 FORMAT(4X,*1SOTDPE*,6(4X,A9,A4),/1H0)
13 FORMAT(5X,A6,6(5X,1PE12.5))
14 FORMAT(1HC)
RETURN
END
SUBROUTINE PLOTTRAT(NP,XP,NI,JF,X,NX,IZ,NZ1,NZ2,NINT,IPLOT,
+ XT,TYPE,TOTRAT,RATISO,IXS,HPLOT)

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CJLJ
CJLJ
CJLJ

S.R. PLOTTRAT PLOTS REACTION RATES BY INTERVAL

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DIMENSION XP(NP),JF(N1),X(NX),IZ(NINT),XT(6),TYPE(IXS)
DIMENSION TOTRAT(IXS,NP),RATISO(IXS,NI,NP),T(3),YT(4)
DIMENSION HPLOT(NP),YL(2)
DATA TOTAL,6H TOTAL/
XMIN = -10.0
DO 1 I=1,IXS
ENCODE(40,11,YT)TYPE(I),TYPE(I)
ENCODE(30,10,T)TOTAL,TYPE(I)
11 FORMAT(A10," RATE (I)",A10,"/CC-SEC) $" ,2X)
10 FORMAT(1H(,A6,1H),1X,A10," RATE $" ,4X)
DO 2 J=1,NP
2 HPLOT(J) = TOTRAT(I,J)
CALL ZMAX(NP,HPLOT,YL(2),YL(1))
IF(YL(2).EQ.0.0.AND.YL(1).EQ.0.0) GO TO 1000
CALL COMPLX
CALL BGNPL(IPLOT)
CALL MX1ALF("L/CSTD","")
CALL MX2ALF("STANDARD","")
CALL TITLE(T,-100,XT,100,YT,100,8.0,6.0)
CALL STEPSIZ(XMIN,XP(NP),XSTEP,YL(1),YL(2),YSTEP,1,0)
CALL YLOG(XMIN,XSTEP,YL(1),YSTEP)
CALL FRAME
CALL ZCURVE(XP,HPLOT,NP,0)
CALL ZONELIN(NZ1,NZ2,IZ,NINT,X,NX,YL)
CALL ENDPL(IPLOT)
IPLOT = IPLOT + 1
1000 CONTINUE
IF(YL(2).EQ.0.0.AND.YL(1).EQ.0.0) WRITE(6,1020)T
DO 3 K=1,N1
ENCODE(30,10,T)JF(K),TYPE(I)
DO 4 J=1,NP
4 HPLOT(J) = RATISO(I,K,J)
CALL ZMAX(NP,HPLOT,YL(2),YL(1))
IF(YL(2).EQ.0.0.AND.YL(1).EQ.0.0) GO TO 1010
CALL COMPLX
CALL BGNPL(IPLOT)
CALL MX1ALF("L/CSTD","")
CALL MX2ALF("STANDARD","")

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CALL TITLE(1,-100,XT,100,YT,100,8.0,6.0)
CALL STEPSIZ(XMIN,XP(NP),XSTEP,YL(1),YL(2),YSTEP,1,0)
CALL YLOG(XMIN,XSTEP,YL(1),YSTEP)
CALL FRAME
CALL ZCURVE(XP,HPLDT,NP,0)
CALL ZONELIN(NZ1,NZ2,IZ,NINT,X,NX,YL)
CALL ENDPL(1PLOT)
IPLOT = IPLOT + 1
1010 CONTINUE
IF(YL(2).EQ.0.0.AND.YL(1).EQ.0.0) WRITE(6,1020)T
1020 FORMAT(1H0,132(1H*),/10X,"ALL DATA FOR ",3A10,
1 " ARE ZERO, PLOT NOT DRAWN",/132(1H*))
3 CONTINUE
1 CONTINUE
RETURN
END
SUBROUTINE ZCHECK3(A,IXS,I,NI,NN,ICOUNT,NC,NUM)
CJLJ
CJLJ S.R. ZCHECK3 CALCULATES THE NUMBER OF COLUMNS FILLED WITH
CJLJ ZEROS IN ONE PLANE OF A 3-D ARRAY
CJLJ
DIMENSION A(IXS,NI,NN),ICOUNT(NC)
NUM = 0
DO 1 J=1,NI
XMIN = 1.0E+99
XMAX = -1.0E+99
DO 2 K=1,NN
XMIN = AMIN1(XMIN,A(I,J,K))
2 XMAX = AMAX1(XMAX,A(I,J,K))
IF(XMIN.EQ.0.0.AND.XMAX.EQ.0.0) GO TO 1
NUM = NUM + 1
ICOUNT(NUM) = J
1 CONTINUE
RETURN
END
SUBROUTINE OUT3(T,NN,NI,JF,A,B,ICOUNT,NC,NUM,ID1,ID2,IXS,I)
CJLJ
CJLJ S.R. OUT3 PRINTS OUT ONE PLANE OF A 3-D ARRAY OF DATA
CJLJ
DIMENSION T(8),A(IXS,NI,NN),B(IXS,NN),ICOUNT(NC),JF(NI)
DIMENSION F(3)
ID = 6H/TOTAL
IDO = 8HFRACTION
DO 20 J=1,NUM,3
J3 = J + 2
IF(J3.GT.NUM) J3 = NUM
WRITE(6,1)T,(JF(ICOUNT(K)),JF(ICOUNT(K)),ID,K=J,J3)
WRITE(6,2)(ID1,ID1,K=J,J3)
WRITE(6,3)(ID2,ID2,K=J,J3)
WRITE(6,5)
DO 22 KK=1,NN
DO 23 JJ=J,J3
F(JJ-J+1) = 0.0
IF(B(1,KK).EQ.0.0) GO TO 23
F(JJ-J+1) = A(I,ICOUNT(JJ),KK) / B(I,KK)
23 CONTINUE
22 WRITE(6,4)KK,(A(I,ICOUNT(JJ),KK),F(JJ-J+1),JJ=J,J3)
20 CONTINUE
1 FORMAT(1H1,10X,8A10,///18X,A6,8X,2A6,2(8X,A6,8X,2A6))
2 FORMAT(16X,A10,5(7X,A10))
3 FORMAT(17X,A8,5(9X,A8))
4 FORMAT(5X,I5,6(5X,1PE12.5))
5 FORMAT(1H0)
RETURN
END
SUBROUTINE HISTGRM(T,T2,SN,SG,EN,EG,EPLDT,NNG,NNG1,NGG,NGG1,
1 NEPLDT,1PLOT,INORM,IDIVID)
DIMENSION T2(4)

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DIMENSION T(4),SN(NNG),SG(NGG),EN(NNG1),EG(NGG1),EPLT(NEPLOT)
CALL HISTPLT(T,SN,EN,EPLT,NNG,NNG1,NEPLOT,IPLT,INORM,IDIVID)
CALL HISTPLT(T2,SG,EG,EPLT,NGG,NGG1,NEPLOT,IPLT,INORM,IDIVID)
RETURN
END
SUBROUTINE HISTPLT(T,S,E,EP,N,N1,NP,IPLT,INORM,IDIVID)
DIMENSION T(4),S(N),E(N1),EP(NP),EL(2),SL(2)
CALL COMPLX
CALL BGNPL(IPLT)
CALL MX1ALF("L/CSTD","")
CALL MX2ALF("STANDARD","")
CALL MX3ALF("INSTRUCTION","+")
IF(INORM.EQ.3.AND.IDIVID.EQ.1) CALL TITLE(T,-100,
1 "(E)ENERGY, ((E(V)))$",100,
2 "(R)ELATIVE FLUX PER UNIT LETHARGY$",100,8.0,6.0)
IF(INORM.EQ.2.AND.IDIVID.EQ.0) CALL TITLE(T,-100,
1 "(E)ENERGY, ((E(V)))$",100,
2 "(F)LUX PER E(V)$",100,8.0,6.0)
IF(INORM.EQ.2.AND.IDIVID.EQ.1) CALL TITLE(T,-100,
1 "(E)ENERGY, ((E(V)))$",100,
2 "(F)LUX PER UNIT LETHARGY$",100,8.0,6.0)
IF(INORM.EQ.3.AND.IDIVID.EQ.0) CALL TITLE(T,-100,
1 "(E)ENERGY, ((E(V)))$",100,
2 "(R)ELATIVE FLUX PER E(V)$",100,8.0,6.0)
CALL MAX(N,S,SMAX,SMIN)
CALL MAX(N,E,EMAX,EMIN)
CALL STEPSIZ(EMIN,EMAX,ESTEP,SMIN,SMAX,SSTEP,1,1)
CALL LOGLOG(EMIN,ESTEP,SMIN,SSTEP)
CALL FRAME
EL(1) = E(1)
EL(2) = E(1)
SL(1) = SMIN
SL(2) = S(1)
CALL CURVE(EL,SL,2,0)
DO 1 I=1,N
IF(S(I).LE.0.0) GO TO 1
EL(1) = E(I)
EL(2) = E(I+1)
IF(E(I+1).LT.EMIN) EL(2) = EMIN
SL(1) = S(I)
SL(2) = S(I)
CALL CURVE(EL,SL,2,0)
EL(1) = E(I+1)
IF(E(I+1).LT.EMIN) EL(1) = EMIN
SL(2) = S(I+1)
IF(1.NE.N) CALL CURVE(EL,SL,2,0)
1 CONTINUE
EL(1) = E(N+1)
IF(E(N+1).LT.EMIN) EL(1) = EMIN
EL(2) = EL(1)
SL(1) = S(N)
SL(2) = SMIN
CALL CURVE(EL,SL,2,0)
CALL ENDPL(IPLT)
IPLT = IPLT + 1
RETURN
END
SUBROUTINE ZMAX(N,X,XMAX,XMIN)
DIMENSION X(N)
XMAX = -1.0E+99
XMIN = 1.0E+99
DO 1 I=1,N
XMAX = AMAX1(XMAX,X(I))
IF(X(I).GT.0.0) XMIN = AMIN1(XMIN,X(I))
1 CONTINUE
IF(XMIN.LT.1.0E+99.AND.XMAX.GT.-1.0E+99) GO TO 3
XMIN = 0.0
XMAX = 0.0

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      RETURN
3  CONTINUE
    AM1 = ALDGL0(XMIN)
    AMA = ALDGL0(XMAX)
    DO 2 J=1,100
    AJ = FLOAT(J-50)
    IF(AJ .LT. AM1) GO TO 10
    IF(AJ .GT. AMA) GO TO 20
    GO TO 2
10  XMIN = 10.0 ** AJ
    2  CONTINUE
20  CONTINUE
    XMAX = 10.0 ** AJ
    RETURN
    END
    SUBROUTINE ZCURVE(X,Y,N,ISYM)
    DIMENSION X(N),Y(N)
    CALL MARKER(ISYM)
    DO 1 I=1,N,2
    IF(Y(I).NE.0.0) CALL CURVE(X(I),Y(I),1,-1)
1  CONTINUE
    RETURN
    END

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