Special Distribution
Issued: April 1976

DSN: A CDC-7600 FORTRAN Program for the Calculation of One-Dimensional, Multigroup Neutron Transport, Worth, and Persistent Fission Chain Probability

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UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
CONTRACT W-7405-ENG. 36

DSN: A CDC-7600 FORTRAN PROGRAM FOR THE CALCULATION OF ONE-DIMENSIONAL, MULTIGROUP NEUTRON TRANSPORT, WORTH, AND PERSISTENT FISSION CHAIN PROBABILITY

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ABSTRACT

A CDC-7600 FORTRAN program is described for the calculation of one-dimensional, multigroup neutron transport, worth, and persistent fission chain probability. A review is given of the modifications necessary in a neutron transport code to permit calculation of probabilities, and the specific coding changes are discussed in detail. A listing of the program DSN and a sample problem are given. (U)

I. INTRODUCTION

A review and derivation of the probability of initiating a persistent fission chain was given in 1961 by Bell and Lee.[1] In that report, a code, the SNP code, was described which utilized a numerical solution to the neutron transport equation[2] to obtain a numerical solution to the nonlinear probability problem.

Subsequently the linear (one-dimensional) neutron transport codes, originally coded in Floco II for the IBM-7094, were transcribed and expanded[3,4] into FORTRAN and became known as DTF
With the retirement in 1971 of the IBM-7094 at Los Alamos, it became desirable to retain the calculational capability of the SNP code.

This report describes briefly those changes made in the code to modernize it to operate on the CDC-7600 and to retain the calculational capability of SNP. This new revised code, which has the full capability of DTF, and SNP, is currently a CDC-7600, Class II, resident file and is called DSN.

We review the calculation method in Sec. II, discuss general programming modifications of DSN in Sec. III, and the specific changes for probability calculations in Sec. IV. A listing of the DSN code is given in Appendix A, and an input summary and sample problem are given in Appendix B.

II. REVIEW OF THE PROBABILITY CALCULATIONAL METHOD

We assume reader familiarity with LA-2608.[1] Here we review only those aspects of the calculational method pertinent to the DSN code changes.

Let $p(\vec{r},\vec{\Omega},v)$ be the probability that a neutron at position $\vec{r}$ with direction $\vec{\Omega}$ and speed v produces a divergent chain. Then, for stationary systems, from Eq. (9) of LA-2608, we have

$$\vec{\Omega}\cdot\text{grad}\, p(\vec{r},\vec{\Omega},v) = \sigma p - \sigma_s \iint dv'd\vec{\Omega}' \times c_s(\vec{r},\vec{\Omega},v \to \vec{\Omega}',v')p(\vec{r},\vec{\Omega}',v') - \sigma_f(\vec{r},v)\Big[\bar{\nu}(\vec{r},v)(fp(\vec{r})) - \frac{\chi_2}{2!}(\vec{r},v)(fp(\vec{r}))^2 + \frac{\chi_3(\vec{r},v)}{3!}(fp(\vec{r}))^3 - \ldots\Big], \quad (1)$$

where

$$fp(\vec{r}) \equiv \int f(v')p(\vec{r},v')dv' \quad (2)$$

and

$$p(\vec{r},v) \equiv \int d\vec{\Omega}\, p(\vec{r},\vec{\Omega},v) \ , \qquad (3)$$

with the boundary conditions $p(r_s,\vec{\Omega},v) = 0$ if $\vec{\Omega}\cdot\vec{n} \geq 0$, and $f(v)$ is the normalized fission spectrum ($\int f(v')dv' = 1$).

In Eq. (1) the probability per cm that a neutron will have a collision is $\sigma(\vec{r},\vec{\Omega},v)$. Assuming that all collisions are either scattering (σ_s), fission (σ_f), or absorption ($\sigma_a = \sigma - \sigma_s - \sigma_f$), the χ_{n+1} terms are given by Eq. (6), LA-2608:

$$\sum_{i=0} \frac{i(i-1)\ldots(i-n)}{(n+1)!}\, c_i^* = \frac{\chi_{n+1}(\vec{r},\vec{\Omega},v)}{(n+1)!} \ , \qquad (4)$$

where

$$\sum_{i=0} i c_i^* = \bar{\nu}(\vec{r},\vec{\Omega},v), \qquad (5)$$

and c_i^* is the probability of i neutrons emerging from a fission and $\bar{\nu}$ is the average number produced.

In multigroup, one-dimensional geometry, Eq. (1) can be rewritten as

$$-\Omega\cdot\text{grad}\, p_g(r,\vec{\Omega}) + \sigma_g(r)p_g(r,\vec{\Omega}) = S_g(r,\vec{\Omega}) \ , \qquad (6)$$

where

$$S_g(r,\vec{\Omega}) \equiv \tilde{S}_g^0(r) + \tilde{S}_g^1(r,\vec{\Omega}) \ , \qquad (7)$$

$$\tilde{S}_g^0(r) \equiv s_g(r) + Q_g(r) \ , \qquad (8)$$

$$s_g(r) = \sum_{g'=1}^{G} \sigma_{s,g\to g'}(r)p_{g'}(r) \ , \qquad (9)$$

$$Q_g(r) \equiv \sigma_{fg}(r)\nu_g(r)P(r) - \sigma_{fg} \sum_{i=2}^{5} (-1)^i \frac{\chi_i(r)}{i!} P^i(r) \ , \qquad (10)$$

and

$$\tilde{S}_g^1(r,\vec{\Omega}) \equiv \int_{v'} \int_{\Omega'} dv'd\vec{\Omega}'\, \sigma_s(r,v\vec{\Omega}\to v'\vec{\Omega}') \times p(r,\vec{\Omega},v) - s_g(r) \ , \qquad (11)$$

with

$$p_g(r) \equiv \int d\vec{\Omega}' p_g(r,\vec{\Omega}'), \quad P(r) \equiv \sum_{g'=1}^{G} f_{g'}p_{g'}(r) \qquad (12)$$

and the boundary condition $p_g(r_{max},\vec{\Omega}) = 0$, $\vec{\Omega}\cdot\vec{n} \geq 0$.

In Eqs. (7) and (11), $\tilde{S}_g^1(r,\vec{\Omega})$ is the standard anisotropic source as computed by WDTF or DTF (Ref. 4), with the $\ell = 0$ terms already accommodated for in $\tilde{S}_g^0(r)$. In Eq. (10) we have assumed that not more than five neutrons are emitted per fission.[1] Comparison of Eqs. (1) and (10), where c_s is c_1 for scattering (elastic or inelastic), leads to χ_1 being given by $\sigma_f\bar{\nu}$.

Except for the terms involving σ_f, Eq. (1) (plus boundary conditions) is identical to that of the neutron adjoint for eigenvalue k. The neutron adjoint equation has the fission term $\sigma_f(\bar{\nu}/k)(fp(\vec{r}))$ (where k is the eigenvalue), instead of the term $\sigma_f(\vec{r},v)[\ ]$ in Eq. (1). Consequently, by introducing the nonlinear terms of Eq. (1) in place of $(\frac{1}{k} - 1)\sigma_f\bar{\nu}(fp(r))$ the problem is formally reduced to solving a neutron adjoint equation.

The DSN code, when operating in the mode to calculate probability, begins by computing the adjoint k distribution (neglecting the nonlinear term), then multiples the distribution by a normalization factor to satisfy the integral of Eq. (1) over the entire system. It then iterates Eq. (1) after each outer iteration and the solution is scaled again. The DSN code can be run as a multigroup, one-dimensional plane, cylinder, or sphere geometry with isotropic or anisotropic scattering. Applications of these techniques to two-dimensional calculations should be straightforward. The procedure will now be described in more detail.

The calculation is begun by solving the linear eigenvalue problem in which $S_g(r,\vec{\Omega})$ is replaced by

$$S_g^0(r,\vec{\Omega}) = s_g(r) + \tilde{S}_g^1(r,\Omega) + \frac{\sigma_{fg}(r)\nu_g(r)P(r)}{k} \ . \qquad (13)$$

"collision source" "fission source"

Once the solution to this problem has been found in the standard manner, we test to determine if $k > 1$. If so, we proceed with the calculation of the probability $p_g(r)$. First we scale $p_g(r)$ by a common factor λ as determined from

$$\sum_g \int d\vec{r}\, \sigma_{fg}(r)\nu_g(r)P(r)\left(\frac{1}{k} - 1\right) = -\sum_g \int d\vec{r}\, \sigma_{fg}(r) \sum_{i=2}^{5} (-1)^i \frac{\chi_i(r)}{i!} P^i(r)\lambda^{i-1} \ . \qquad (14)$$

This normalization insures that if $\lambda P(r)$ is used to compute $Q_g(r)$, Eq. (10), then the integral of Eq. (1) over angle and volume is satisfied. (Recall that we neglected the nonlinear terms in the k calculation.) From $\lambda P(r)$ we then form $Q_g(r)$ and use it as a fixed source during the next outer iteration. At the end of each outer iteration, a new $p_g(r)$ and $P(r)$ have been determined, using Eq. (12). A new value of k is computed from the ratio of the new $\Sigma\int\sigma_f \nu p$ to the old $\Sigma\int\sigma_f \nu p$. In addition, a new scale factor is determined such that the integral of Eq. (1) over the entire system holds when the new $p_g(r)$ are used. Thus, λ is found from the relationship

$$\sum_g \int d\vec{r}\, \sigma_{fg}(r)\nu_g(r)P(r)\left(\frac{1}{k} - 1\right) + \sum_g \int d\vec{r}\, Q_g(r) + \sum_g \int d\vec{r}\, \sigma_{fg}(r) \sum_{i=2}^{5} (-1)^{i-1} \frac{\chi_i(r)}{i!} P^i(r)\lambda^{i-1} \equiv 0 , \tag{15}$$

and the new value of λP is used to compute the new $Q_g(r)$ which is held fixed during the next outer iteration. This overall iteration procedure is continued until k and λ are within ϵ (specified) of unity, at which point we have achieved a "converged" solution to Eq. (1).

The original SNP code used a Newton-Raphson technique to determine λ from Eq. (15). This procedure sometimes presented difficulties, possibly because the solution spectrum of this quartic equation ordinarily admits two real roots and a complex conjugate pair. A Newton-Raphson method will sometimes settle on the magnitude of the complex root and then the overall λ will oscillate about some value rather than uniformly converge to unity.

A simple remedy for this difficulty is achieved by evaluating directly the roots of Eq. (15) and by performing the scaling using the real root closest to unity (comparisons being made by mapping all roots onto $(1, \infty)$ and ignoring roots smaller than 10^{-10} before the mapping). This procedure apparently works, and removes the necessity of slowly turning on the nonlinear terms of Eq. (15) (as was done previously in SNP). In the event that all complex roots are determined (as can occur if $P(r) < 0$), the code aborts. The root structure of Eq. (15) is exhibited in the monitor print.

III. GENERAL PROGRAMMING MODIFICATIONS

During the requisite programming changes to instigate the probability calculation, the extent and number of changes became significant enough to warrant a code name-change to DSN

The general changes and differences are as follows:

(1) The code has been tidied by using the TIDY program.

(2) It has been transferred from the AFWL edit program to the more sophisticated UPDATE program. UPDATE is maintained on the CDC-7600 by LASL's C-Division, whereas AFWL is not.

(3) The code has been transferred to a Class II, Resident file (with backup tape) on the CDC-7600 to take advantage of "Cafeteria" instant turnaround for short (30 sec) problems (equivalent to CDC-6600 2-min-plus problems) with an overall page limit of 50 (TL=30S, PL=50).

(4) The code has been revised to run a sequence of problems by the addition, before each subsequent job, of a card containing the words "NEXT JOB" starting in column 1. In the event that some nonfatal errors occur in a problem, the code will search for this card, and continue with the next problem, until it reaches the EOJ card ($EJ).

(5) The ordering of the subroutines has been made more logical:

Main Control Routines	DSN, DTF
Input Routines	REAG, REAI, RECS, SNCN, CLEAR
Initialization Routines	ADJREV, IFUNC, MIXCX, RMAVGF, DSOUR, FCSOUR
Computation Routines	OUTER, INNER, TOTGP, FISSN, NEWPAR
Special Computation Routines	
Worth Calculation	INTEG, UPSET
Probability Calculation	PASS2, NEWPOL, SCPTACO, SCALE
Output Routines	FINPR, PRNT

A particular advantage to this arrangement is that it will be easy to convert to OVERLAY should it be needed.

(6) Additional changes:

(a) The manner of handling the Negative Flux Fixup has been changed so that the step function is the natural default value but the DTF mode can be obtained by setting the parameter IGE negative.

(b) Other convergence methods, which were removed when the Negative Alpha treatment was added (in particular the quadratic approximation technique), have been reinserted into the code.

In making these changes many difficulties were encountered because of the particular manner in which integer parameters are stored. If further changes are to be made, it is our recommendation that they be put on a COMDECK and taken out of the IA block. Also needed is the facility to use smeared densities as in the original DSN code.[2]

We now note some changes in the input options not documented elsewhere:

(1) Degree of S_n quadrature: ISN
Degrees 2, 4, 8, 16 are available internally. If they are to be read in from cards, ISN is set negative.

(2) Input flux guess options: IFN
IFN = -2: Flux from tape or disk - IGM long
-1: Flux from cards - IGM long
0: Fissions from tape - IM long
1: Equal fractions to fissions - IM long
2: Equal fractions to flux - IM*IGM long

(3) Theory desired: ITH
ITH = 0 Regular
1 Adjoint
2 Worth
3 Probability

(4) Position in the cross-section table of self scatter: IHS. If IHS < 0, cross-section prints are suppressed.

(5) Type of Distributed Source: IQM
IQM = -2 Surface source - MM*IGM long
-1 Distributed source - IGM long
0 None
1 Distributed Source - IM long and Source Spectrum - IGM long
2 Distributed Source - MM long and Source Spectrum - IGM long

(6) Input of cross sections, fission spectrum, and velocities: MCR, MTP
MCR > 0: Materials from cards, spectrum and velocities from tape
MCR < 0: Spectrum and velocities also from cards
MTP > 0: Materials, spectrum, and velocities from tape
MTP < 0: Materials from tape, spectrum and velocities from cards.
In all cases the absolute value of the parameter gives the number to be read.

(7) Negative Flux Fixup: To indicate the type of negative flux fixup desired, the sign of IGE is used.
IGE > 0: Step function (default option)
IGE < 0: Old method (DTF) of fixup is used.

IV. PROGRAMMING MODIFICATIONS FOR PROBABILITY CALCULATION

We will outline briefly the particular coding additions that were made for the probability calculation. The calculation is performed in two phases. The calculation is requested by the user by setting the theory parameter, ITH, to 3. The code sets the control trigger, IPRE, to 1, where it remains throughout Phase A.

In Phase A, storage is allowed for a fixed source block, Q(I,G), and an ordinary adjoint k calculation is performed. When convergence is obtained, the eigenvalue k, (EV), is tested. If k is less than one, the program is exited and a comment is printed to this effect. If k is greater than one, Phase B is entered.

In Phase B, we enter subroutine PASS2, at the end of which we return to the sequence OUTER, INNER, TOTGP, and PASS2 again after one iteration. This cycling continues until both EV and XLA are within EPS of 1.0. In the description that follows, subscripts are given in FORTRAN type format where the ranges are: I = 1, 2, . . . , IM (number of intervals), G = 1, 2, . . . , IGM (number of groups), and L = 1, 2, . . . , IZM (number of zones).

On the first entry (only) to PASS2 the following operations are performed

(1) Form F_{new} = FTMP = $\sum_I$ F(I)*V(I)

(2) Use FTMP to scale the fissions and fluxes from the Phase A calculation:

F(I) = F(I)*EV/FTMP

XN(I,G) = XN(I,G)/FTMP .

(3) Set the following triggers and values:

IPRE = 2, ICVT = 0, XLA = 1

F_{old} = FSUM = FTMP/EV .

(4) Normalize the XKE block to unity:

XKE(G) = XKE(G)/$\sum_G$ XKE(G) .

On subsequent entries to PASS2 we bypass the above initializations and:

(1) Compute new fissions and a new sum (the old one having been saved as FSUM):

$$F(I) = \sum_G XKE(G)*XN(I,G)$$

$$F_{new} = FTMP = \sum_I F(I)*V(I) .$$

In all cases we then compute the new eigenvalue from F_{new}/F_{old} = FTMP/FSUM. It is tested for convergence within EPS of 1.0. If the problem is converged, the trigger ICVT is set to one.

Next we proceed to determine the scaling parameter λ (=XLA) from the following: Let

$$f(\lambda) = B + \lambda X_2 + \lambda^2 X_3 + \lambda^3 X_4 + \lambda^4 X_5 = 0 ,$$

where

$$X_K = \sum_{I,G} (-1)^{K*}C(J,I,G)*V(I)*(F(I))^{K*}DF(I)$$

for K = 2, ..., 5 and J = K-1 ,

$$B = (\frac{1}{EV} - 1)*B1 + B2 ,$$

$$B1 = \sum_{I,G} C(N,I,G)*F(I)*DF(I)*V(I)$$

for N = IHT-1 = position of $\nu\sigma^f$,

$$B2 = \sum_{I,G} V(I)*Q(I,G) \quad \text{(initially zero)} ,$$

and

$$Q(I,G) = -\sum_K (-1)^{K*}(F(I))^{K*}DF(I)*C(J,I,G)$$

for K = 2, ..., 5 and J = K-1 .

After the coefficients of $f(\lambda)$ have been formed, the subroutine NEWPOL* is used to solve for all roots, real and imaginary. From these roots the code selects the real positive ($> 10^{-10}$) one closest to unity. This scale factor, λ (=XLA), is then used to scale the fissions, scalar fluxes and, if anisotropic, the angular fluxes by

F(I) = F(I)*XLA

XN(I,G) = XN(I,G)*XLA

XND(P,M) = XND(P,M)*XLA ,

where P = 1, ..., IM+1 and M = 1, ..., MM.

From these scaled values we recompute the source term, Q(I,G), defined above, and in addition, the volume weighted fission sum, FG(G), and volume weighted source term, QG(G),

$$FG(G) = \sum_I F(I)*V(I)*DF(I)*C(N,I,G)$$

for N = IHT-1 = position of $\nu\sigma^f$

$$QG(G) = \sum_I Q(I,G)*V(I) ,$$

and finally we recompute F_{old} = FSUM as described above.

This overall loop ends on two tests:

(1) If the iteration counter, ICC, is greater than the number of iterations allowed, ICM, the final print exit is taken.

(2) If the convergence trigger, ICVT has been set to one and XLA is within EPS of 1.0, then the final print exit is taken.

(3) If neither of the conditions (1) or (2) is satisfied, we return to the main control routine, DTF, which cycles through OUTER, INNER, TOTGP, and back to PASS2.

(4) If either of the conditions (1) or (2) is satisfied, IPRE is set to 3 and on return to DTF, control is transferred to the final print routine, FINPR.

In addition to the standard DTF output, the following special output (IPRE=3) has been added:

(1) For each material, tables are given which consist of:

(a) Total mass of material M

MASS = $\sum_I$ DF(I)*V(I), where material M is contained in cell I.

(b) A sum for each group, labelled SIGMA 0, consisting of

SUM(G) = $\sum_I$ DF(I)*XN(G,I)*V(I)/VE(G).

(c) Then a sum for each group and each table position of the cross-section table for K = 1, ..., IHT

* NEWPOL and SCPTACO (used by NEWPOL) were coded by Billy L. Buzbee and John H. Hancock, LASL Group C-4.

$$SUM(K,G) = \sum_{I} XN(G,I)*DF(I)*V(I)*C(K,G,L) ,$$

where L is the index of the material.

(2) Finally, special output for probability calculations includes the following:

(a) A table of "fluxes," multiplied by the density for each space point and the cross section in position 5, is prepared and printed for each group:

$$SP(I,G) = C(5,G,L)*DF(I)*XN(IG) ,$$

where L is the index of the material in interval I.

(b) Then the following two values are computed and printed:

$$PI = -\sum_{I,G} SP(I,G)*V(I)$$

$$PIP = 1.0 - e^{PI} .$$

The programming modifications reproduce the results of SNP test problems to 1 part in 10^{-4} (epsilon) in flux, eigenvalue, and probability when the same initial conditions, direction sets, cross-sections, and spacings are used. The new scaling technique converges about 10-20% faster than does the Newton-Raphson.

REFERENCES

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2. B. Carlson, C. E. Lee, and W. Worlton, "The DSN and TDC Neutron Transport Codes," Los Alamos Scientific Laboratory Report LAMS-2346 (October 1959).

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4. K. D. Lathrop, "DTF-IV, a FORTRAN-IV Program for Solving the Multigroup Transport Equation with Anisotropic Scattering," Los Alamos Scientific Laboratory Report LA-3373 (July 1965).

APPENDIX A

DSN PROGRAM LISTING

SUBROUTINE	CARD NUMBER	SUBROUTINE	CARD NUMBER
WDTF	1	NEGALF	1315
UTF	16	OUTER	1395
RECS	533	INNER	1712
REA1	6AB	FISSN	19A0
REAG	687	TOTGP	2032
SNCN	756	UPSET	2116
CLEAR	907	INTEG	2127
ADJREV	925	PASS2	2A37
IFSINC	990	NEWPOL	264A
RMAVGF	1027	SCPTACO	2758
MIXCX	1105	SCALE	2807
DSOUR	1151	FINPR	281A
FCSOUR	1191	PRNT	30A6
NEWPAP	1225		0

```
      PROGRAM MAIN (INP,OUT,FSET10=INP,FSET9=OUT,FSET2,FSET3,FSET4,FSET5
     1,FSET6,PUNCH)
C           MAIN CODE
      COMMON IA (10000), A (34700)
      DATA A/NEXT/10HNEXT JOB  /
   10 CALL JOB
   20 READ (10,40)A(1)
      PRINT 30, A(1)
   30 FORMAT (*0   CARD READ = *A10)
   40 FORMAT (A10)
      IF (EOF,10) 60,50
   50 IF (A(1).NE.A/NEXT) GO TO 20
      GO TO 10
   60 CALL EXIT
      END
      SUBROUTINE DTP
      COMMON /ALPHA/ LOAFM,TAMA,SCATT,SCATTP,BAL,XLAMAX,XLAMIN,EVMAX,EVM
     1IN,IPRT,FSUM,INEG,KK
C
      COMMON IA(10009),A(10000)
      DIMENSION SNM(94), SMD(94)
      EQUIVALENCE (JO,IA(1)), (ITM,IA(2)), (ISCI,IA(3)), (ISN,IA(4)), (I
     1NE,IA(5)), (IPL,IA(6)), (IRR,IA(7)), (IZERO,A(8)), (IO,IA(9)), (IFN
     2,IA(10)), (IEVT,IA(11)), (IGM,IA(12)), (IHT,IA(13)), (IMS,IA(14)),
     3 (IDM,IA(15)), (MS,IA(16)), (MCP,IA(17)), (ITP,IA(18)), (MT,IA(19)
     4), (IPZT,IA(20)), (IDM,IA(21)), (IIM,IA(22)), (IOI,IA(23)), (IO2,I
     5A(24)), (IO3,IA(25)), (IO4,IA(26)), (ICM,IA(27)), (IOT,IA(28)), (I
     6C,IA(29)), (IO(31,KSIZE2), (IA(30),LC), (IA(31),ILC), (IA(32),NFN)
     7, (IA(33),NM), (IA(34),IG), (IA(35),IIC), (IA(36),KSIZ), (IA(39)
     8,IGVT), (IA(40),IMG), (IA(41),IM), (IA(42),IG), (IA(43),IG), (IA(4
     946),IP), (IA(45),MI), (IA(46),IZERO), (IA(47),IGP), (IA(48),ML)
      EQUIVALENCE (IA(50),JMF)
      EQUIVALENCE (IA(51),JO), (IA(52),JKT), (IA(53),JVE), (IA(54),JW),
     1(IA(55),JU), (IA(56),JW), (IA(57),JF), (IA(58),JN), (IA(59),JMO),
     2 (IA(60),JRM), (IA(61),JQ), (IA(62),JC), (IA(63),JL), (IA(64),JOO)
     3, (IA(65),JKE), (IA(66),JRA), (IA(67),JA), (IA(68),JV), (IA(69),JA
     4V), (IA(70),MA), (IA(71),JOO), (IA(72),JOC), (IA(73),JOS), (IA(74
     5),JNS), (IA(75),JX), (IA(76),JU), (IA(77),JFG), (IA(78),JTR), (IA(
     679),JSN), (IA(80),JSC), (IA(81),JSN), (IA(82),JCT), (IA(83),JCS),
     7(IA(84),JCM), (IA(85),JSA), (IA(86),JNN), (IA(87),JJJ), (IA(88),JN
     8O), (IA(89),JNC), (IA(90),JRL), (IA(91),JAF), (IA(92),JST), (IA(93
     9),JNA), (IA(94),JAT), (IA(95),JNI), (IA(96),JIO), (IA(97),JNF), (I
     $A(98),MR), (IA(99),JMR)
      EQUIVALENCE (IA(100),JSC), (IA(101),JAG), (IA(102),JNG), (IA(103),
     1JP), (IA(104),JDG), (IA(105),JSO), (IA(106),JNB), (IA(107),JCA),
     2(IA(108),KMA), (IA(109),KMZ), (IA(110),KM), (IA(111),KMC), (IA(1
     312),KMT), (IA(113),KG), (IA(114),KMR), (IA(115),KQ), (IA(116),JT),
     4 (IA(117),JSM), (IA(118),JSZ), (IA(119),JT3), (IA(120),JTS), (A(1
     5),EV), (A(2),EVM), (A(3),EPS), (A(4),EPSA), (A(5),HF), (A(6),HY), (
     6A(7),O/), (A(8),XNF), (A(9),PV), (A(10),AEPS), (A(11),XLAL), (A(12
     7),XLAM), (A(13),XNPM), (A(14),STT), (A(15),FTP), (A(16),XLA), (IA(
     816),KM), (IL,IA(17)), (A(18),FQ)
      EQUIVALENCE (IA(19),IER)
      EQUIVALENCE (IA(195),ISF)
      IER=0
C     TO PREVENT TRUNCATION CHANGE THIS VALUE AND LENGTH OF COMMON A
      IAA = 34700
      TREG=3000.0
```

```
      DO 10 I=1,1000                                                       DSN   00058
      IF (I.LE.50) A(I)=0.0                                                DSN   00059
   10 IA(I)=0                                                              DSN   00060
   20 FORMAT (12A6)                                                        DSN   00061
   30 CONTINUE                                                             DSN   00062
      READ (5,20) (A(I),I=1,12)                                            DSN   00063
      IF (EOF,5) 30,40                                                     DSN   00064
   40 CONTINUE                                                             DSN   00065
      WRITE (9,20) (A(I),I=1,12)                                           DSN   00066
   50 FORMAT (12I6)                                                        DSN   00067
      READ (5,50) (IA(I),I=1,31)                                           DSN   00068
   60 FORMAT (6E12.5)                                                      DSN   00069
      READ (5,60) (A(I),I=1,1)                                             DSN   00070
      WRITE (9,70) (IA(I),I=1,13)                                          DSN   00071
      WRITE (9,80) (IA(I),I=14,23)                                         DSN   00072
      WRITE (9,90) (IA(I),I=24,31)                                         DSN   00073
      WRITE (9,100) (A(I),I=1,13)                                          DSN   00074
   70 FORMAT (1H0,27H  ID  (PENT)(FICTION NUMBER,60X,I8/35H  ITH  THEORY DSN   00075
     1 (0/1=REGULAR/ADJOINT),53X,I8/55H ISCT  SCATTERING IO/N=ISO)ROPIC/ DSN   00076
     2NTH ORDER ANISOTROPIC),33X,I8/43H  ISN  QUADRATURE (SN, PN-1, OPN/ DSN   00077
     3N-1, ETC.),45X,I8/45H  IGE  GEOMETRY (1/2/3=PLANE/CYLINDER/SPHERE) DSN   00078
     4,43X,I8/73H (BL/IBR LEFT/RIGHT BOUNDARY CONDITION (0/1/2=VACUUM/RE DSN   00079
     5FLECTIVE/PERIODIC),I?,I8/22H  IZM  NUMBER OF ZONES,66X,I8/26H   IM DSN   00080
     6  NUMBER OF INTERVALS,62X,I8/37H  IFN  INPUT GUESS (0/1=FISSION/FL DSN   00081
     7UX),51X,I8/78H IEVT  EIGENVALUE TYPE (0/1/2/3/4/5=SOURCE/K/ALPHA/C DSN   00082
     8ONCENTRATION/DELTA/RADIUS),10X,I8/23H  IGM  NUMBER OF GROUPS,65X,I DSN   00083
     98/47H  IHT  POSITION OF TOTAL CROSS SECTION IN TABLE,41X,I8)      DSN   00084
   80 FORMAT (54H  IHS  POSITION OF SELF-SCATTER CROSS SECTION IN TABLE, DSN   00085
     134X,I8/33H  IHM  CROSS SECTION TABLE LENGTH,55X,I8/39H   MS  NUMBE DSN   00086
     2R OF MIXTURE SPECIFICATIONS,49X,I8/63H MCR/MTP NUMBER OF MATERIAL  DSN   00087
     3CROSS SECTIONS READ FROM CARDS/TAPE,9X,2I8/32H   MT  TOTAL NUMBER  DSN   00088
     4OF MATERIALS,56X,I8/54H IPVT  PARAMETRIC EIGENVALUE TYPE (0/1/2=NO DSN   00089
     5NE/K/ALPHA),34X,I8/72H  IQM  DISTRIBUTED SOURCE INDICATOR (0/1/2=N DSN   00090
     6ONE/REGULAR/FIRST COLLISION),16X,I8/42H  IIM  INNER ITERATION MAXI DSN   00091
     7MUM (PER GROUP),46X,I8/38H  IDI  PRINT ANGULAR FLUX (0/1=NO/YES),5 DSN   00092
     80X,I8)                                                              DSN   00093
   90 FORMAT (49H  IO2  PRINT BALANCE TABLES BY GROUP (0/1=NO/YES),39X,I DSN   00094
     18/57H  IO3  PRINT ACTIVITIES BY ZONE (0/N=NO/YES-LENGTH OF J3),31X DSN   00095
     2,I8/46H  IO4  PRINT ACTIVITIES BY RADIUS (0/1=NO/YES),42X,I8/30H   DSN   00096
     3ICO  OUTER ITERATION MAXIMUM,58X,I8/88H  IOT  DIFFUSION THEORY OPT DSN   00097
     4ION (0/1=NO/YES-ENTER APPLICABLE GROUPS-AFTER CROSS SECTIONS),I8/7 DSN   00098
     54H   IC  ITERATION COUNT (NON-ZERO ONLY FOR PROBLEM STARTING FROM  DSN   00099
     6FLUX DUMP),14X,I8/74H  IIL  INNER ITERATION LIMIT USED UNTIL ONE M DSN   00100
     7INUS LAMBDA IS WITHIN TEN*EPS,14X,I8/58H  IXS  FLOOR CROSS SECTION DSN   00101
     8S IF ZERO/TRUNCATE IF NON-ZERO  ,30X,I8//)                          DSN   00102
  100 FORMAT (21H   EV  EIGENVALUE TRY,57X,1PE18.7/26H  EVM  EIGENVALUE  DSN   00103
     1MODIFIER,52X,E18.7/29H  EPS  CONVERGENCE CRITERION,50X,E18.7/58H E DSN   00104
     2PSA  SPECIAL CONVERGENCE CRITERION-USED ONLY IF NON-ZERO,20X,E18.7 DSN   00105
     3/22H   BF  BUCKLING FACTOR,56X,E18.7/28H DY/DZ BUCKLING HEIGHT/DEP DSN   00106
     4TH,16X,2E16.7/27H  XNF  NORMALIZATION FACTOR,51X,E18.7/28H   PV  P DSN   00107
     5ARAMETRIC EIGENVALUE,50X,E18.7/24H XEPS  RELAXATION FACTOR,54X,E18 DSN   00108
     6.7/36H XLAL/XLAH LAMBDA LOWER/HIGHER LIMIT,28X,2E16.7/29H XNPM  NF DSN   00109
     7= PARAMETER MODIFIER,49X,E18.7//)                                   DSN   00110
C     COMPUTE INITIAL VALUES                                               DSN   00111
      A(21)=1.0                                                            DSN   00112
      A(22)=6.2831853                                                      DSN   00113
      A(23)=12.5661706                                                     DSN   00114
      A(24)=1.0                                                            DSN   00115
      A(25)=.5                                                             DSN   00116
      A(26)=.33333333                                                      DSN   00117
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      ISF=0                                                             DSN 00118
      IF (IGE.GT.0) GO TO 110                                           DSN 00119
      ISF=1                                                             DSN 00120
      IGE=-IGE                                                          DSN 00121
  110 CONTINUE                                                          DSN 00122
      IPRE=0                                                            DSN 00123
      IF (ITH.NE.3) GO TO 120                                           DSN 00124
      FSUM=0.0                                                          DSN 00125
      IPRE=1                                                            DSN 00126
      ITH=1                                                             DSN 00127
  120 CONTINUE                                                          DSN 00128
      IF (ITH.NE.2) GO TO 130                                           DSN 00129
      ITH=0                                                             DSN 00130
      IEVT=-IABS(IEVT)                                                  DSN 00131
  130 CONTINUE                                                          DSN 00132
      IMG=IM*IGM                                                        DSN 00133
      BAC=0.0                                                           DSN 00134
      MM=IABS(ISN)+1                                                    DSN 00135
      IF (IGT.EQ.2) MM=(IABS(ISN)*IABS(ISN)+A))/A                       DSN 00136
      NM=1                                                              DSN 00137
      MG=MM*IGM                                                         DSN 00138
      IG=IM*IGM                                                         DSN 00139
      IP=IM+1                                                           DSN 00140
      MI=MM*IP                                                          DSN 00141
      IZP=IZM+1                                                         DSN 00142
      IGP=IGM+1                                                         DSN 00143
      ML=IABS(MCR)+IABS(MTP)                                            DSN 00144
      IF (ISCT.LT.1) GO TO 140                                          DSN 00145
      NM=ISCT                                                           DSN 00146
      IF (IGT.EQ.2) NM=(NM*(NM+A))/A                                    DSN 00147
C     COMPUTE STORAGE REQUIREMENTS AND STORAGE INDICES                  DSN 00148
  140 LOAFR=51                                                          DSN 00149
      JUF=LOAFR+IM*MM                                                   DSN 00150
      JR=JUF+IM                                                         DSN 00151
      JKI=JR+IP                                                         DSN 00152
      JVE=JKI+IGP                                                       DSN 00153
      JW=JVE+IGP                                                        DSN 00154
      JU=JW+IG                                                          DSN 00155
      JMU=JU+MM                                                         DSN 00156
      JF=JMU+MM                                                         DSN 00157
      JN=JF+IP                                                          DSN 00158
      JMN=JN+IG                                                         DSN 00159
      JRM=JMN+IS                                                        DSN 00160
      JQ=JRM                                                            DSN 00161
      IF (IABS(IEVT).EQ.4) JQ=JRM+IZM                                   DSN 00162
      JC=JQ                                                             DSN 00163
      IF (IABS(IQM).EQ.1) JC=JQ+IG                                      DSN 00164
      IF (IABS(IQM).EQ.2) JC=JQ+MG                                      DSN 00165
      IF (IEVT.EQ.-1.OR.IEVT.EQ.-2) JC=JQ+MG                            DSN 00166
      IF (IPRE.GT.0) JC=JQ+IG                                           DSN 00167
      JL=JC+(MM*IG)*MT                                                  DSN 00168
      JMG=JL+IM*NM                                                      DSN 00169
      JKE=JMG+IGP                                                       DSN 00170
      JRA=JKE+IGP                                                       DSN 00171
      JA=JRA+IP                                                         DSN 00172
      JV=JA+IP                                                          DSN 00173
      JAV=JV+IP                                                         DSN 00174
      JHA=JAV+IP                                                        DSN 00175
      JHB=JHA+MI                                                        DSN 00176
      JHC=JHB+MI                                                        DSN 00177
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      JUS=JUE+MI                                                DSN 00178
      JRS=JUS+MI                                                DSN 00179
      JX=JRS+IDM                                                DSN 00180
      JH=JX+IDI*NM                                              DSN 00181
      JFG=JG                                                    DSN 00182
      IF (IMH.EQ.1) JFG=JH+MG                                   DSN 00183
      JTU=JFG+IGP                                               DSN 00184
      JSR=JTU+IGM                                               DSN 00185
      JSG=JSR+IM                                                DSN 00186
      JSM=JSG+IGP                                               DSN 00187
      JCT=JSM+IGP                                               DSN 00188
      JCS=JCT+IM                                                DSN 00189
      JCH=JCS+IM                                                DSN 00190
      JSA=JCH+IM*TSCT                                           DSN 00191
      JHN=JSA+IM*MH                                             DSN 00192
      JJJ=JHN+IM                                                DSN 00193
      JHO=JJJ+IM*NM                                             DSN 00194
      JNL=JHO+MM                                                DSN 00195
      JRL=JNL+IGP                                               DSN 00196
      JAF=JRL+IGP                                               DSN 00197
      JST=JAF+MI                                                DSN 00198
      JNA=JST+IM                                                DSN 00199
      JAT=JNA+IM                                                DSN 00200
      JHT=JAT+IM*MM                                             DSN 00201
      JTH=JHT+MM                                                DSN 00202
      JNE=JTH+MM                                                DSN 00203
      JNR=JNE+IM                                                DSN 00204
      JOR=JNR+IM                                                DSN 00205
      JSC=JOR+MM                                                DSN 00206
      JAG=JSC+IGP                                               DSN 00207
      JNG=JAG+IGP                                               DSN 00208
      JFN=JNG+IGP                                               DSN 00209
      JUG=JFN+IGP                                               DSN 00210
      JSU=JUG+IGP                                               DSN 00211
      JNH=JSU+IGP                                               DSN 00212
      JCA=JNH+IGP                                               DSN 00213
      KMA=200                                                   DSN 00214
      KMZ=KMA+IM                                                DSN 00215
      KMB=KMZ+IZM                                               DSN 00216
      KMC=KMB+MS                                                DSN 00217
      KMT=KMC+MS                                                DSN 00218
      KGT=KMT+MTP                                               DSN 00219
      KHN=KGT+IGM                                               DSN 00220
      KM3=KHN+MM                                                DSN 00221
      KM4=KM3+ID3                                               DSN 00222
      KO=JCA+IM                                                 DSN 00223
      JT=KO                                                     DSN 00224
      IF (IABS(IOM).EQ.2) JT=KO+MM                              DSN 00225
      JSH=JT+IZP*(MM+IS)                                        DSN 00226
      JSZ=JSH+(NM+IS)                                           DSN 00227
      JT3=JSZ+(NM+IS)                                           DSN 00228
      JTS=JT3+ID3*IZP                                           DSN 00229
      JFIN=JTS+ID3*IM                                           DSN 00230
      IF (ISIGN(I,ILVT).EQ.1) GO TO 150                         DSN 00231
      JG7=JFIN                                                  DSN 00232
      JTF=JG7+IGP*IZP                                           DSN 00233
      JTS=JTF+IM                                                DSN 00234
      JTT=JTS+IM                                                DSN 00235
      JFIN=JTT+IM                                               DSN 00236
  150 CONTINUE                                                  DSN 00237
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C      STARTING INDICES
       DO 160 I=1,70
  160  IA(I+120)=IA(I+50)-1
       JTOTI=KH4+103
       JTOTAL=JFIN+JTOTI
       WRITE (9,170) JTOTI,JFIN,JTOTAL
       WRITE (9,50) (IA(I),I=1,192)
       IF (JFIN.GT.IA4) RETURN
  170  FORMAT (//20HINTEGER STORAGE=I5/24H FLOATING POINT STORAGE=I5/20H T
      1OTAL DATA STORAGE=I6,6H WORDS,//)
       DO 180 I=51,JFIN
  180  A(I)=0.
C      READ RADII
       CALL REAG (A(JR),IP,6HRADII ,6H        )
C      READ DENSITIES
       CALL REAG (A(JDF),IM,6HDENSIT,6HIES    )
C      READ ZONE NUMBERS
       CALL REAI (IA(KMA),IM,6HZONE N,6HUMBERS)
C      READ MATERIAL NUMBERS
       CALL REAI (IA(KMZ),IZM,6HMATERI,6HAL NO.)
       IF (IER.GT.0) RETURN
       IF (MTP.GT.0) GO TO 190
C      READ FISSION FRACTIONS AND VELOCITIES
       CALL REAG (A(JKI),IGM,6HFISSIO,6HN FRAC)
       CALL REAG (A(JVE),IGM,6HVELOCI,6HTIES  )
       IF (IER.GT.0) RETURN
C      READ QUADRATURE COEFFICIENTS
C      CHECK FOR INTERNAL SN CONSTANTS
  190  IF (ISN.LT.0) GO TO 210
       IF (IGE.NE.2) GO TO 200
       J=ISN/2-1
       L=(J*(J+1)*(2*J+7))/6+3
       GO TO 250
  200  L=1
       IF (ISN.EQ.2) GO TO 250
       IF (ISN.EQ.4) GO TO 240
       IF (ISN.EQ.8) GO TO 230
       IF (ISN.EQ.16) GO TO 220
  210  CALL REAG (A(JW),MM,6H WEIGH,6HTS    )
       CALL REAG (A(JU),MM,6H DIREC,6HTIONS )
       IF (IER.GT.0) RETURN
       GO TO 270
C      LOAD STANDARD SN CONSTANTS FROM INTERNAL TABLES
  220  L=L+9
  230  L=L+5
  240  L=L+3
  250  J=JW
       K=JU
       M=L+MM-1
       DO 260 I=L,M
       A(J)=SNW(I)
       A(K)=SNU(I)
       J=J+1
  260  K=K+1
  270  IF (ISIGN(1,ILVT).EQ.-1) CALL UPSET (IP,IM,IGM,A(JAF))
C      DONE WITH UNCONDITIONAL INPUT****
C      TEST FOR FISSION OR FLUX INPUT
       IF (IABS(IFN).EQ.0.AND.ISIGN(1,IFN).EQ.-1) CALL REAG (A(JF),IM,6HF
      1ISSIO,6HNS    )
       IF (IFN.EQ.-1) CALL REAG (A(JN),IG,6HINITIA,6HL FLUX)
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      IF (IER.GT.0) RETURN                                            DSN  00298
      J=JM0-1                                                         DSN  00299
      IF ((FN.EQ.-2) REWIND 6                                         DSN  00300
      IF (IFN.EQ.-2) READ (6)(A(I),I=JN,J)                            DSN  00301
      IF (IFN.EQ.-2) REWIND 6                                         DSN  00302
      IF ((SIGN(1,IFN).EQ.-1) GO TO 290                               DSN  00303
      H=1./FLOAT(IGM)                                                 DSN  00304
      J1=JF                                                           DSN  00305
      IF (IFN.GT.0) J1=JN                                             DSN  00306
      J2=1                                                            DSN  00307
      IF (IFN.GT.0) J2=IGM                                            DSN  00308
      DO 280 J3=1,J2                                                  DSN  00309
      C=1.                                                            DSN  00310
      DO 280 J4=1,IM                                                  DSN  00311
      A(J1)=C                                                         DSN  00312
      C=C-H                                                           DSN  00313
  280 J1=J1+1                                                         DSN  00314
C     TEST FOR MIXTURE COMMANDS                                       DSN  00315
  290 IF (MS.LE.0) GO TO 300                                          DSN  00316
      CALL REAI (IA(KMB),MS,6HMIX NU,6HMBER  )                        DSN  00317
      CALL REAI (IA(KMC),MS,6HMIX CO,6HMMAND )                        DSN  00318
      CALL REAG (A(JMD),MS,6HMIX DE,6HNSITY )                         DSN  00319
      IF (IER.GT.0) RETURN                                            DSN  00320
C     TEST FOR DELTA CALCULATION                                      DSN  00321
  300 IF (IABS(IEVT).NE.4) GO TO 310                                  DSN  00322
C     READ RADIAL MODIFIERS                                           DSN  00323
      CALL REAG (A(JRM),IZM,6HRADIAL,6H MODS )                        DSN  00324
      IF (IER.GT.0) RETURN                                            DSN  00325
C     TEST FOR DISTRIBUTED SOURCE                                     DSN  00326
  310 IF (IABS(IQM).EQ.0) GO TO 340                                   DSN  00327
      IF (IQM.EQ.-1) CALL REAG (A(JQ),IG,6HDIST. ,6HSOURCE)           DSN  00328
      IF (IQM.EQ.-2) CALL REAG (A(JQ),MG,6HSURF. ,6HSOURCE)           DSN  00329
      IF (IER.GT.0) RETURN                                            DSN  00330
      IF (IQM.LT.0) GO TO 340                                         DSN  00331
      IF (ISIGN(1,IQM).EQ.-1) GO TO 340                               DSN  00332
      IF (IQM.GT.0.OR.ISIGN(1,IEVT).EQ.-1) CALL REAG (A(JRS),IGM,6HSOURC DSN  00333
     1E,6H SPECT)                                                     DSN  00334
      J1=MM                                                           DSN  00335
      IF (IQQ.EQ.1) J1=IM                                             DSN  00336
      CALL REAG (A(JQ),J1,6HSOURCE,6H DIST.)                          DSN  00337
      IF (IER.GT.0) RETURN                                            DSN  00338
      J3=JQ+J1-1                                                      DSN  00339
      J4=JQ+J1                                                        DSN  00340
      DO 320 I=2,IGM                                                  DSN  00341
      DO 320 J=JQ,J3                                                  DSN  00342
      A(J4)=A(J)                                                      DSN  00343
  320 J4=J4+1                                                         DSN  00344
      J2=JRS+IGM-1                                                    DSN  00345
      J3=JQ                                                           DSN  00346
      DO 330 J=JRS,J2                                                 DSN  00347
      DO 330 I=1,J1                                                   DSN  00348
      A(J3)=A(J3)*A(J)                                                DSN  00349
  330 J3=J3+1                                                         DSN  00350
C     TEST FOR NUCLIDES TO BE READ FROM DISK AND CARDS                DSN  00351
  340 MTPA=IABS(MTP)                                                  DSN  00352
      IF (MTPA.EQ.0) GO TO 350                                        DSN  00353
      CALL REAI (IA(KMT),MTPA,6HDISK M,6HAT NO.)                      DSN  00354
  350 CALL RECS (A(JC),IHM,IGM,MT)                                    DSN  00355
C     DONE WITH INPUT****                                             DSN  00356
C     COMPUTE AND PRINT SN CONSTANTS                                  DSN  00357
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C       TEMPORARY STORAUE                                                    DSN    00358
360     CALL SECOND (TBEG)                                                   DSN    00359
        JI=JKE                                                               DSN    00360
        J2=JI+KM                                                             DSN    00361
        J3=J2+MM                                                             DSN    00362
        J4=J3+MM                                                             DSN    00363
        KA=ISCT+I                                                            DSN    0036A
        KB=KA+ISCT                                                           DSN    00365
        J5=J4+KM                                                             DSN    00366
        J6=J5+MM*KA*KA                                                       DSN    00367
        CALL SNCM (A(JW)+A(JU)+A(JWO)+A(JL)+IA(KMR)+A(JI)+A(J2)+A(J3)+A(JA   DSN    00368
       I)+A(J5)+MM+NM+KA+KM)                                                 DSN    00369
        IF (IER.GT.0) RETURN                                                 DSN    00370
C       ZERO TEMPORARY STORAGE                                               DSN    00371
        DO 370 K=JI+J6                                                       DSN    00372
370     A(K)=0.0                                                             DSN    00373
C       TEST FOR ADJOINT PROBLEM                                             DSN    0037A
        IF (IIM.NE.I) GO TO 380                                              DSN    00375
C       COMPUTE ADJOINT REVERSALS AND CROSS SECTIONS                         DSN    00376
        CALL ADJREV (A(JKI)+A(JVF)+A(JO)+A(JN)+IQM+IFN+IGM+IM+IC+A(JC)+IMM   DSN    00377
       I+MT+NL+IMT)                                                          DSN    0037A
C       COMPUTE INITIAL FUNCTIONS                                            DSN    00379
380     CALL IFUNC (A(JKI)+A(JKE)+A(JVE)+IGP+IQM+PV+IPVT+IEVT)               DSN    00380
        IF (IER.GT.0) RETURN                                                 DSN    00381
C       MIX AND PRINT CROSS SECTIONS                                         DSN    00382
        IF (ICC.EQ.0) GO TO 400                                              DSN    00383
390     IF (IABS(IEVT).NE.3) GO TO 410                                       DSN    0038A
A00     CALL MIXCX (A(JC)+IA(KMB)+IA(KMC)+A(JMD)+IMM+IGM+MT+MS+EV+IEVT+ICC   DSN    00385
       I)                                                                    DSN    00386
410     MFN=I                                                                DSN    00387
C       MODIFY RADII AND COMPUTE AREAS, VOLUMES, AND GEOMETRIC FUNCTIONS     DSN    00388
        CALL RMAVGF (A(JRA)+A(JA)+A(JR)+A(JV)+A(JRM)+A(JAV)+IA(KMA)+A(JW)+   DSN    00389
       IA(JUO)+A(JUA)+A(JUB)+A(JUC)+A(JDS)+IP+IM+IZM+MM)                     DSN    00390
        IF (IER.GT.0) RETURN                                                 DSN    00391
C       CHECK FOR DISTRIBUTED SOURCE                                         DSN    00392
        IF (ICC.NE.0.OR.(IQM.EQ.0.AND.IPRE.EQ.0)) GO TO A30                  DSN    00393
        IF (IQM.EQ.2) GO TO 420                                              DSN    0039A
C       DISTRIBUTED SOURCE                                                   DSN    00395
        CALL USOUR (A(JU)+A(JMG)+A(JV)+IM+IGM+IGP+IP+XNF+A(JVE)+IQM+IPRE)    DSN    00396
        IF (IER.GT.0) RETURN                                                 DSN    00397
        GO TO 430                                                            DSN    00399
C       FIRST COLLISION SOURCE                                               DSN    00399
A20     CALL FCSOUR (A(JQ)+A(JOG)+A(JRS)+A(JW)+A(JO)+A(JA)+XNF+MM+IGM+IGP+   DSN    00400
       IIS2+IP+ISN)                                                          DSN    00401
C       FISSION CALCULATIONS AND NORMALIZATIONS                              DSN    00402
A30     CALL FISSN (A(JN)+A(JC)+A(JX)+A(JB)+IGM+IM+IMM+MT+NM+MM+A(JFG)+IGP   DSN    00403
       I+A(JF)+A(JKE)+IA(KMA)+(A)KMZ)+IZM+A(JV)+A(JQG)+A(JDF))               DSN    00404
        IF (IER.GT.0) RETURN                                                 DSN    00405
C       MONITOR PRINT                                                        DSN    00406
        IF (ICC.GT.0) GO TO 450                                              DSN    00407
        WRITE (9+440)EPS+EPS)                                                DSN    00408
AA0     FORMAT (1H0//16H ITERATION COUNT+7X+4HEPS=1PE16.8+5X+5HEPSA=F16.8/   DSN    00409
       I//6H PROBLEM+4X+5HOUTER+7X+5HINNER+7X+7HNEUTRON+7X+10HEIGENVALUE+5   DSN    00410
       2X+10HEIGENVALUE+7X+6HLAMBDA/5H    10+4X+10HITERATIONS+2X+10HITERATI   DSN    00411
       3ONS+5X+7HBALANCE+24X+5HSLOPE/)                                       DSN    00412
A50     JNBG=JNB+IGM                                                         DSN    00413
        WRITE (9+460)IN+ICC+ C+A(JNBG)+EV+EQ+XLA                             DSN    00414
A60     FORMAT (I5+3X+I8+4X+I8+4X+1P4E15.8)                                  DSN    00415
        IF (ICC.LT.I) GO TO 490                                              DSN    00416
        CALL SECOND (TIME)                                                   DSN    00417
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      TEXT=TIME-TREG+1.5*(TIME-TREG)/FLOAT(ICC)
      IF (TEXT.GT.0.) WRITE (9,470)
  470 FORMAT (31H0 PROBLEM ABORTED ON TIME LIMIT)
      IF (TEXT.GT.0.) GO TO 530
      IF (ICC.LE.ICM) GO TO 490
C     FLUX DUMP
      WRITE (9,480)
      GO TO 530
  480 FORMAT (40H0TOO MANY OUTER ITERATIONS-FLUXES DUMPED)
C     ALPHA OPTION
  490 EI=0.0
      IF (IABS(IEVT).EQ.2) EI=EV
      IF (IPVT.EQ.2) EI=EI+PV
      DO 500 I=1,IGM
      JTBI=JTB+I-1
      JVEI=JVE+I-1
  500 A(JTBI)=EI/A(JVEI)
C     BEGIN GROUP LOOP
      IS=IM
      IF (IGM.EQ.2) IS=MM
      IT=IS+NM
      CALL OUTER (A(JC),A(JSA),A(JL),A(JN),A(JX),A(JCH),A(JQ),A(JB),A(JA
     1F),A(JJJ),A(JT),A(JS4),A(JS7),IHD,IGM,MT,IM,MM,NM,ISCT,IT,IP,IZP,I
     2S,IA(KMA),IA(KMZ),IZ4,A(JF),A(JCS),A(JV),A(JSR),A(JCT),A(JCA),A(JN
     3N),A(JNO),A(JST),A(JNR),A(JW),A(JRS),A(KH),A(JRA),A(JH),A(JA),A(JW
     4D),A(JJF),A(JS),IA(KGT))
C     TOTAL GROUP, FISSION, AND CONVERGENCE NUMBERS CALCULATIONS
  510 CONTINUE
      CALL TOTGP (A(JSN),A(JSC),A(JNL),A(JAG),A(JSO),A(JRL),A(JNH),IGP,A
     1(JFN),A(JNG),A(JDG),A(JOG),A(JFG),A(JKE),A(JKI))
      IF (IER.GT.0) RETURN
      GO TO (530,450,520,600), KS851
C     NEW PARAMETERS FOR IMPLICIT SEARCH
  520 CALL NEWPAR
      GO TO (530,450,390), KS852
  530 CONTINUE
C     FINAL PRINT
      IF (IPRE.EQ.1.OR.IPRE.EQ.2) GO TO 600
      CALL FINPR (A(JN),A(JX),A(JT3),A(JTS),A(JC),IGM,IM,NM,ID3,IZP,IHM,
     1MT,A(JNB),IGP,IA(KMA),A(JRA),A(JAV),A(JV),A(JF),IP,IA(KM3),IA(KMA
     2),JJ3,JJA,IA(KMZ),IZM,A(JMU),MS,IA(KMC),IA(KMB),A(JDF),A(JVE),A(JQ
     3),A(JH))
C     CHECK FOR OVERLAP INTEGRAL
      IF (ISIGN(1,IEVT).NE.-1) RETURN
      IF (ITH.EQ.0) GO TO 560
      REWIND 3
      DO 550 I=1,IGM
      J=IGP-1
      REWIND 4
      DO 540 JI=1,J
      K=JST-1
  540 READ (4)(A(J2),J2=JAF,K)
  550 WRITE (3)(A(J2),J2=JAF,K)
  560 CALL INTEG (IM,IP,IGM,IZM,IHM,IA(KMA),A(JVE),A(JV),A(JAF),A(JDS),A(
     1JW),A(JGZ),IGP,IZP,IA(KMB),A(JTF),A(JTS),A(JTT),IHM,MT,IA(KMZ),A(J
     2F),A(JDF),A(JC),A(JK),A(JA),A(JD))
      IF (IEVT.LE.-1) GO TO 580
      IF (ITH.EQ.0) RETURN
      DO 570 L=1,IGM
      I=JRS+L
```

```
      J=I+L
      A(I)=1.
  570 A(J)=0.
  580 IF (IHM.EQ.2) RETURN
      IF (IPVT.EQ.1) IPVT=0
      IFN=1
      ICC=0
      KSAS1=0
      KSAS2=0
      LC=0
      LCC=0
      NFN=0
      IIG=0
      IIC=0
      ICVT=0
      XLAMIN=0.0
      EVMIN=0.0
      EVMAX=0.0
      XLAMAX=1.E+80
      EPSA=0.
      IF (ITH.EQ.1) RETURN
      ITH=1
      IF IEV.GT.0.) EQ=0.
      WRITE (6,590)
      GO TO 260
  590 FORMAT (30H1  ADJOINTED PROBLEMME FOLLOWS)
  600 CONTINUE
      CALL PASS2 (A(JV),A(JC),A(JQ),A(JF),A(JN),A(JDF),A(JAF),IA(KMA),IA
     1(KM2)),IHM,IGM,IM,IP,IGP,A(JKE),A(JFG),A(JQG))
      IF (IPRE.EQ.0) GO TO 510
      GO TO 490
      DATA (SNW(I),I=1,84)/0.,2*.5,0.,.16666667,2*.33333333,.16666667,0.,
     1.,05330038,.1011727?,.13775342,.20777348,.20777348,.13775342,.1011
     27272,.15330038,0.,.0427558,.03977460,.046AA72,.04596055,.05263464
     3,.06401735,.09050406,.14266428,.14266428,.09050406,.06401735,.0526
     43464,.04596055,.0416?472,.03977460,.0227?58,0.,2*.5,0.,4*.16666667
     5,0.,2*.16666667,0.,.08043062,.08623604,2*.08043062,.08623604,.080
     643062,0.,4*.13623605,0.,2*.08043062,0.,.05330038,2*.05058636,2*.05
     7330038,2*.05058636,.05330038,0.,.05058636,.03658070,2*.05058636,.0
     83658070,.05058636,0.,4*.05058636,0.,2*.05330038/
      DATA (SNU(I),I=1,84)/-1.,-.57735027,.57735027,-1.,-.88191710,-.333
     133333,.33333333,.88191710,-1.,-.95118973,-.78679579,-.57735027,-.2
     2182179?,.21821789,.57735027,.78679579,.95118973,-1.,-.97752522,-.9
     3067647?,-.82999331,-.74535599,-.64978629,-.53748385,-.39440532,-.1
     44907120,.14907120,.31440532,.53748385,.64978629,.74535599,.8299933
     51,.90576470,.97752522,-.88164966,-.5773503,.5773503,-.94280?10,-.881
     691710,-.3333333,.3333333,.88191710,-.471A045,-.3333333,.3333333,-.96
     7609?9,-.9309493,-.6831301,-.2581989,.2581989,.6831301,.9309493,-.7
     8302967,-.6831301,-.2581989,.2581989,.6831301,-.3651484,-.2581989,.
     92581989,-.9759001,-.9511897,-.7867958,-.5773503,-.2182179,.2182179
     $,.5773503,.7867958,.9511897,-.8164966,-.7867958,-.5773503,-.218217
     $9,.2182179,.5773503,.7867958,-.6172134,-.5773503,-.2182179,.218217
     $9,.5773503,-.3086067,-.2182179,.2182179/
      END
      SUBROUTINE RECS (CS,IHM,IGM,MT)
      DIMENSION CS(IHM,IGM,MT), AO(12)
      COMMON IA(1003),A(10000)
      EQUIVALENCE (KO,IA(112)), (MCR,IA(17)), (JA,IA(52)), (JB,IA(53)),
     1(IA(18),MIP), (IA(8),ML), (IA(1),IHT), (A(3),EPS)
      EQUIVALENCE ( IA (31), IXS )
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                NX=0                                                                    DSN     00538
                IF (MTP.GT.0) GO TO 10                                                  DSN     00539
                NX=1                                                                    DSN     00540
                MTP=IABS(MTP)                                                           DSN     00541
10      CONTINUE                                                                        DSN     00542
                IMS=IABS(IA(I+1))                                                       DSN     00543
                IF (MCR.LE.0) GO TO 40                                                  DSN     00544
                L=MCR                                                                   DSN     00545
                DO 30 IMT=1,L                                                           DSN     00546
                READ (10,20)AD                                                          DSN     00547
20      FORMAT (12A6)                                                                   DSN     00548
                WRITE (9,20)AD                                                          DSN     00549
                READ (10,290)((CS(I,J,IMT),I=1,IMM),J=1,IGM)                            DSN     00550
30      CONTINUE                                                                        DSN     00551
40      IF (MTP.EQ.0) GO TO 180                                                         DSN     00552
                NT=KI                                                                   DSN     00553
                NE=1+MCR                                                                DSN     00554
                MMK=0                                                                   DSN     00555
50      REWIND 5                                                                        DSN     00556
60      READ (5,280)(AD(I),I=1,4),ITG,AD(5),ITL,AD(6),AD(7),ITN,(AD(I),I=8              DSN     00557
        1,11)                                                                           DSN     00558
                IF (ITN.GE.9999) GO TO 90                                               DSN     00559
                NR=(11*ITL)/ITG+MIN0(1,MOD(ITG*ITL,6))                                  DSN     00560
                IF (MU)(ITN,IJU).EQ.0) NR=ITG/3+MIN0(1,MOD(ITG,3))                      DSN     00561
                IF (ITN.EQ.10J*(IA(NT)/100)) GO TO 110                                  DSN     00562
                IF (ITN.EQ.IA(NT)) GO TO 140                                            DSN     00563
70      DO 80 I=1,NR                                                                    DSN     00564
80      READ (5,20)AD(I)                                                                DSN     00565
                GO TO 40                                                                DSN     00566
90      IF (MMK.GT.0) GO TO 260                                                         DSN     00567
                MMK=1                                                                   DSN     00568
                GO TO 50                                                                DSN     00569
100     IF (NE.GE.ML) GO TO 180                                                         DSN     00570
                NE=NE+1                                                                 DSN     00571
                NT=NT+1                                                                 DSN     00572
                MMK=0                                                                   DSN     00573
                GO TO 40                                                                DSN     00574
110     IF (NX.GT.0) GO TO 70                                                           DSN     00575
                NX=1                                                                    DSN     00576
                K=1                                                                     DSN     00577
                L=JA                                                                    DSN     00578
                M=JM-ITG                                                                DSN     00579
                DO 130 I=1,NR                                                           DSN     00580
                READ (5,290)(AD(J),J=1,6)                                               DSN     00581
                DO 120 J=1,6                                                            DSN     00582
                IF (K.LE.MIN0(IGM,ITG)) A(L)=AD(J)                                      DSN     00583
                IF (K.GT.ITG.AND.K.LE.ITG+MIN0(IGM,ITG)) A(M)=AD(J)                     DSN     00584
                K=K+1                                                                   DSN     00585
                L=L+1                                                                   DSN     00586
120     M=M+1                                                                           DSN     00587
130     CONTINUE                                                                        DSN     00588
                GO TO 50                                                                DSN     00589
140     DO 150 L=1,IGM                                                                  DSN     00590
                DO 150 K=1,IMM                                                          DSN     00591
150     CS(K,L,NF)=0.                                                                   DSN     00592
                K=1                                                                     DSN     00593
                L=1                                                                     DSN     00594
                WRITE (9,280)(AD(I),I=1,4),ITG,AD(5),ITL,AD(6),AD(7),ITN,(AD(I),I=      DSN     00595
        18,11)                                                                          DSN     00596
                DO 170 I=1,NR                                                           DSN     00597
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      READ (5,290)(AD(J),J=1,6)                                          DSN  00598
      DO 160 J=1,6                                                       DSN  00599
      IF (K.LE.MIN0(IMM,ITL).AND.L.LE.MIN0(IGM,ITG)) CS(K,L)=AD(J)       DSN  00600
      K=K+1                                                              DSN  00601
      IF (K.LE.ITL) GO TO 160                                            DSN  00602
      L=L+1                                                              DSN  00603
      K=1                                                                DSN  00604
160   CONTINUE                                                           DSN  00605
170   CONTINUE                                                           DSN  00606
      GO TO 100                                                          DSN  00607
180   REWIND 5                                                           DSN  00608
      JAM=IMT-2                                                          DSN  00609
      DO 250 I=1,ML                                                      DSN  00610
      IF (CS(IMT,I,1).LE.0.0) GO TO 250                                  DSN  00611
      DO 240 J=1,IGM                                                     DSN  00612
      A=CS(IMT,J,1)-CS(JAM,J,1)                                          DSN  00613
      JC=IMM-J+1                                                         DSN  00614
      JD=1                                                               DSN  00615
190   IF (JC.GT.IMT) GO TO 200                                           DSN  00616
      JC=JC+1                                                            DSN  00617
      JD=JD+1                                                            DSN  00618
      GO TO 190                                                          DSN  00619
200   A=A-CS(JC,JD,1)                                                    DSN  00620
      JC=JC+1                                                            DSN  00621
      JD=JD+1                                                            DSN  00622
      IF (JC.LE.IMM.AND.JD.LE.IGM) GO TO 200                             DSN  00623
      IF (A.LE.1.E-5*ABS(CS(IMT,J,1))) GO TO 240                         DSN  00624
      IF (IXS.LE.0) GO TO 220                                            DSN  00625
      CS(JAM,J,1)=CS(JAM,J,1)+A                                          DSN  00626
      WRITE (6,210) I,J                                                  DSN  00627
210   FORMAT ((2H0IN MATERIAL ,I3,6H,GROUP,I3,35H, SIG(G)PI HAS BEEN TRU DSN  00628
     1NCATED)      )                                                    DSN  00629
      GO TO 240                                                          DSN  00630
220   CONTINUE                                                           DSN  00631
      CS(JC-1,JD-1,1)=CS(JC-1,JD-1,1)+A                                  DSN  00632
      WRITE (6,230) I,J                                                  DSN  00633
230   FORMAT (12H0IN MATERIAL ,I3,6H,GROUP,I3,40H, SIG(G)PI HAS BEEN FLO DSN  00634
     1OWED              )                                               DSN  00635
240   CONTINUE                                                           DSN  00636
250   CONTINUE                                                           DSN  00637
      IXS=0                                                              DSN  00638
      RETURN                                                             DSN  00639
260   WRITE (6,270)                                                      DSN  00640
      RETURN                                                             DSN  00641
270   FORMAT (62H0NUCLIDE REQUESTED NOT ON DISK OR NUCLIDE NUMBERS OUT O DSN  00642
     1F ORDER,AM  RECS)                                                 DSN  00643
280   FORMAT (3A6,A4,I2,4A,I2,2A6,I6,4A6)                                DSN  00644
290   FORMAT (6E12.5)                                                    DSN  00645
      END                                                                DSN  00646
      SUBROUTINE REAI (IARRAY,NCOUNT,MOL1,MOL2)                          DSN  00647
C                                                                        DSN  00648
C     READS INTEGER DATA                                                 DSN  00649
      DIMENSION IARRAY(NCOUNT), IV(6), K(6), IN(6)                       DSN  00650
      COMMON IA(1000)                                                    DSN  00651
      EQUIVALENCE (IA(191),IFR)                                          DSN  00652
      J=1                                                                DSN  00653
10    READ (10,20)(K(I),IN(I),IV(I),I=1,6)                               DSN  00654
20    FORMAT (6(I1,I2,I9))                                               DSN  00655
      DO 80 I=1,6                                                        DSN  00656
      L=K(I)+1                                                           DSN  00657
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      GO TO (30,40,50,90), L                                            DSN   00658
C     NO MODIFICATION                                                   DSN   00659
30    IARRAY(J)=IV(I)                                                   DSN   00660
      J=J+1                                                             DSN   00661
      GO TO 60                                                          DSN   00662
C     REPEAT                                                            DSN   00663
40    L=IN(I)                                                           DSN   00664
      DO 50 M=I,L                                                       DSN   00665
      IARRAY(J)=IV(I)                                                   DSN   00666
50    J=J+1                                                             DSN   00667
      GO TO 60                                                          DSN   00668
C     INTERPOLATE                                                       DSN   00669
60    WRITE (9,120)MOLI,MOL2                                            DSN   00670
70    IER=1                                                             DSN   00671
      RETURN                                                            DSN   00672
80    CONTINUE                                                          DSN   00673
      GO TO 10                                                          DSN   00674
C     TERMINATE                                                         DSN   00675
90    J=J-1                                                             DSN   00676
      WRITE (9,110)MOLI,MOL2,J,(IARRAY(II),I=1,NCOUNT)                  DSN   00677
      IF (J-NCOUNT) 100,140,100                                         DSN   00678
100   WRITE (9,130)MOLI,MOL2                                            DSN   00679
      GO TO 70                                                          DSN   00680
110   FORMAT (1H0,2A6,I6/(10I12))                                       DSN   00681
120   FORMAT (44HOATTEMPTING TO INTERPOLATE BETWEEN INTEGERS ,2A6)      DSN   00682
130   FORMAT (33HOINCORRECT NUMBER OF INPUT ITEMS ,2A6)                 DSN   00683
140   RETURN                                                            DSN   00684
      END                                                               DSN   00685
      SUBROUTINE READ (ARRAY,NCOUNT,MOLI,MOL2)                          DSN   00686
C                                                                       DSN   00687
C     READS FLOATING POINT DATA                                         DSN   00688
      DIMENSION ARRAY(NCOUNT), V(12), K(12), IN(12)                     DSN   00689
      COMMON IA(1000)                                                   DSN   00690
      EQUIVALENCE (IA(191),IFR)                                         DSN   00691
      JFLAG=0                                                           DSN   00692
      J=1                                                               DSN   00693
10    IF (JFLAG).EQ.0) GO TO 30                                         DSN   00694
      DO 20 JJ=1,6                                                      DSN   00695
      K(JJ)=K(JJ+6)                                                     DSN   00696
      IN(JJ)=IN(JJ+6)                                                   DSN   00697
20    V(JJ)=V(JJ+6)                                                     DSN   00698
      JFLAG=0                                                           DSN   00699
      GO TO 50                                                          DSN   00700
30    READ (10,40)(K(I),IN(I),V(I),I=1,6)                               DSN   00701
40    FORMAT (6(I1,I2,E9.4))                                            DSN   00702
50    DO 170 I=1,6                                                      DSN   00703
      L=K(I)+1                                                          DSN   00704
      GO TO (60,70,90,180,130), L                                       DSN   00705
C     NO MODIFICATION                                                   DSN   00706
60    ARRAY(J)=V(I)                                                     DSN   00707
      J=J+1                                                             DSN   00708
      GO TO 170                                                         DSN   00709
C     REPEAT                                                            DSN   00710
70    L=IN(I)                                                           DSN   00711
      DO 80 M=1,L                                                       DSN   00712
      ARRAY(J)=V(I)                                                     DSN   00713
80    J=J+1                                                             DSN   00714
      GO TO 170                                                         DSN   00715
C     INTERPOLATE                                                       DSN   00716
90    IF (I-6) 110,100,100                                              DSN   00717
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      READ (10,A0)(K(JJ),IN(JJ),V(JJ),JJ=7,121                          DSN   00718
      JFLAG=1                                                           DSN   00719
110   L=IN(I)-I                                                         DSN   00720
      DEL=(V(I+1)-V(I))/FLOAT(L)                                        DSN   00721
      DO 120 M=1,L                                                      DSN   00722
      ARRAY(J)=V(I)+DEL*FLOAT(M-1)                                      DSN   00723
120   J=J+1                                                             DSN   00724
      GO TO 170                                                         DSN   00725
C     INTERPOLATE WITH CONSTANT RATIO                                   DSN   00726
130   IF (1.LT.6) GO TO 140                                             DSN   00727
      READ (10,40)(K(JJ),IN(JJ),V(JJ),JJ=7,12)                         DSN   00728
      JFLAG=1                                                           DSN   00729
140   L=MAX0(2,IN(I)-1)                                                 DSN   00730
      T1=0.                                                             DSN   00731
      T2=1.                                                             DSN   00732
      DO 150 JJ=1,L                                                     DSN   00733
      T1=T1+T2                                                          DSN   00734
150   T2=T2*V(I)                                                        DSN   00735
      T2=(V(I+1)-ARRAY(J-1))/T1                                         DSN   00736
      L=MAX0(1,IN(I))                                                   DSN   00737
      DO 160 JJ=1,L                                                     DSN   00738
      ARRAY(J)=ARRAY(J-1)+T2                                            DSN   00739
      T2=T2*V(I)                                                        DSN   00740
160   J=J+1                                                             DSN   00741
170   CONTINUE                                                          DSN   00742
      GO TO 10                                                          DSN   00743
C     TERMINATE                                                         DSN   00744
180   J=J-1                                                             DSN   00745
      WRITE (9,190)MOL1,MOL2,J,(ARRAY(I),I=1,NCO(IN7)                   DSN   00746
190   FORMAT (1HO,2A6,I6/(1P10E12.5))                                   DSN   00747
      IF (J-NCOUNT) 210,220,200                                         DSN   00748
200   WRITE (9,210)MOL1,MOL2                                            DSN   00749
      IER=1                                                             DSN   00750
      RETURN                                                            DSN   00751
210   FORMAT (33H0INCORRECT NUMBER OF INPUT ITEMS ,2A6)                 DSN   00752
220   RETURN                                                            DSN   00753
      END                                                               DSN   00754
      SUBROUTINE SNCN (W,D,WD,CL,MR,AB,Z,CP,AF,CT,MM,NM,ISC,IFM)        DSN   00755
C                                                                       DSN   00756
C     COMPUTE, PRINT DISCRETE ORDINATE CONSTANTS                        DSN   00757
      DIMENSION W(MM), D(MM), WD(MM), CL(MM,NM), MR(MM), AF(IFM, AB(MM) DSN   00758
     1, Z(MM), CP(44), CT(MM,ISC,ISC)                                   DSN   00759
      COMMON IA(1000)                                                   DSN   00760
      EQUIVALENCE (IA(191),IFR)                                         DSN   00761
      IS=ISC-1                                                          DSN   00762
C     FORM MATED DIRECTIONS AND TEST INPUT DATA FOR ERRORS              DSN   00763
      EI=0.0                                                            DSN   00764
      M=MM                                                              DSN   00765
10    B=W(M)                                                            DSN   00766
      C=D(M)                                                            DSN   00767
      A=M*C                                                             DSN   00768
      WD(M)=A                                                           DSN   00769
      EI=EI+A*M                                                         DSN   00770
      IF (A) 20,20,30                                                   DSN   00771
20    IF (C.EQ.0.0) GO TO 300                                           DSN   00772
      MR(M)=MR(M+1)                                                     DSN   00773
30    M=M-1                                                             DSN   00774
      IF (M.GT.0) GO TO 10                                              DSN   00775
      IF (.0001-ABS(1.-EI).GE.0.01) GO TO 60                            DSN   00776
      WRITE (9,340)                                                     DSN   00777
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      GO TO 310                                                  DSN   00778
40    K=M                                                        DSN   00779
50    K=K+1                                                      DSN   00780
      IF (K.GT.MM) GO TO 320                                     DSN   00781
      IF (.0001-ABS(D(K)+C).LT.0.0) GO TO 50                     DSN   00782
      MR(K)=M                                                    DSN   00783
      MR(M)=K                                                    DSN   00784
      GO TO 30                                                   DSN   00785
C     CHECK FOR ANISOTROPIC SCATTERING                           DSN   00786
60    IF (IS.EQ.0) GO TO 290                                     DSN   00787
C     CHECK GEOMETRY TYPE                                        DSN   00788
      IF (NM.GT.15) GO TO 110                                    DSN   00789
C     SPHERES AND SLABS  ((F LINEAR SCATTER, CYLINDER ALSO)      DSN   00790
      DO 70 M=1,MM                                               DSN   00791
70    CL(M,1)=D(M)                                               DSN   00792
      IF (IS.EQ.1) GO TO 230                                     DSN   00793
      DO 80 M=1,MM                                               DSN   00794
80    CL(M,2)=.5*(3.*D(M)**2-1.)                                 DSN   00795
      IF (IS.EQ.2) GO TO 100                                     DSN   00796
      DO 90 N=3,IS                                               DSN   00797
      A=N                                                        DSN   00798
      B=1.-1./A                                                  DSN   00799
      C=B+1.                                                     DSN   00800
      DO 90 M=1,MM                                               DSN   00801
90    CL(M,N)=C*CL(M,N-1)*D(M)-B*CL(M,N-2)                       DSN   00802
100   WRITE (9,360)                                              DSN   00803
      GO TO 261                                                  DSN   00804
C     CYLINDERS                                                  DSN   00805
C     GENERATE  XI FUNCTIONS AND ANGLE PHI                       DSN   00806
110   DO 140 M=1,MM                                              DSN   00807
      A=D(M)                                                     DSN   00808
      IF (W(M).NE.0.0) GO TO 120                                 DSN   00809
      Z(M)=SQRT(1.-A**2)                                         DSN   00810
      AB(M)=ABS(A)                                               DSN   00811
      GO TO 130                                                  DSN   00812
120   Z(M)=Z(M-1)                                                DSN   00813
      AB(M)=AB(M-1)                                              DSN   00814
130   B=ATAN(SQRT(1.-Z(M)**2-A**2)/A)                            DSN   00815
      IF (A.LT.0.0) B=B+3.1415927                                DSN   00816
      IF (A.EQ.0.0) B=1.5707963                                  DSN   00817
140   CP(M)=B                                                    DSN   00818
C     GENERATE COEFFICIENTS FOR GENERAL SCATTER                  DSN   00819
      DO 150 M=1,MM                                              DSN   00820
      CT(M,1,1)=1.0                                              DSN   00821
      CT(M,2,1)=Z(M)                                             DSN   00822
      DO 150 N=2,IS                                              DSN   00823
      A=N                                                        DSN   00824
      B=1.-1./A                                                  DSN   00825
      C=B+1.                                                     DSN   00826
150   CT(M,N+1,1)=C*CT(M,N,1)*Z(M)-B*CT(M,N-1,1)                 DSN   00827
      DO 180 M=1,MM                                              DSN   00828
      DO 180 J=2,ISC                                             DSN   00829
      A=2*J-3                                                    DSN   00830
      DO 180 N=1,ISC                                             DSN   00831
      IF (N-J) 180,160,170                                       DSN   00832
160   CT(M,N,J)=AB(M)*CT(M,N-1,J-1)*A                            DSN   00833
170   IF (N.EQ.ISC) GO TO 180                                    DSN   00834
      A=N+J-2                                                    DSN   00835
      B=N-J+1                                                    DSN   00836
      C=2*N-1                                                    DSN   00837
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```
                CT(M,N,(I,J)=(C*Z(M)*CT(M,N,J)-A*CT(M,N-1,J))/B                  DSN   00438
180             CONTINUE                                                        DSN   00439
                AF(1)=1.                                                        DSN   00440
                DO 190 I=2,IFM                                                  DSN   00441
190             AF(I)=FLOAT(I-1)*AF(I-1)                                        DSN   00442
                DO 200 J=2,ISC                                                  DSN   00443
                A=J-1                                                           DSN   00444
                DO 200 N=J,ISC                                                  DSN   00445
                K=N*J-1                                                         DSN   00446
                KA=N-J+1                                                        DSN   00447
                B=SQRT(2.*AF(KA)/AF(K))                                         DSN   00448
                DO 200 M=1,MM                                                   DSN   00449
200             CT(M,N,J)=B*CT(M,N,J)*COSIA**CP(M)                              DSN   00450
C               STORE FUNCTIONS IN CL                                           DSN   00451
                IR=1                                                            DSN   00452
                DO 220 N=2,ISC                                                  DSN   00453
                DO 220 J=1,N                                                    DSN   00454
                K=(N*J)/2                                                       DSN   00455
                KA=(N*J+1)/2                                                    DSN   00456
                IF (K.NE.KA) GO TO 220                                          DSN   00457
                DO 210 M=1,MM                                                   DSN   00458
210             CL(M,IR)=CT(M,N,J)                                              DSN   00459
                IR=IR+1                                                         DSN   00460
220             CONTINUE                                                        DSN   00461
                WRITE (3,390)                                                   DSN   00462
                DO 250 J=1,ISC                                                  DSN   00463
                JJ=J-1                                                          DSN   00464
                NA=1                                                            DSN   00465
                NM=9                                                            DSN   00466
230             NC=MIN0(NM,ISC)                                                 DSN   00467
                WRITE (3,400)(N,N=NA,NC)                                        DSN   00468
                DO 240 M=1,MM                                                   DSN   00469
240             WRITE (9,380) M,(CT(M,N,J),N=NA,NC)                             DSN   00470
                NA=NA+9                                                         DSN   00471
                NM=NM+9                                                         DSN   00472
                IF (NA.LE.ISC) GO TO 230                                        DSN   00473
250             CONTINUE                                                        DSN   00474
                GO TO 290                                                       DSN   00475
260             NA=1                                                            DSN   00476
                NM=9                                                            DSN   00477
270             NC=MIN0(NM,IS)                                                  DSN   00478
                WRITE (9,370) (N,N=NA,NC)                                       DSN   00479
                DO 280 M=1,MM                                                   DSN   00480
280             WRITE (9,380) M,(CL(M,N),N=NA,NC)                               DSN   00481
                NA=NA+9                                                         DSN   00482
                NM=NM+9                                                         DSN   00483
                IF (NA.LE.IS) GO TO 270                                         DSN   00484
290             WRITE (9,410) (M,MR(M),W(M),D(M),U(M),M=1,MM)                   DSN   00485
                RETURN                                                          DSN   00486
300             WRITE (9,330)                                                   DSN   00487
310             IER=1                                                           DSN   00488
                RETURN                                                          DSN   00489
320             WRITE (9,350)                                                   DSN   00490
                GO TO 310                                                       DSN   00491
330             FORMAT (28H0INCORRECT DIRECTION COSINES)                        DSN   00492
340             FORMAT (18H0INCORRECT WEIGHTS)                                  DSN   00493
350             FORMAT (28H0ORDER INDEX EXCEEDS MAXIMUM)                        DSN   00494
360             FORMAT (37H0ANISOTROPIC SCATTER=SLAB OR SPHERE  *27HLEGENDRE POLYN DSN   00495
               1OMIALS PN(MM))                                                  DSN   00496
370             FORMAT (17H0)(RECTION NUMBER,9(3X,2HN=I3,3X))                   DSN   00497
```

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 380    FORMAT (7X,I5,5X,1P9E11.4)                                              DSN  00898
 390    FORMAT (41H0ANISOTROPIC SCATTER-CYLINDER, ASSOCIATED,18H LEGENDRE       DSN  00899
       1POLYNOMIALS P(N,R)COS(R*PHI)//)                                        DSN  00900
 400    FORMAT (17H0DIRECTION NUMBER,9(1X,2HN=I2,3H R=I2,1X))                   DSN  00901
 410    FORMAT (14H0DIRECTION NO.,25H  REFLECTED DIRECTION NO.,5X,6HWEIGHT     DSN  00902
       1,7X,20H  DIRECTION COSINE  ,20H WEIGHT X DIRECTION //(3X,I4,13X,I4      DSN  00903
       2,14X,1PE14.7,3X,E14.7,6X,E14.7))                                       DSN  00904
        END                                                                    DSN  00905
        SUBROUTINE CLEAR (C,IHT,IHM,IGM,MT)                                    DSN  00906
        COMMON IA(1000),A(19000)                                               DSN  00907
        DIMENSION C(IHM,IGM,MT)                                                DSN  00908
        REWIND 4                                                               DSN  00909
        WRITE (4)C                                                             DSN  00910
        K=1                                                                    DSN  00911
 10     J=1                                                                    DSN  00912
 20     I=1                                                                    DSN  00913
 30     IF (I.NE.IHT) C(I,J,K)=0.                                              DSN  00914
        IF (I.EQ.IHT-2) C(I,J,K)=C(IHT,J,K)                                    DSN  00915
        I=I+1                                                                  DSN  00916
        IF (I.LE.IHM) GO TO 10                                                 DSN  00917
        J=J+1                                                                  DSN  00918
        IF (J.LE.IGM) GO TO 20                                                 DSN  00919
        K=K+1                                                                  DSN  00920
        IF (K.LE.MT) GO TO 10                                                  DSN  00921
        RETURN                                                                 DSN  00922
        END                                                                    DSN  00923
        SUBROUTINE ADJREV (XKI,VE,Q,XN,IGM,IFN,IGM,IM,LC,C,IHM,MT,IL,IHT)      DSN  00924
 C                                                                             DSN  00925
 C      ADJOINT REVERSALS                                                      DSN  00926
        DIMENSION XKI(IGM), VE(IGM), Q(IM,IGM), XN(IM,IGM), C(IHM,IGM,MT)      DSN  00927
        COMMON IA(1000)                                                        DSN  00928
        IMS=IABS(IA(14))                                                       DSN  00929
        IG=1                                                                   DSN  00930
        K=IGM                                                                  DSN  00931
 10     IF (K.LE.IG) GO TO 20                                                  DSN  00932
        T=XKI(IG)                                                              DSN  00933
        TA=VE(IG)                                                              DSN  00934
        XKI(IG)=XKI(K)                                                         DSN  00935
        VE(IG)=VE(K)                                                           DSN  00936
        XKI(K)=T                                                               DSN  00937
        VE(K)=TA                                                               DSN  00938
        IG=IG+1                                                                DSN  00939
        K=K-1                                                                  DSN  00940
        GO TO 10                                                               DSN  00941
 20     IF (IABS(IGM).NE.1) GO TO 50                                           DSN  00942
        DO 40 I=1,IM                                                           DSN  00943
        IG=1                                                                   DSN  00944
        K=IGM                                                                  DSN  00945
 30     IF (K.LE.IG) GO TO 40                                                  DSN  00946
        T=Q(I,IG)                                                              DSN  00947
        Q(I,IG)=Q(I,K)                                                         DSN  00948
        Q(I,K)=T                                                               DSN  00949
        K=K-1                                                                  DSN  00950
        IG=IG+1                                                                DSN  00951
        GO TO 30                                                               DSN  00952
 40     CONTINUE                                                               DSN  00953
 50     IF (LC.GE.IABS(IFN)) GO TO 80                                          DSN  00954
        DO 70 I=1,IM                                                           DSN  00955
        IG=1                                                                   DSN  00956
        K=IGM                                                                  DSN  00957
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      60    IF (K.LE.IG) GO TO 70                                          DSN   00958
            T=XN(I,IG)                                                     DSN   00959
            XN(I,ID)=XNTI,K)                                               DSN   00960
            XN(I,K)=T                                                      DSN   00961
            K=K-1                                                          DSN   00962
            IG=IG+1                                                        DSN   00963
            GO TO 60                                                       DSN   00964
      70    CONTINUE                                                       DSN   00965
      80    DO 110 I=1,MT                                                  DSN   00966
            DO 110 JJ=1,IDM                                                DSN   00967
            J=IDM+1-JJ                                                     USN   00968
            IG=I                                                           DSN   00969
            K=IGM                                                          DSN   00970
            IF (J.LE.IMT) GO TO 100                                        DSN   00971
            L=J-IMS                                                        DSN   00972
            IF (L.LE.0) GO TO 90                                           DSN   00973
            IG=L+I                                                         DSN   00974
            GO TO 100                                                      DSN   00975
      90    L=L+IGO                                                        DSN   00976
            IF (L.LE.0) GO TO 110                                          DSN   00977
            K=L                                                            DSN   00978
      100   IF (K.LE.IG) GO TO 110                                         DSN   00979
            T=C(J,K,I)                                                     DSN   00980
            C(J,K,I)=C(J,IG,I)                                             DSN   00981
            C(J,IG,I)=T                                                    DSN   00982
            IG=IG-1                                                        USN   00983
            K=K-1                                                          DSN   00984
            GO TO 100                                                      DSN   00985
      110   CONTINUE                                                       DSN   00986
            RETURN                                                         DSN   00987
            END                                                            DSN   00988
            SUBROUTINE ICONC (XKI,XKE,VE,IGP,IGM,PV,IPVT,IEVT)             DSN   00989
      C                                                                    DSN   00990
      C     COMPUTES INITIAL FUNCTIONS                                     DSN   00991
            DIMENSION XKI(IGP), XKE(IGP), VE(IGP)                          DSN   00992
            COMMON IA(1000)                                                DSN   00993
            EQUIVALENCE (IA(191),IFM)                                      DSN   00994
            IGM=IGP-1                                                      DSN   00995
            IF (IGP.EQ.0.AND.IABS(IEVT).LE.0) GO TO 40                     DSN   00996
            IF (IPV).NE.1) GO TO 20                                        DSN   00997
            IF (PV.EQ.0.0) GO TO 60                                        DSN   00998
      10    DO 10 I=1,IGP                                                  DSN   00999
      10    XKI(I)=XKI(I)/PV                                               DSN   01000
      20    T=0.0                                                          DSN   01001
            DO 30 I=1,IGM                                                  DSN   01002
            XKE(I)=XKI(I)                                                  DSN   01003
            T=T+XKE(I)                                                     DSN   01004
            IF (VE(I).EQ.0.0) GO TO 70                                     DSN   01005
      30    CONTINUE                                                       DSN   01006
            XKE(IGP)=T                                                     DSN   01007
            XKI(IGP)=1                                                     DSN   01008
            WRITE (IFM,80) (XKI(I),XKE(I),VE(I),I=1,IGP)                   DSN   01009
            RETURN                                                         DSN   01010
      40    WRITE (IFM,90)                                                 DSN   01011
      50    IER=1                                                          DSN   01012
            RETURN                                                         DSN   01013
      60    WRITE (IFM,100)                                                DSN   01014
            GO TO 50                                                       DSN   01015
      70    WRITE (IFM,110)                                                DSN   01016
            GO TO 50                                                       DSN   01017
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 80   FORMAT (1H0/8X,3HCHI,12X,6HCHI/PV,7X,12H VELOCITIES 17H  GROUP//(1 DSN   01018
     1P3F16.7,I5))                                                      DSN   01019
 90   FORMAT (56HONO DISTRIBUTED SOURCE SPECIFIED FOR SOURCE ,I2,11TYPE PR DSN 01020
     1OBLEM,//)                                                         DSN   01021
 100  FORMAT (17H0T-V=0 WHEN IPVT=1,//)                                 DSN   01022
 110  FORMAT (22H0ZERO VELOCITY, GROUP=,I4,//)                          DSN   01023
      END                                                               DSN   01024
C     MODIFY RADII-COMPUTE POINT AREAS AND VOLUMES-GEOMETRIC FUNCTIONS  DSN   01025
      SUBROUTINE RHAVGF (RA,AA,R,V,RM,RAV,MA,W,U,DA,DB,DC,DS,IP,IM,IZM,M DSN  01026
     1M)                                                                DSN   01027
      COMMON IA(1000),X(10000)                                          DSN   01028
      DIMENSION RA(IP), R(IP), RM(IZM), MA(IM), AA(IP), V(IP), RAV(IP), DSN   01029
     1W(MM), U(MM), DA(IP,MM), DB(IP,MM), DC(IP,MM), DS(IP,MM)          DSN   01030
      EQUIVALENCE (IGE,IA(5)), (ICC,IA(33)), (IEVT,IA(11)), (EV,A(1))   DSN   01031
      EQUIVALENCE (IA(191),IER)                                         DSN   01032
      IF (ICC.NE.0) GO TO 20                                            DSN   01033
      DO 10 I=1,IM                                                      DSN   01034
      RA(I+1)=R(I+1)                                                    DSN   01035
      IF (RA(I+1).LE.0.0) GO TO 70                                      DSN   01036
      IF (R(I+1).LE.R(I)) GO TO 80                                      DSN   01037
 10   CONTINUE                                                          DSN   01038
      RA(1)=0.0                                                         DSN   01039
 20   IF (IABS(IEVT)-4) 140,30,50                                       DSN   01040
 30   DO 40 I=1,IM                                                      DSN   01041
      K=MA(I)                                                           DSN   01042
      B=1.+EV*RM(K)                                                     DSN   01043
      RA(I+1)=RA(I)+(R(I+1)-R(I))*B                                     DSN   01044
      IF (B.LE.0.0) GO TO 90                                            DSN   01045
 40   CONTINUE                                                          DSN   01046
      GO TO 140                                                         DSN   01047
 50   DO 60 J=1,IP                                                      DSN   01048
 60   RA(J)=EV*R(J)/R(IP)                                               DSN   01049
      GO TO 140                                                         DSN   01050
 70   WRITE (9,110)                                                     DSN   01051
      GO TO 100                                                         DSN   01052
 80   WRITE (9,120) I                                                   DSN   01053
      GO TO 100                                                         DSN   01054
 90   WRITE (9,130)                                                     DSN   01055
 100  IER=1                                                             DSN   01056
      RETURN                                                            DSN   01057
 110  FORMAT (31H0RADIUS LESS THAN OR EQUAL ZERO)                       DSN   01058
 120  FORMAT (31H0R(I+1) LESS THAN OR EQUAL R(I),2HI=I3)                DSN   01059
 130  FORMAT (39H0NEGATIVE FINAL RADIUS FOR DELTA OPTION)               DSN   01060
 140  IF (ICC.NE.0.AND.IABS(IEVT).LE.3) GO TO 280                       DSN   01061
      IF (IGE.NE.1) GO TO 160                                           DSN   01062
      DO 150 J=1,IP                                                     DSN   01063
 150  AA(J)=1.0                                                         DSN   01064
      GO TO 180                                                         DSN   01065
 160  AF=A(IGE+20)                                                      DSN   01066
      IH=IGE-1                                                          DSN   01067
      DO 170 J=1,IP                                                     DSN   01068
 170  AA(J)=AF*RA(J)**IH                                                DSN   01069
 180  VF=A(IGE+23)                                                      DSN   01070
      IF (VF.GT.0.0) GO TO 200                                          DSN   01071
      WRITE (9,190)                                                     DSN   01072
 190  FORMAT (24H0INCORRECT VOLUME FACTOR,//)                           DSN   01073
      GO TO 100                                                         DSN   01074
 200  DO 210 I=1,IM                                                     DSN   01075
      RAV(I)=.5*(RA(I+1)+RA(I))                                         DSN   01076
 210  V(I)=VF*(AA(I+1)*RA(I+1)-AA(I)*RA(I))                             DSN   01077
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1079          IF (ICC.GT.0) GO TO 230                                          DSN   01078
1080          WRITE (9,220)(RAV(I),V(I),AA(I),I=1,IP1                          DSN   01079
1081    220   FORMAT (1H0/6X,10HAVG RADII,5X,10X,6HRADIUS,10X,6HVOLUME,12X,6HAREA/  DSN   01080
1082         1/(1P6E16.7,15))                                                  DSN   01081
1083    230   DO 270 M=1,MM                                                    DSN   01082
1084          AB=U(M)                                                          DSN   01083
1085          AC=AMS(AB)                                                       DSN   01084
1086          AD=M(M)                                                          DSN   01085
1087          AE=AB*AB                                                         DSN   01086
1088          AF=M(M-1)                                                        DSN   01087
1089          AG=U(M-1)*AF                                                     DSN   01088
1090          DO 270 I=1,IM                                                    DSN   01089
1091          AH=AA(I+1)                                                       DSN   01090
1092          BC=AA(I)                                                         DSN   01091
1093          DA(I,M)=AC*(AB+BC)                                               DSN   01092
1094          IF (AB.LE.0.0) GO TO 240                                         DSN   01093
1095          DS(I,M)=AH*AC                                                    DSN   01094
1096          GO TO 250                                                        DSN   01095
1097    240   DS(I,M)=BC*AC                                                    DSN   01096
1098    250   IF (AD.NE.0.0) GO TO 260                                         DSN   01097
1099          DC(I,M)=0.0                                                      DSN   01098
1100          GO TO 270                                                        DSN   01099
1101    260   DC(I,M)=((BC-BB)*(AE+AG)+DC(I,M-1)*AF)/AD                        DSN   01100
1102    270   DM(I,M)=DA(I,M)+DC(I,M)                                          DSN   01101
1103    280   RETURN                                                           DSN   01102
1104          END                                                              DSN   01103
1105          SUBROUTINE MIACX (C,M),MC,XMD,IMM),IGM,MT,MS,EV,IEVT,ICC1        DSN   01104
1106    C                                                                      DSN   01105
1107    C     MIX AND PRINT CROSS SECTIONS                                     DSN   01106
1108          DIMENSION C(IGM,IGM,MT), MM(MS), MC(MS), XMD(MS)                 DSN   01107
1109          COMMON IA(10M0)                                                  DSN   01108
1110          EQUIVALENCE (IMS,IA(1))                                          DSN   01109
1111          IF (MS.EQ.0) GO TO 60                                            DSN   01110
1112          DO 50 K=1,MS                                                     DSN   01111
1113          K=MM(M)                                                          DSN   01112
1114          L=MC(K)                                                          DSN   01113
1115          A=XMD(M)                                                         DSN   01114
1116          DO 50 I=1,IGM                                                    DSN   01115
1117          DO 50 J=1,IGM                                                    DSN   01116
1118          IF (L) 20,10,20                                                  DSN   01117
1119    10    C(I,J,K)=C(I,J,K)*A                                              DSN   01118
1120          GO TO 50                                                         DSN   01119
1121    20    IF (A) 30,40,30                                                  DSN   01120
1122    30    C(I,J,K)=C(I,J,K)+A*(C(I,J,L)                                    DSN   01121
1123          GO TO 50                                                         DSN   01122
1124    40    C(I,J,K)=C(I,J,K)*FV                                             DSN   01123
1125    50    CONTINUE                                                         DSN   01124
1126          IF ((ABS(IEV)).EQ.3.AND.ICC.NE.0) GO TO 100                      DSN   01125
1127          WRITE (9,150)(MM(I),MC(I),XMD(I),I=1,MS)                         DSN   01126
1128    60    IF (IA(14).LT.0) GO TO 100                                       DSN   01127
1129          DO 90 I=1,MT                                                     DSN   01128
1130          WRITE (9,110)I                                                   DSN   01129
1131          KA=1                                                             DSN   01130
1132          KB=8                                                             DSN   01131
1133    70    KC=MIN0(KB,IGM)                                                  DSN   01132
1134          WRITE (9,140)(K,K=KA,KC)                                         DSN   01133
1135          WRITE (9,130)                                                    DSN   01134
1136          DO 80 J=1,IGM                                                    DSN   01135
1137    80    WRITE (9,140)J,(C(J,K,I),K=KA,KC)                                DSN   01136
1138          KA=KA+8                                                          DSN   01137
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            K0=K8+6                                                     DSN     01138
            IF (K=.LE.IGM) GO TO 70                                     DSN     01139
   90       CONTINUE                                                    DSN     01140
   100      IF (IA(NS)IEV)).NE.3) NS=0                                  DSN     01141
            RETURN                                                      DSN     01142
   110      FORMAT )1H0//(26H CROSS SECTION OF MATERIAL .I3/)           DSN     01143
   120      FORMAT (1H0.5A.8(2X.5HGROUP.I3.3X)I                         DSN     01144
   130      FORMAT (1H0)                                                DSN     01145
   140      FORMAT (I4.1PE13.5)                                         DSN     01146
   150      FORMAT (1H0/16H MIXTURE NUMBER .16H   MIX COMMAND  )26H MATERIAL A DSN  01147
           1TOMIC DENSITY/(4X.I4.8X.I8.8X.E16.8.8X.IA))                 DSN     01148
            END                                                         DSN     01149
            SUBROUTINE DSOUR (Q.QG.V.IM.IGM)IGP.IP.XNF.VE)IQM)IPRE)     DSN     01150
   C                                                                    DSN     01151
   C        COMPUTE DISTRIBUTED SOURCE                                  DSN     01152
            DIMENSION Q(IM.IGM). QG(IGP)) V(IP). VE(IGP)                DSN     01153
            COMMON IA(1000)                                             DSN     01154
            EQUIVALENCE (IA(191).IER)                                   DSN     01155
            IF (IPRE.GT.0) GO TO 100                                    DSN     01156
            IQM=IABS(IQM)                                               DSN     01157
            B=0.0                                                       DSN     01158
            DO 20 J=1.IGM                                               DSN     01159
            A=0.0                                                       DSN     01160
            DO 10 I=1.IM                                                DSN     01161
   10       A=A+Q(I.J)*V(I)                                             DSN     01162
            QG(J)=A                                                     DSN     01163
   20       B=B+A                                                       DSN     01164
            IF (B.LE.0.0) GO TO 80                                      DSN     01165
            QG)IGP)=B                                                   DSN     01166
            IF (XNF.LE.0.0) GO TO 40                                    DSN     01167
            E=XNF/B                                                     DSN     01168
            DO 30 J=1.IGM                                               DSN     01169
            QG)J)=QG)J)*E                                               DSN     01170
            DO 30 I=1.IM                                                DSN     01171
   30       Q(I.J)=Q(I.J)*E                                             DSN     01172
            QG(IGP)=XNF                                                 DSN     01173
   40       DO 50 J=1.IGM                                               DSN     01174
   50       WRITE (9.60)J.(Q(I.J).I=1.IM)                               DSN     01175
   60       FORMAT (19H0DISTRIBUTED SOURCE.5X.6H GROUP.I3/(1P10E12.5II  DSN     01176
            WRITE (9.70)(QG(I).I=1.IGP)                                 DSN     01177
   70       FORMAT (19H0GROUP TOTAL SOURCE/(1P10E12.5))                 DSN     01178
            RETURN                                                      DSN     01179
   80       WRITE (9.90)                                                DSN     01180
   90       FORMAT (36H0ZERO OR NEGATIVE DISTRIBUTED SOURCE//I          DSN     01181
            IER=1                                                       DSN     01182
            RETURN                                                      DSN     01183
   100      CONTINUE                                                    DSN     01184
            IG=IM*IGM                                                   DSN     01185
            DO 110 J=1.IG                                               DSN     01186
   110      Q(J)=0.0                                                    DSN     01187
            RETURN                                                      DSN     01188
            END                                                         DSN     01189
            SUBROUTINE FCSOUR (Q.QG)SS.W)D.AA.XNF.MM.IGM.IGP.IG2)IP)ISN) DSN    01190
   C                                                                    DSN     01191
   C        COMPUTE SURFACE SOURCE                                      DSN     01192
            DIMENSION Q(MM.IGM). QG(IGP). SS(IG2)) W(MM). D(MM)) AA(IP) DSN     01193
            IQM=IABS(IQM(                                               DSN     01194
            QG(IGP)=0.                                                  DSN     01195
            DO 20 IG=1.IGM                                              DSN     01196
            QG(IG)=0.                                                   DSN     01197
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1199          DO 10 M=1,MM                                                    DSN     01198
1200    10    QG(IG)=QG(IG)+W(M)*ABS(D(M))*Q(M,IG)*AA(IP)                     DSN     01199
1201    20    QG(IGP1)=QG(IGP)+QG(IG)                                         DSN     01200
1202          IF (XNF.EQ.0.) GO TO 50                                         DSN     01201
1203          EI=XNF/QG(IGP)                                                  DSN     01202
1204          DO 40 IG=1,IGM                                                  DSN     01203
1205          QG(IG)=EI*QG(IG)                                                DSN     01204
1206          DO 30 M=1,MM                                                    DSN     01205
1207    30    Q(M,IG)=EI*Q(M,IG)                                              DSN     01206
1208    40    CONTINUE                                                        DSN     01207
1209          QG(IGP)=XNF                                                     DSN     01208
1210    50    WRITE (9,80)                                                    DSN     01209
1211          KA=1                                                            DSN     01210
1212          KB=8                                                            DSN     01211
1213    60    KC=MIN0(KB,IGM)                                                 DSN     01212
1214          WRITE (9,90) (K,K=KA,KC)                                        DSN     01213
1215          DO 70 M=1,MM                                                    DSN     01214
1216    70    WRITE (9,100) M,(Q(M,IG),IG=KA,KC)                              DSN     01215
1217          KA=KA+8                                                         DSN     01216
1218          KB=KB+8                                                         DSN     01217
1219          IF (KA.LE.IGM) GO TO 60                                         DSN     01218
1220          RETURN                                                          DSN     01219
1221    80    FORMAT (1H0///36H     SOURCE SOURCE BY DIR. AND GROUP)          DSN     01220
1222    90    FORMAT (1H0,4HDIR.,8(2X,5HGROUP,I3,3X)/)                        DSN     01221
1223    100   FORMAT (I4,1P8E13.5)                                            DSN     01222
1224          END                                                             DSN     01223
1225          SUBROUTINE NE=PAR                                               DSN     01224
1226    C                                                                     DSN     01225
1227    C     COMPUTE NEW PARAMETERS FOR IMPLICIT SEARCH                      DSN     01226
1228          COMMON IA(10000),A(10000)                                       DSN     01227
1229          COMMON /ALPHA/ LOAFH,TABA,SCATT,SCATTP,BAL,XLAMAX,XLAMIN,EVMAX,EVM ALPHA  00002
1230         1IN,IPRE,FSUM,INEG,KK                                            ALPHA   00003
1231    C                                                                     ALPHA   00004
1232          EQUIVALENCE (A(16),XLA), (A(11),XLALI), (A(12),XLAMI), (A(13),XNPMI), DSN     01229
1233         1 (A(10),EPS), (A(3),EPS), (A(47),XLAR)) (A(31),EQPI), (A(32),EQ), DSN     01230
1234         2(A(1),EV), (A(33),EVP), (A(34),EI), (A(35),E2), (IA(39),ICVT), (A( DSN     01231
1235         32),EVPI), IIA(3)),KSH52), TIA(11),IFVT)) (A(36),EVPP)) (A(37),XLAPP DSN     01232
1236         4), (A(30),XLAP), (IA(49),ICNI)                                  DSN     01233
1237          IF (ICVT.EQ.1) GO TO 140                                        DSN     01234
1238          IF (E2.LT.EPS) ICVT=1                                           DSN     01235
1239          IF (INEG.EQ.1) GO TO 160                                        DSN     01236
1240          E3=ABS(XLA-XLAR)                                                DSN     01237
1241          IF (XLAP2.EQ.0.0) GO TO 20                                      DSN     01238
1242          IF (E3.GT.XEPS) GO TO 150                                       DSN     01239
1243          D=EVPP-EVP                                                      DSN     01240
1244          E=EVPP-EV                                                       DSN     01241
1245          F=EVP-EV                                                        DSN     01242
1246          DEN=D*F-F                                                       DSN     01243
1247          E2A=((XLAPP-1.)*F*EVP*FV-(XLAP-1.)*E*EV*EVPP+(XLA-1.)*D*EVPP*EVPI/ DSN     01244
1248         1DEN                                                             DSN     01245
1249          EQB=-(XLAPP*F*(EVP*EV)-XLAP*E*(EV*EVPP)+XLA*(EVPP*EVP)*D)/DEN   DSN     01246
1250          EQC=(XLAP2*F-XLAP*E+XLA*D)/DEN                                  DSN     01247
1251          R=EQB**2-4.*EQA*EQC                                             DSN     01248
1252          IF (R.LT.0.0) GO TO 30                                          DSN     01249
1253          IF (E2.LE.XLAL) GO TO 80                                        DSN     01250
125A          EQ=1./(EQB+2.*EV*EQC)                                           DSN     01251
1255          XLAPP=XLAP                                                      DSN     01252
1256          XLAP=XLA                                                        DSN     01253
1257          EVPP=EVP                                                        DSN     01254
1258          EVP=EV                                                          DSN     01255
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1259          EV1=(-EQB+SQRT(R1))/(2.*EQC)                                    DSN   01256
1260          EV2=(-EQB-SQRT(R1))/(2.*EQC)                                    DSN   01257
1261          IF (ABS(EV1-EV).GT.ABS(EV2-EV)) GO TO 10                        DSN   01258
1262          EV=EV1                                                          DSN   01259
1263          GO TO 60                                                        DSN   01260
1264    10    EV=EV2                                                          DSN   01261
1265          GO TO 60                                                        DSN   01262
1266    20    IF (XLAP.EQ.0.0) GO TO 70                                       DSN   01263
1267          IF (E3.GT.XEPS) GO TO 150                                       DSN   01264
1268    30    EQ=(EVP-EV)/(ALAP-XLA)                                          DSN   01265
1269          IF (ICNT.NE.0) GO TO 40                                         DSN   01266
1270          IF (E2.LE.XLAL) GO TO 40                                        DSN   01267
1271          IF (E2.LE.XLAM) GO TO 40                                        DSN   01268
1272          EI=SIGN(XLAM,E1)                                                DSN   01269
1273    40    XLAPP=XLAP                                                      DSN   01270
1274          XLAP=XLA                                                        DSN   01271
1275          EVPP=EVP                                                        DSN   01272
1276          EVP=EV                                                          DSN   01273
1277    50    EV=EV+XNPM*EQ*EI                                                DSN   01274
1278    60    IF ((XLAPP-1.)/(XLAP-1.).GT.0.0) GO TO 110                      DSN   01275
1279          B=AMAX1(EVP,EVPP)                                               DSN   01276
1280          C=AMIN1(EVP,EVPP)                                               DSN   01277
1281          IF (EV.GT.B.OR.EV.LT.C) EV=(EVP+EVPP)*.5                        DSN   01278
1282          GO TO 110                                                       DSN   01279
1283    70    IF (EQ.EQ.0.0) GO TO 90                                         DSN   01280
1284          IF ( ICVT .NE. 0 ) GO TO 150                                    DSN   01281
1285          IF (E2.GT.EPS) GO TO 50                                         DSN   01282
1286          ICVT=1                                                          DSN   01283
1287          GO TO 130                                                       DSN   01284
1288    80    ICN1=1                                                          DSN   01285
1289          XLAP=0.0                                                        DSN   01286
1290          XLAPP=0.0                                                       DSN   01287
1291          GO TO 50                                                        DSN   01288
1292    90    IF (E3.GT.EPS) GO TO 150                                        DSN   01289
1293          XLAP=XLA                                                        DSN   01290
1294          EVP=EV                                                          DSN   01291
1295          IF (E1.GT.0.01) GO TO 100                                       DSN   01292
1296          EV=EV+EVM                                                       DSN   01293
1297          GO TO 110                                                       DSN   01294
1298   100    EV=EV-EVM                                                       DSN   01295
1299   110    CALL SSWTCH (4,K0J0FX)                                          DSN   01296
1300          GO TO (1140,120), K000FX                                        DSN   01297
1301   120    IF (I.EQ.IEVT).EQ.2) GO TO 130                                  DSN   01298
1302          KSWS2=3                                                         DSN   01299
1303          RETURN                                                          DSN   01300
1304   130    KSWS2=2                                                         DSN   01301
1305          RETURN                                                          DSN   01302
1306   140    KSWS2=1                                                         DSN   01303
1307          RETURN                                                          DSN   01304
1308   150    CALL SSWTCH (4,K000FX)                                          DSN   01305
1309          GO TO (1140,130), K000FX                                        DSN   01306
1310   160    CONTINUE                                                        DSN   01307
1311          CALL NEGALF                                                     DSN   01308
1312          INEG=0                                                          DSN   01309
1313          RETURN                                                          DSN   01310
1314          END                                                             DSN   01311
1315          SUBROUTINE NEGALF                                               DSN   01312
1316    C                                                                     DSN   01313
1317    C     CONVERGENCE TECHNIQUE WHEN ALPHA NEGATIVE                       DSN   01314
1318          COMMON IA(10000),A(10000)                                       DSN   01315
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      COMMON /ALPHA/ LOAFH,TABA,SCATI,SCATTP,HAL,XLAMAX,XLAMIN,EVMAX,EVM  ALPHA   00002
     1IN,IPHE,FSUM,INEG,KK                                               ALPHA   00003
C                                                                         ALPHA   00004
      EQUIVALENCE (A(16),XLA), (A(11),XLAL), (A(12),XLAM), (A(13),XNPM),  DSN     01317
     1 (A(10),XEPS), (A(3),EPS), (A(27),XLAR), (A(31),EQP), (A(32),EQI),  DSN     01318
     2(A(1),EV), (A(33),EVP), (A(34),EI), (A(35),E2), (IA(39),ICVT), (A(  DSN     01319
     J2),EVM), (IA(31),KSHS2), (IA(11),IEVT), (A(36),EVPP), (A(37),XLAPP DSN     01320
     4), (A(JV),XLAP), (IA(49),ICNT)                                      DSN     01321
      IF (EVP.EQ.0.0) KK=0                                                DSN     01322
      E3=ABS(1.-XLAM/XLA)                                                 DSN     01323
      IF (ABS(1.0-XLA).LT.50.0*EPS) XEPS=EPS                              DSN     01324
      IF (XLAP.EQ.0.0) GO TO 80                                           DSN     01325
      IF (HAL.LT.0.1) GO TO 10                                            DSN     01326
      EV=.5*(EV+EVP)                                                      DSN     01327
      GO TO 120                                                           DSN     01328
10    IF (E3.GT.XEPS) GO TO 130                                           DSN     01329
      EQ=(EVP-EV)/(XLAP-XLA)                                              DSN     01330
      XLAP=XLA                                                            DSN     01331
      EVP=EV                                                              DSN     01332
      IF (XLA.GT.1.0) GO TO 20                                            DSN     01333
      IF (XLA.LT.XLAMIN) GO TO 30                                         DSN     01334
      XLAMIN=XLA                                                          DSN     01335
      EVMIN=EV                                                            DSN     01336
      GO TO 50                                                            DSN     01337
20    IF (XLA.GT.XLAMAX) GO TO 30                                         DSN     01338
      XLAMAX=XLA                                                          DSN     01339
      EVMAX=EV                                                            DSN     01340
      GO TO 50                                                            DSN     01341
30    IF ((EVMAX.EQ.0.0).OR.(EVMIN.EQ.0.0)) GO TO 50                      DSN     01342
40    EV=.5*(EVMAX+EVMIN)                                                 DSN     01343
      GO TO 120                                                           DSN     01344
50    IF (ABS(1.-XLA).LT.XLAM) GO TO 60                                   DSN     01345
      EI=SIGN(XLAM,EI)                                                    DSN     01346
60    EV=EV+XNPM*EQ*EI                                                    DSN     01347
      IF ((EVMAX.EQ.0.0).OR.(EVMIN.EQ.0.0)) GO TO 120                     DSN     01348
      IF (EVMAX.GT.EVMIN) GO TO 70                                        DSN     01349
      IF ((EV.GT.EVMIN).OR.(EV.LT.EVMAX)) GO TO 40                        DSN     01350
      GO TO 120                                                           DSN     01351
70    IF ((EV.GT.EVMAX).OR.(EV.LT.EVMIN)) GO TO 40                        DSN     01352
      GO TO 120                                                           DSN     01353
80    IF (HAL.LT.0.1) GO TO 90                                            DSN     01354
      EV=.5*EV                                                            DSN     01355
      GO TO 120                                                           DSN     01356
90    IF (E3.GT.EPS) GO TO 130                                            DSN     01357
      XLAP=XLA                                                            DSN     01358
      EVP=EV                                                              DSN     01359
      IF (XLA.GT.1.0) GO TO 100                                           DSN     01360
      XLAMIN=XLA                                                          DSN     01361
      XLAMAX=1.0E+30                                                      DSN     01362
      EVMIN=EV                                                            DSN     01363
      EVMAX=0.0                                                           DSN     01364
      GO TO 110                                                           DSN     01365
100   XLAMAX=XLA                                                          DSN     01366
      XLAMIN=0.0                                                          DSN     01367
      EVMAX=EV                                                            DSN     01368
      EVMIN=0.0                                                           DSN     01369
110   IF (EI.GT.0.0) EVM=-EVM                                             DSN     01370
      EV=EV+EVM                                                           DSN     01371
120   KK=0                                                                DSN     01372
      IF ((E2.LT.0.010).AND.(XNPM.LT.0.5)) XNPM=0.5                       DSN     01373
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      IF ( IAHS (IEVT) .EQ. 2 ) GO TO 130                          DSN     01374
C                                                                  DSN     01375
C     MODIFY PARAMETERS                                            DSN     01376
C                                                                  DSN     01377
      KSAS2=3                                                      DSN     01378
      RETURN                                                       DSN     01379
C                                                                  DSN     01380
C     ANOTHER OUTER ITERATION                                      DSN     01381
C                                                                  DSN     01382
130   KSAS2=2                                                      DSN     01383
      KK=KK+1                                                      DSN     01384
      IF (KK.LT.10) RETURN                                         DSN     01385
      EV=.5*(EV+EVP)                                               DSN     01386
      KK=0                                                         DSN     01387
      RETURN                                                       DSN     01388
      END                                                          DSN     01389
      SUBROUTINE OUTER (C,SA,CL,XN,XJ,CH,Q,B,XNO,XJJ,T,SUMT,SUMZ,IMM,IGM DSN 01390
     1,MT,IM,MM,NM,ISCT,IT,IP,IZ,IS,HA,HZ,IZM,F,CS,V,SR,CT,CA,XNN,XNO,ST DSN 01391
     2,XNR,W,RS,RQ,RA,O,AV,WO,DF,AR,KOT)                           DSN     01392
C                                                                  DSN     01393
C     POWER ITERATION FOR ALL GROUPS                               DSN     01394
      COMMON /ALPHA/ LOAFB,TAUA,SCATI,SCATTP,HAL,XLAMAX,XLAMIN,EVMAX,EVM ALPHA 00002
     1IN,IPRE,FSUM,INEG,KK                                         ALPHA   00003
C                                                                  ALPHA   00004
      DIMENSION C(IMM,IGM,MT), SA(IM,MM), CL(MK,NM), XN(IM,IGM), XJ(IGM, DSN 01396
     1IM,NM), CH(IM,ISCT), Q(IS,IGM), B(IGM,MM), XNO(IP,MM), XJJ(IM,NM), DSN 01397
     2 T(IZ,IT), SUMT(IT), SUMZ(IT), HA(IM), HZ(IZM), F(IM), CS(IM), V(I DSN 01398
     3P), SR(IM), CT(IM), CA(IM), XNN(IM), XNO(MM), RQ(MM), ST(IM), XNR( DSN 01399
     4IM), W(MM), RA(IP), RS(IM), O(MM), AV(IP), WO(MM), DF(IM), AR(IP), DSN 01400
     5 KOT(IGM)                                                    DSN     01401
      COMMON (A(1000),A(10000))                                    DSN     01402
      EQUIVALENCE (ITM,IA(2)), (IG,IA(36)), (IMT,IA(13)), (IGM,IA(21)), DSN 01403
     1(JF,A(5)), (JT,A(6)), (JZ,A(7)), (IGE,IA(5)), (IBR,IA(7)), (IUT,IA DSN 01404
     2(29)), (JAT,IA(94)), (JOA,IA(70)), (JOB,IA(71)), (JDC,IA(72)), (JD DSN 01405
     3S,IA(73)), (JCVT,(A(39)), (ID1,IA(23)), (ID2,IA(24)), (JNA,IA(93)) DSN 01406
     4, (JN1,IA(95)), (KMR,IA(116)), (JNE,IA(97)), (JOR,IA(99)), (JIC,IA DSN 01407
     5(37)), (JOGA,IA(134)), (JKEA,IA(135)), (JTRA,IA(148)), (JSGA,IA(15 DSN 01408
     60)), (JSNA,IA(151)), (JFGA,IA(147)), (JSCA,IA(170)), (JAGA,IA(171) DSN 01409
     7)                                                            DSN     01410
      EQUIVALENCE (JFNA,IA(173)), (JNGA,IA(172)), (JDGA,IA(174)), (JVEA, DSN 01411
     1IA(123)), (JSUA,IA(175)), (JNBA,IA(176)), (JNLA,IA(159)), (JRLA,IA DSN 01412
     2(160))                                                       DSN     01413
      EQUIVALENCE (IEVT,IA(1))                                     DSN     01414
      IMS=IABS(IA(14))                                             DSN     01415
      IG=1                                                         DSN     01416
      XT=1.42089216                                                DSN     01417
10    JOG=JOGA+IG                                                  DSN     01418
      JFG=JFGA+IG                                                  DSN     01419
      JKE=JKEA+IG                                                  DSN     01420
      JTR=JTRA+IG                                                  DSN     01421
      JSG=JSGA+IG                                                  DSN     01422
      JSN=JSNA+IG                                                  DSN     01423
      JSC=JSCA+IG                                                  DSN     01424
      JAG=JAGA+IG                                                  DSN     01425
      JFN=JFNA+IG                                                  DSN     01426
      JNG=JNGA+IG                                                  DSN     01427
      JDG=JDGA+IG                                                  DSN     01428
      JVE=JVEA+IG                                                  DSN     01429
      JSD=JSUA+IG                                                  DSN     01430
      JNB=JNBA+IG                                                  DSN     01431
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      JNL=JNLA+I3                                                     DSN 01432
      JNL=JNLA+IG                                                     DSN 01433
      S=0.0                                                           DSN 01434
      R=0.0                                                           DSN 01435
      TAO=A(JT9)                                                      DSN 01436
      TAUA=0.0                                                        DSN 01437
      IF (TAH.GE.0.0) GO TO 20                                        DSN 01438
      TAHA=-TA3                                                       DSN 01439
20    CONTINUE                                                        DSN 01440
C     ISOTROPIC SOURCE NOT INCLUDING SELF SCATTER                     DSN 01441
      IF (ITH.GT.0) IHA=IHT-I                                         DSN 01442
      DO 60 I=I,IM                                                    DSN 01443
      L=MA(I)                                                         DSN 01444
      L=IABS(MZ(L))                                                   DSN 01445
      AS=0.0                                                          DSN 01446
      IF (IQM.EQ.I) AS=Q(I,IG)                                        DSN 01447
      IF (IPRE.GT.I) AS=Q(I,IG)                                       DSN 01448
      IF ( ITH .LE. 0 ) GO TO 25                                      DSN 01449
      AS=AS+F(I)*C(IHA+IG,L)*DF(I)                                    DSN 01450
      GO TO 30                                                        DSN 01451
   25 CONTINUE                                                        DSN 01452
      AS=AS+F(I)*A(JKE)                                               DSN 01453
30    IH=IHT+I                                                        DSN 01454
      IHX=MIN0(IHM,IHS+IG-1)                                          DSN 01455
40    K=IG+IHS-IH                                                     DSN 01456
      IF (K.GT.IGM) GO TO 50                                          DSN 01457
      IF (IH.EQ.IHS) GO TO 50                                         DSN 01458
      AA=C(IH,IG,L)*DF(I)                                             DSN 01459
      AS=AS+AA*XN(I,K)                                                DSN 01460
50    IH=IH+I                                                         DSN 01461
      IF (IH.LE.IHX) GO TO 40                                         DSN 01462
      CS(I)=V(I)*C(IHS+IG,L)*DF(I)                                    DSN 01463
      S=S+CS(I)                                                       DSN 01464
      AS=AS*V(I)                                                      DSN 01465
      R=R+AS                                                          DSN 01466
      SR(I)=AS                                                        DSN 01467
      SRI=0.0                                                         DSN 01468
      AT=C(IHT+IG,L)*DF(I)                                            DSN 01469
      AA=C(IHT-2,IG,L)*DF(I)                                          DSN 01470
      IF (DY.GT.0.0) SRI=(DF/(DY*ABS(AT+TAH)+XT))**2)*AT              DSN 01471
      IF (DZ.GT.0.0) SRI=SRI+((BF/(DZ*ABS(AT+TAH)+XT))**2)*AT         DSN 01472
      CT(I)=V(I)*(SRI+AT+TAH)                                         DSN 01473
60    CA(I)=V(I)*(SRI+AA+TAH)                                         DSN 01474
      A(J8)=S                                                         DSN 01475
      A(JSG)=R                                                        DSN 01476
      IF (IQM.EQ.2.OR.IQM.LT.0) A(JSG)=R+A(JQG)                       DSN 01477
      A(JSN)=A(JSG)-A(JQG)-A(JFG)                                     DSN 01478
      S=0.0                                                           DSN 01479
C     ANISOTROPIC SOURCE NOT INCLUDING SELF SCATTER                   DSN 01480
      IF (ISCT.EQ.0) GO TO 190                                        DSN 01481
      DO 100 I=I,IM                                                   DSN 01482
      DO 70 M=I,MM                                                    DSN 01483
70    SA(I,M)=0.0                                                     DSN 01484
      IF (IQM.GE.0) GO TO 100                                         DSN 01485
      AA=0.0                                                          DSN 01486
      DO 80 M=I,MM                                                    DSN 01487
80    IF (D(M).LE.0.0) AA=AA-WD(M)                                    DSN 01488
      DO 90 M=I,MM                                                    DSN 01489
90    IF (D(M).LE.0.0) SA(I,M)=-D(M)*Q(I,IG)*V(I)/AA                  DSN 01490
      CM(I,1)=0.0                                                     DSN 01491
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100   CONTINUE                                                         DSN   01492
      DO 180 I=1,IM                                                    DSN   01493
      L=MA(I)                                                          DSN   01494
      L=MZ(L)                                                          DSN   01495
      IF (L.GE.0) GO TO 180                                            DSN   01496
      DO 170 N=1,ISCT                                                  DSN   01497
      J=N-L                                                            DSN   01498
      CH(I,N)=V(I)*C(IHS,IG,J)*DF(I)                                   DSN   01499
      S=S+CH(I,N)                                                      DSN   01500
      IH=IHT+1                                                         DSN   01501
110   K=IG+IHS-IH                                                      DSN   01502
      IF (K.GT.IGM) GO TO 160                                          DSN   01503
      IF (IH.EQ.IHS) GO TO 140                                         DSN   01504
      AH=FLOAT(IH)+.5                                                  DSN   01505
      AA=AH*V(I)*C(IH,IG,J)*DF(I)                                      DSN   01506
      IF (AH.NE.0.0) GO TO 120                                         DSN   01507
      IF (IH-IHS) 160,160,170                                          DSN   01508
120   IF (IGF.EQ.2) GO TO 140                                          DSN   01509
      AC=AA*XJ(K,I,N)                                                  DSN   01510
      DO 130 M=1,MM                                                    DSN   01511
130   SA(I,M)=SA(I,M)+AC*CL(M,N)                                       DSN   01512
      GO TO 160                                                        DSN   01513
140   IHS=((N+1)*(N+1))/4                                              DSN   01514
      IRT=IHS+(2*N+1)/4                                                DSN   01515
      DO 150 IR=IHS,IRT                                                DSN   01516
      AC=AA*XJ(K,I,IR)                                                 DSN   01517
      DO 150 M=1,MM                                                    DSN   01518
150   SA(I,M)=SA(I,M)+AC*CL(M,IR)                                      DSN   01519
160   IH=IH+1                                                          DSN   01520
      IF (IH.LE.IHM) GO TO 110                                         DSN   01521
170   CONTINUE                                                         DSN   01522
180   CONTINUE                                                         DSN   01523
      A(19)=S                                                          DSN   01524
C     FLUX CONTROL                                                     DSN   01525
190   IIC=0                                                            DSN   01526
      IF (A(JSG).EQ.0.0) GO TO 220                                     DSN   01527
      DO 200 I=1,IM                                                    DSN   01528
      XNN(I)=XN(I,IG)                                                  DSN   01529
      DO 200 N=1,NM                                                    DSN   01530
200   XJJ(I,N)=XJ(IG,I,N)                                              DSN   01531
      DO 210 M=1,MM                                                    DSN   01532
      XND(M)=0.0                                                       DSN   01533
      IF (IQM.EQ.2) RQ(M)=Q(M,IG)                                      DSN   01534
      IF (IHR.GT.0) XND(M)=H(IG,M)                                     DSN   01535
210   CONTINUE                                                         DSN   01536
      GO TO 260                                                        DSN   01537
220   A(JNL)=0.0                                                       DSN   01538
      A(JRL)=5.0                                                       DSN   01539
      DO 230 I=1,IP                                                    DSN   01540
      DO 230 M=1,MM                                                    DSN   01541
230   XNO(I,M)=0.0                                                     DSN   01542
      DO 240 I=1,IM                                                    DSN   01543
      ST(I)=0.0                                                        DSN   01544
240   XNN(I)=0.0                                                       DSN   01545
      DO 250 M=1,MM                                                    DSN   01546
250   XND(M)=0.0                                                       DSN   01547
      GO TO 270                                                        DSN   01548
C     BEGIN INNER ITERATION                                            DSN   01549
260   CALL INNER (A(JAT),SA,CH,XJJ,CL,XND,A(JOA),A(JDB),A(JDC),A(JDS),IM DSN   01550
     1,MM,ISCT,NO,IP,A(JNA),XNN,ST,CS,SH,W,O,A(JNI),XNO,IA(KMR),A(JNE),C DSN   01551
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      2T,RS,HQ,WD,AV,XNR,A(JDR),A(LOAFR))                             DSN 01552
C      GROUP CODE                                                     DSN 01553
  270  SC=0.0                                                         DSN 01554
       AG=0.0                                                         DSN 01555
       EI=0.0                                                         DSN 01556
       DO 280 I=1,IM                                                  DSN 01557
       SC=SC+CS(I)*XNN(I)                                             DSN 01558
       AG=AG+CA(I)*XNN(I)                                             DSN 01559
       XNR(I)=CT(I)*XNN(I)                                            DSN 01560
  280  EI=EI+XNR(I)                                                   DSN 01561
       A(JSC)=SC                                                      DSN 01562
       A(JAG)=AG                                                      DSN 01563
       FG=0.0                                                         DSN 01564
       XG=0.0                                                         DSN 01565
       DO 290 I=1,IM                                                  DSN 01566
       L=M4(I)                                                        DSN 01567
       L=IABS(M7(L))                                                  DSN 01568
       FG=FG+V(I)*C(IMT-I,I...)*XNN(I)*DF(I)                          DSN 01569
  290  XG=XG+V(I)*XNN(I)                                              DSN 01570
       A(JFN)=FG                                                      DSN 01571
       A(JNG)=XG                                                      DSN 01572
       A(JUG)=XG/A(JVF)                                               DSN 01573
       A(JSN)=EI-SC-AG                                                DSN 01574
       A(JNB)=A(JDG)*A(JFG)+A(JSN)-A(JNL)-AG-A(JSO)                   DSN 01575
       IF (INR.EQ.0) GO TO 310                                        DSN 01576
       DO 300 M=1,MM                                                  DSN 01577
  300  D(IG,MM)=XND(M)                                                DSN 01578
  310  DO 320 I=1,IM                                                  DSN 01579
  320  XN(I,IG)=XNN(I)                                                DSN 01580
       IF (ISCT.EQ.0) GO TO 150                                       DSN 01581
       DO 330 M=1,MM                                                  DSN 01582
       EI=W(M)                                                        DSN 01583
       DO 330 N=1,NM                                                  DSN 01584
       E2=EI*CL(M,N)                                                  DSN 01585
       DO 330 I=1,IM                                                  DSN 01586
       IF (M.EQ.1) XJJ(I,N)=0.0                                       DSN 01587
  330  XJJ(I,N)=XJJ(I,N)+E2*(XND(I,M)+XND(I+1,M))                     DSN 01588
       DO 340 I=1,IM                                                  DSN 01589
       DO 340 N=1,NM                                                  DSN 01590
  340  XJ(IG,I,N)=XJJ(I,N)                                            DSN 01591
  350  IF (ICVT.GT.0) GO TO 370                                       DSN 01592
  360  IG=IG+1                                                        DSN 01593
       IF (IG.LE.IGM) GO TO 10                                        DSN 01594
       RETURN                                                         DSN 01595
  370  IF (ISIGN(1,IEVT).NE.-1) GO TO 380                             DSN 01596
       IDISK=2                                                        DSN 01597
       IF (ITM.NE.0) IDISK=4                                          DSN 01598
       IF (IG.EQ.1) REWIND IDISK                                      DSN 01599
       WRITE (IDISK)XN                                                DSN 01600
  380  IF (IOI.EQ.0) GO TO 420                                        DSN 01601
       WRITE (9,410)IG,MM                                             DSN 01602
       DO 390 I=1,IP                                                  DSN 01603
  390  IF (I.EQ.IOI) WRITE (9,400)I,RA(I),(XND(I,M),M=1,MM)           DSN 01604
  400  FORMAT (7H RADIUS,I3,1H=,E16.8/(1P9E15.5))                     DSN 01605
  410  FORMAT (37H1FLUX BY RADIUS AND DIRECTION, GROUP=,I3,10X,18H DIRECT DSN 01606
      1IONS (1 TO ,I3,22H) SEQUENTIALLY BY ROWS.//)                   DSN 01607
  420  IF (ID2.EQ.0) GO TO 360                                        DSN 01608
C      BALANCE EDIT BY GROUP AND ZONE                                 DSN 01609
       WRITE (9,430)IG                                                DSN 01610
  430  FORMAT (1H0,///,18H BALANCE FOR GROUP,I3,///)                  DSN 01611
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1619          DO 440 I=1,IT                                              DSN     01612
1620          IF (IG.EQ.1) SUMT(I)=0.0                                   DSN     01613
1621    AA0   SUMZ(I)=0.0                                                DSN     01614
1622          DO 5A0 L=1,IM                                              DSN     01615
1623          DO 450 I=1,IT                                              DSN     01616
1624    A50   T(L,I)=0.0                                                 DSN     01617
1625          DO 4B0 I=1,IM                                              DSN     01618
1626          IF (MA(I).NE.L) GO TO 480                                  DSN     01619
1627          V=V(I)                                                     DSN     01620
1628          AN=XNN(I)                                                  DSN     01621
1629    C     FIXED SOURCE                                               DSN     01622
1630          IF (IABS(IQM).EQ.1) T(L,I)=T(L,I)+V*Q(I,IG)                DSN     01623
1631          LA=IABS(MZ(L))                                             DSN     01624
1632    C     FISSIONS                                                   DSN     01625
1633          IF (ITH.GT.0) GO TO 460                                    DSN     01626
1634          T(L,2)=T(L,2)+V*F(I)*A(JKE)                                DSN     01627
1635          GO TO 470                                                  DSN     01628
1636    460   T(L,2)=T(L,2)+V*F(I)*C(IMT-1,IG,LA)*DF(I)                 DSN     01629
1637    A70   T(L,3)=T(L,3)+ST(I)                                        DSN     01630
1638    C     SELF-SCATTER                                               DSN     01631
1639          T(L,4)=T(L,4)+CS(I)*AN                                     DSN     01632
1640          T(L,5)=T(L,5)+CT(I)*AN                                     DSN     01633
1641    C     ABSORPTION                                                 DSN     01634
1642          T(L,6)=T(L,6)+CA(I)*AN                                     DSN     01635
1643    C     TOTAL FLUX AND FISSION DENSITY                             DSN     01636
1644          T(L,9)=T(L,9)+AN*V                                         DSN     01637
1645          T(L,15)=T(L,15)+AN*V*C(IMT-1,IG,LA)*DF(I)                  DSN     01638
1646    480   CONTINUE                                                   DSN     01639
1647          LMAX=0                                                     DSN     01640
1648          LMIN=IM+2                                                  DSN     01641
1649          DO 490 I=1,IM                                              DSN     01642
1650          IF (MA(I).NE.L) GO TO 490                                  DSN     01643
1651          IF (I.GE.LMAX) LMAX=I                                      DSN     01644
1652          IF (LMIN.GT.I) LMIN=I                                      DSN     01645
1653    490   CONTINUE                                                   DSN     01646
1654          DO 520 M=1,MM                                              DSN     01647
1655    C     LEFT CURRENT                                               DSN     01648
1656          T(L,7)=T(L,7)+XNO(LMIN,M)*WD(M)                            DSN     01649
1657          E1=XNO(LMAX+1,M)*W(M)                                      DSN     01650
1658    C     RIGHT FLUX                                                 DSN     01651
1659          T(L,11)=T(L,11)+E1                                         DSN     01652
1660          E=O(M)                                                     DSN     01653
1661          IF (E.LE.0.0) GO TO 500                                    DSN     01654
1662          IF (E.LT.0.0) GO TO 520                                    DSN     01655
1663    C     RIGHT FLOW                                                 DSN     01656
1664          T(L,12)=T(L,12)+E*F1                                       DSN     01657
1665    C     RIGHT CURRENTS                                             DSN     01658
1666    500   T(L,13)=T(L,13)+E*F1                                       DSN     01659
1667          IF (ISC.EQ.0) GO TO 520                                    DSN     01660
1668          DO 510 N=1,NM                                              DSN     01661
1669    510   T(L,N+13)=T(L,N+15)+E1*CL(M,N)                             DSN     01662
1670    520   CONTINUE                                                   DSN     01663
1671    C     RIGHT LEAKAGE                                              DSN     01664
1672          T(L,14)=T(L,13)*AV(LMAX+1)                                 DSN     01665
1673    C     NET LEAKAGE                                                DSN     01666
1674          T(L,7)=T(L,14)-T(L,7)*AV(LMIN)                             DSN     01667
1675    C     IN SCATTER                                                 DSN     01668
1676          T(L,3)=T(L,3)+T(L,4)-T(L,2)                                DSN     01669
1677    C     OUT SCATTER                                                DSN     01670
1678          T(L,5)=T(L,5)-T(L,4)-T(L,6)                                DSN     01671
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C       NEUTRON BALANCE                                                 DSN      01672
        T(L,10)=T(L,1)+T(L,2)+T(L,3)-T(L,7)-T(L,6)-T(L,5)               DSN      01673
C       TOTAL DENSITY                                                   DSN      01674
        T(L,8)=T(L,9)/A(JVF)                                            DSN      01675
        DO 530 I=1,IT                                                   DSN      01676
        SUMZ(I)=SUMZ(I)+T(L,I)                                          DSN      01677
530     SUMT(I)=SUMT(I)+T(L,I)                                          DSN      01678
540     CONTINUE                                                        DSN      01679
        WRITE (9,560)(L,(T(L,I),I=1,8),L=1,IZM)                         DSN      01680
        WRITE (9,570)(SUMZ(I),I=1,8)                                    DSN      01681
        WRITE (9,580)(L,(T(L,I),I=9,15),L=1,IZM)                        DSN      01682
        WRITE (9,570)(SUMZ(I),I=9,15)                                   DSN      01683
        IF (ISCT.LE.1) GO TO 550                                        DSN      01684
        WRITE (9,590)(L,(T(L,I),I=16,IT),L=1,IZM)                       DSN      01685
        WRITE (9,570)(SUMZ(I),I=16,IT)                                  DSN      01686
550     IF (IG.NE.IGM) GO TO 360                                        DSN      01687
        WRITE (9,600)                                                   DSN      01688
        WRITE (9,560)L,(SUMT(I),I=1,8)                                  DSN      01689
        WRITE (9,580)L,(SUMT(I),I=9,15)                                 DSN      01690
        IF (ISCT.LE.1) GO TO 360                                        DSN      01691
        WRITE (9,590)L,(SUMT(I),I=16,IT)                                DSN      01692
        GO TO 360                                                       DSN      01693
560     FORMAT (7H ZONE  ,14H FIXED SOURCE ,14H   FISSIONS   ,14H  IN SCAT DSN   01694
       1TER  ,14H SELF SCATTER ,14H OUT SCATTER  ,14H  ABSORPTION  ,14H NE DSN   01695
       2T LEAKAGE  ,14H TOTAL DENSITY//(I4,3X,1P8E14.6))                DSN      01696
570     FORMAT (7H0 TOTAL,1P8E14.6,////)                                DSN      01697
580     FORMAT (7H ZONE  ,14H  TOTAL FLUX  ,14H NEUTRON BAL  ,14H  RIGHT F DSN   01698
       1LUX  ,14H  RIGHT FLOW  ,14H RIGHT CURRENT,14H RIGHT LEAKAGE,14H FI OSN   01699
       2SSION DENS //(I4,3X,1P7E14.6))                                  DSN      01700
590     FORMAT (40H0RIGHT CURRENTS - ANISOTROPIC SCATTERING,22H ISCT GREAT DSN   01701
       1ER THAN ONE//7H ZONE  /(I4,3X,1P8E14.6))                        DSN      01702
600     FORMAT (1H0,///,29H TOTAL BALANCE FOR ALL GROUPS,////)          DSN      01703
        END                                                             DSN      01704
        SUBROUTINE INNER (SAT,SA,CH,XJJ,CL,XND,OA,OB,OC,OS,IM,MM,ISCT,NM,I DSN   01705
       1P,XNA,XUN,ST,CS,SR,W,D,XNI,XNO,MR,XNE,CT,RS,RQ,WD,AV,XNR,XNOR,QA) DSN    01706
C                                                                       DSN      01707
C       INNER ITERATION LOOP FOR ONE GROUP                              DSN      01708
        COMMON /ALPHA/ LOAFU,TAMA,SCATT,SCATTP,BAL,XLAMAX,XLAMIN,EVMAX,EVM ALPHA  00002
       1IN,IPRE,FSUM,INEG,KK                                            ALPHA    00003
C                                                                       ALPHA    00004
C       PERFORMS INNER ITERATION                                        DSN      01710
        COMMON IA(1000),A(10000)                                        DSN      01711
        DIMENSION SAT(IM,MM), SA(IM,MM), CH(IM,ISCT), XJJ(IM,NM), CL(MM,NM DSN   01712
       1), XNO(IP,MM), OA(IP,IM), OB(IP,MM), OC(IP,MM), OS(IP,MM), XNA(IM) DSN   01713
       2, XUN(IM), ST(IM), CS(IM), SR(IM), W(MM), D(MM), XNI(MM), XND(MM), DSN   01714
       3 MR(MM), XNE(MM), CT(IM), RS(IM), RQ(MM), WD(MM), AV(IP), XNR(IM), DSN   01715
       4 XNOR(MM), QA(IM,MM)                                            DSN      01716
        EQUIVALENCE (IG,IA(36)), (IGE,IA(5)), (ILC,IA(32)), (IBR,IA(71)), (I DSN 01717
       1DL,IA(6)), (EFG,A(17)), (IIC,IA(37)), (XTTR,A(18)), (XITA,A(19)), DSN    01718
       2(IIL,IA(30)), (IUM,IA(21)), (EPSA,A(A)), (ICVT,IA(39)), (JNLA,IA(1 DSN   01719
       359)), (JRLA,IA(160)), (JSGA,IA(150)), (IA(68),JV)               DSN      01720
        EQUIVALENCE (IA(195),ISF)                                       DSN      01721
        JNL=JNLA+IG                                                     DSN      01722
        JRL=JRLA+IG                                                     DSN      01723
        JSG=JSGA+IG                                                     DSN      01724
        DO 10 M=1,MM                                                    DSN      01725
        DO 10 I=1,IM                                                    DSN      01726
10      OA(I,M)=0.0                                                     DSN      01727
C       COMPUTE SOURCE FOR GROUP BY INCLUDING SELF SCATTER              DSN      01728
20      DO 80 I=1,IM                                                    DSN      01729
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                XNA(I)=XNN(I)                                                   DSN  01730
                ST(I)=XNN(I)*CS(I)+SN(I)                                        DSN  01731
                XNI(I)=0.0                                                      DSN  01732
                IF (ISCT.LT.1) GO TO 40                                         DSN  01733
                DO 30 M=1,MM                                                    DSN  01734
 30             SAT(I,M)=SA(I,M)                                                DSN  01735
                DO 70 N=1,LSCT                                                  DSN  01736
                EI=(FLOAT(N)+.5)*CH(I,N)                                        DSN  01737
                IF (IGE.EQ.2) GO TO 50                                          DSN  01738
                E2=EI*XJJ(I,N)                                                  DSN  01739
                DO 40 M=1,MM                                                    DSN  01740
 40             SAT(I,M)=SAT(I,M)+E2*PL(M,N)                                    DSN  01741
                GO TO 70                                                        DSN  01742
 50             IRS=(N+1)*(N+1)/4                                               DSN  01743
                IRT=IRS+(2*N+1)/4                                               DSN  01744
                DO 60 M=IRS,IRT                                                 DSN  01745
                E2=EI*XJJ(I,M)                                                  DSN  01746
                DO 60 M=1,MM                                                    DSN  01747
 60             SAT(I,M)=SAT(I,M)+E2*PL(M,IR)                                   DSN  01748
 70             CONTINUE                                                        DSN  01749
 80             CONTINUE                                                        DSN  01750
C               COMPUTE ANGULAR FLUX AND NEUTRON SUMS                           DSN  01751
                IRIG=0                                                          DSN  01752
C               COMPUTE ANGULAR FLUX BOUNDARY CONDITIONS                        DSN  01753
 90             LC=LC+1                                                         DSN  01754
                DO 310 M=1,MM                                                   DSN  01755
                IF (D(M).GE.0.0) GO TO 150                                      DSN  01756
                II=1P                                                           DSN  01757
                IS=IP+1                                                         DSN  01758
                IF (IBR.EQ.II GO TO 100                                         DSN  01759
                XNI(M)=XNO(M)                                                   DSN  01760
                IF (IOM.EQ.2) XNI(M)=RQ(M)                                      DSN  01761
                GO TO 110                                                       DSN  01762
 100            K=MR(M)                                                         DSN  01763
                XNO(M)=XNO(K)                                                   DSN  01764
                XNI(M)=XNI(K)                                                   DSN  01765
 110            IF (W(II).LE.0.0) GO TO 120                                     DSN  01766
                GO TO 140                                                       DSN  01767
 120            DO 130 I=1,IM                                                   DSN  01768
 130            XNE(I)=0.0                                                      DSN  01769
 140            XNMM=XNI(M)                                                     DSN  01770
                GO TO 200                                                       DSN  01771
 150            IT=0                                                            DSN  01772
                IS=0                                                            DSN  01773
                IF (IBL-1) 170,160,180                                          DSN  01774
 160            K=MR(M)                                                         DSN  01775
                XNO(M)=XNI(K)                                                   DSN  01776
                XNI(M)=XNI(K)                                                   DSN  01777
                GO TO 190                                                       DSN  01778
 170            XNO(M)=0.0                                                      DSN  01779
                XNI(M)=0.0                                                      DSN  01780
                GO TO 190                                                       DSN  01781
 180            XNI(M)=XNO(M)                                                   DSN  01782
 190            XNMM=XNI(M)                                                     DSN  01783
C               COMPUTE INFLOW OR OUTFLOW NEUTRON FLOW                          DSN  01784
 200            DIFFU=0                                                         DSN  01785
                DO 290 J=1,II                                                   DSN  01786
                I=IABS(IT-J)                                                    DSN  01787
                K=IABS(IS-J)                                                    DSN  01788
                TEMP=CT(I)                                                      DSN  01789
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      XND(K,M)=XNMM                                                    DSN 01790
      EI=ST(I)                                                          DSN 01791
      IF (ISCT.GT.0) EI=EI+SAT(I,M)                                     DSN 01792
      IF (CT(I).GE.0.0) GO TO 210                                       DSN 01793
      EI=EI+TABA*QA(I,M)*A(JV-1+I)                                      DSN 01794
      CT(I)=CT(I)+TABA*A(JV-1+I)                                        DSN 01795
      IDEG=1                                                            DSN 01796
  210 CONTINUE                                                          DSN 01797
      E2=(XNMM*QA(I,M)+XNE(I)*QC(I,M)+EI)/(DB(I,M)+CT(I))               DSN 01798
      E3=XNE(I)                                                         DSN 01799
      E4=XNMM                                                           DSN 01800
      XNE(I)=E2+E2-XNE(I)                                               DSN 01801
      XNMM=E2+E2-XNMM                                                   DSN 01802
      IF (W(J).EQ.0.0) XNE(I)=E2                                        DSN 01803
      IF (XNE(I).GE.0.0.AND.XNMM.GE.0.0) GO TO 280                      DSN 01804
C     STEP FUNCTION                                                     DSN 01805
      IF (ISF.GT.0) GO TO 220                                           DSN 01806
      E2=((QA(I,M)-DS(I,M))*E4+(DC(I,M)-0.5*DB(I,M)+DS(I,M))*E3+EI)/(CT(DSN 01807
     1I)+0.5*DB(I,M))                                                   DSN 01808
      XNE(I)=E2                                                         DSN 01809
      XNMM=E2                                                           DSN 01810
      GO TO 260                                                         DSN 01811
  220 CONTINUE                                                          DSN 01812
C     NEGATIVE FLUX FIXUP                                               DSN 01813
      IF (XNE(I).GE.0.0) GO TO 230                                      DSN 01814
      IF (XNMM.GE.0.0.OR.XNMM.GE.XNE(I)) GO TO 240                      DSN 01815
  230 XNMM=0.0                                                          DSN 01816
      E2=((DA(I,M)-DS(I,M))*E4+DC(I,M)*E3+EI)/(CT(I)+DB(I,M)-2.*DS(I,M)) DSN 01817
      XNE(I)=E2+E2-E3                                                   DSN 01818
      IF (XNE(I).GE.0.0) GO TO 260                                      DSN 01819
      GO TO 250                                                         DSN 01820
  240 XNE(I)=0.0                                                        DSN 01821
      E2=(QA(I,M)*E4+(DC(I,M)-.5*DB(I,M)+DS(I,M))*E3+EI)/(CT(I)+2.*DS(I,DSN 01822
     1M))                                                               DSN 01823
      XNMM=E2+E2-E4                                                     DSN 01824
      IF (XNMM.GE.0.0) GO TO 260                                        DSN 01825
  250 IF (CT(I).EQ.0.0) GO TO 260                                       DSN 01826
      XNMM=0.0                                                          DSN 01827
      XNE(I)=0.0                                                        DSN 01828
      E2=((QA(I,M)-DS(I,M))*E4+(DC(I,M)-.5*DB(I,M)+DS(I,M))*E3+EI)/CT(I DSN 01829
  260 IF (ILVC.LT.1) GO TO 280                                          DSN 01830
      NFFU=NFFU+1                                                       DSN 01831
      IF (NFFU.EQ.1) WRITE (9,270) IG,M,I,XNE(I),XNMM                   DSN 01832
  270 FORMAT (28H NEGATIVE FLUX FIXUP, GROUP=I4,12H, DIRECTION=I3,14H, SDSN 01833
     1PACE POINT=I5,10X,8H XNE(I)=E14.5,6H XNMM=E14.5)                  DSN 01834
  280 XIN(I)=XNN(I)+W(M)*E2                                             DSN 01835
      QA(I,M)=E2                                                        DSN 01836
  290 CT(I)=TEMP                                                        DSN 01837
      I=IABS(IS-IP)                                                     DSN 01838
      XI0(I,M)=XNMM                                                     DSN 01839
      IF (U(J).GE.0.0) GO TO 300                                        DSN 01840
      XNI(M)=XNMM                                                       DSN 01841
      GO TO 310                                                         DSN 01842
  300 XNO(M)=XNMM                                                       DSN 01843
  310 CONTINUE                                                          DSN 01844
C     COMPUTE NEUTRON SUMS                                              DSN 01845
      IF (IBP.NE.2) GO TO 330                                           DSN 01846
      DO 320 M=1,MM                                                     DSN 01847
      IF (U(M).LE.0.0) XNO(M)=XNI(M)                                    DSN 01848
  320 CONTINUE                                                          DSN 01849
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330   E1=0.0                                                   DSN   01850
      F2=0.0                                                   DSN   01851
      DO 340 M=1,MM                                            DSN   01852
      E1=E1+WD(M)*XNI(M)                                       DSN   01853
340   E2=E2+WD(M)*XNO(M)                                       DSN   01854
      A(JRL)=E2*AV(IP)                                         DSN   01855
      A(JNL)=A(JRL)-E1*AV(I)                                   DSN   01856
      IF (ITRIG.GT.0) GO TO 370                                DSN   01857
      IF (IHR.LT.1.OR.A(JNL).LE.EPG) GO TO 400                 DSN   01858
C     COMPUTE BOUNDARY SOURCE                                  DSN   01859
      DO 350 I=1,IM                                            DSN   01860
      XNN(I)=XNN(I)                                            DSN   01861
      XNN(I)=0.0                                               DSN   01862
      ST(I)=0.0                                                DSN   01863
      DO 350 M=1,MM                                            DSN   01864
350   SAT(I,M)=0.0                                             DSN   01865
      DO 360 M=1,MM                                            DSN   01866
360   XNOR(M)=XNO(M)                                           DSN   01867
      XNLR=A(JNL)                                              DSN   01868
      RLR=A(JRL)                                               DSN   01869
      ITRIG=1                                                  DSN   01870
      GO TO 90                                                 DSN   01871
C     COMBINE FLUX COMPONENTS                                  DSN   01872
370   E1=-XNLR/A(JNL)                                          DSN   01873
      A(JNL)=0.0                                               DSN   01874
      A(JRL)=E1*A(JRL)+RLR                                     DSN   01875
      DO 380 I=1,IM                                            DSN   01876
380   XNN(I)=E1*XNN(I)+XNR(I)                                  DSN   01877
      DO 390 M=1,MM                                            DSN   01878
390   XNO(M)=E1*XNO(M)+XNOR(M)                                 DSN   01879
C     PERFORM INNER ITERATION                                  DSN   01880
400   IIC=IIC+1                                                DSN   01881
      E1=0.0                                                   DSN   01882
      E2=0.0                                                   DSN   01883
      E4=0.0                                                   DSN   01884
      E3=0.0                                                   DSN   01885
      IFLAG=0                                                  DSN   01886
      DO 420 I=1,IM                                            DSN   01887
      TM=ANN(I)-XNA(I)                                         DSN   01888
      T=TM*CS(I)                                               DSN   01889
      IF (CT(I).GE.0.0) GO TO 410                              DSN   01890
      IFLAG=1                                                  DSN   01891
      IF (IIC.EQ.1) T=TM*CS(I)+XNN(I)*TARA*A(JV-I+1)           DSN   01892
      IF (IIC.GT.1) T=TM*(CS(I)+TARA*A(JV-I+1))                DSN   01893
410   CONTINUE                                                 DSN   01894
      E1=E1+T                                                  DSN   01895
      E2=E2+ABS(TM)*CS(I)                                      DSN   01896
      E3=E3+ABS(TM)*(CT(I)-CS(I))                              DSN   01897
      IF (EPSA.GT.0.0) E4=AMAX1(E4,ABS(TM/XNA(I)))             DSN   01898
420   CONTINUE                                                 DSN   01899
      E1=A(JSG)/(A(JSG)-E1)                                    DSN   01900
      DO 430 M=1,MM                                            DSN   01901
      DO 430 I=1,IM                                            DSN   01902
430   QA(I,M)=QA(I,M)*E1                                       DSN   01903
      A(JNL)=A(JNL)*E1                                         DSN   01904
      A(JRL)=A(JRL)*E1                                         DSN   01905
      DO 440 I=1,IM                                            DSN   01906
440   XNN(I)=XNN(I)*E1                                         DSN   01907
      DO 450 M=1,MM                                            DSN   01908
450   XNO(M)=XNO(M)*E1                                         DSN   01909
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1919          IF (ABS(XITA)*ABS(XITH).EQ.0.0.OR.IIC.GT.IILI GO TO A90                 DSN     01910
1920          IF (E2.GT.EPG.OR.E3.GT.EPG) GO TO 470                                   DSN     01911
1921          IF (EPSA.EQ.0.0) GO TO 460                                              DSN     01912
1922          IF (E4.GT.EPSA) GO TO 470                                               DSN     01913
1923    A60   IF (IHR.LT.I.OR.ABS(A(JNL)).LT.EPG) GO TO A90                           DSN     01914
1924    A70   IF (XITA.EQ.0.0) GO TO 20                                              DSN     01915
1925    C     COMPUTE CORRECTS                                                        DSN     01916
1926          DO 480 M=I,MM                                                           DSN     01917
1927          E2=W(M)*E1                                                              DSN     01918
1928          DO 480 N=I,MM                                                           DSN     01919
1929          EJ=E2*CL(M,N)                                                           DSN     01920
1930          DO 480 I=I,IM                                                           DSN     01921
1931          IF (M.EQ.I) XJJ(I,N)=0.0                                                DSN     01922
1932    A80   XJJ(I,N)=XJJ(I,N)+EJ*(XND(I,M)*XND(I,I,M))                              DSN     01923
1933          GO TO 20                                                                DSN     01924
1934    C     FLUX CONVERGED                                                          DSN     01925
1935    A90   DO 500 I=I,IP                                                          DSN     01926
1936          DO 500 M=I,MM                                                           DSN     01927
1937    500   XND(I,M)=E1*XND(I,M)                                                    DSN     01928
1938          RETURN                                                                  DSN     01929
1939          END                                                                     DSN     01930
1940          SUBROUTINE FISSN (XN,C,XJ,B,IHM,IM,IMM,MT,NM,MM,FG,IGP,F,AKE,MA,MZ      DSN     01931
1941         1,I/M,V,G,DF)                                                            DSN     01932
1942    C                                                                             DSN     01933
1943    C     FISSION CALCULATION AND NORMALIZATIONS                                  DSN     01934
1944          COMMON /ALPHA/ IGAFM,TAUA,SCATT,SCATTP,BAL,XLAMAX,XLAMIN,EVMAX,EVM      ALPHA   00002
1945         1IN,IPRE,FSUM,INEG,KK                                                    ALPHA   00003
1946    C                                                                             ALPHA   00004
1947          DIMENSION XN(IB,IGM), C(IHM,IGM,MT), XJ(IGM,IM,NM), B(IGM,MM), FG(      DSN     01936
1948         1IGP), ATM), AKE(IGP), MA(IM), MZ(IZM), V(IM), QG(IGP), DF(IM)           DSN     01937
1949          COMMON IA(1000),A(10000)                                                DSN     01938
1950          EQUIVALENCE (IMT,IA(13)), (ITP,A(15)), (IA(2),ITH), (IA(3),NFNI,        DSN     01939
1951         1(A),A(16)), (IEV,IA(14)), (XNF,A(18)), (IHR,IA(7)), (IGM,IA(21)),       DSN     01940
1952         2 (IA(10),IFN), (A(17),FPG), (EPS,A(31)                                  DSN     01941
1953          EQUIVALENCE (IA(19)),IFR)                                               DSN     01942
1954          IFN=IABS(IFN)                                                           DSN     01943
1955          IM=IM-1                                                                 DSN     01944
1956          FTP=FG(IGP)                                                             DSN     01945
1957          IF (IFN.GT.0) GO TO 20                                                  DSN     01946
1958          DO 10 J=I,IM                                                            DSN     01947
1959          DO 10 I=I,IGM                                                           DSN     01948
1960    10    XN(J,I)=0.0                                                             DSN     01949
1961          IFN=1                                                                   DSN     01950
1962          GO TO 80                                                                DSN     01951
1963    20    DO 30 I=),IM                                                            DSN     01952
1964    30    F(I)=0.0                                                                DSN     01953
1965          IF (ITH.LE.0) GO TO 60                                                  DSN     01954
1966          DO 40 I=I,IM                                                            DSN     01955
1967          DO 40 J=I,IGM                                                           DSN     01956
1968    40    F(I)=F(I)+XKE(J)*XN(I,J)                                                DSN     01957
1969          DO 50 J=I,IGM                                                           DSN     01958
1970          FG(J)=0.0                                                               DSN     01959
1971          DO 50 I=I,IM                                                            DSN     01960
1972          L=MA(I)                                                                 DSN     01961
1973          L=IABS(MZ(L))                                                           DSN     01962
1974    50    FG(J)=FG(J)+V(I)*F(I)*C(IM,J,L)*DF(I)                                   DSN     01963
1975          GO TO 110                                                               DSN     01964
1976    60    DO 70 I=),IM                                                            DSN     01965
1977          L=MA(I)                                                                 DSN     01966
1978          L=IABS(MZ(L))                                                           DSN     01967
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1979          DO 70 J=1,IGM                                                    DSN     01968
1980     70   F(I)=F(I)+XN(I,J)*C(IN,J,L)*DF(I)                                DSN     01969
1981     80   E1=0.0                                                           DSN     01970
1982          DO 90 I=1,IM                                                     DSN     01971
1983     90   E1=E1+V(I)*F(I)                                                  DSN     01972
1984          DO 100 J=1,IGM                                                   DSN     01973
1985     100  FG(J)=E1*XKF(J)                                                  DSN     01974
1986     110  UH=0.0                                                           DSN     01975
1987          DO 120 J=1,IGM                                                   DSN     01976
1988     120  UH=UH+FG(J)                                                      DSN     01977
1989          FG(IGP)=UH                                                       DSN     01978
1990          IF (NEW.EQ.1) GO TO 150                                          DSN     01979
1991          E1=FTP*SG(IGP)                                                   DSN     01980
1992          IF (E1.LE.0.0) GO TO 210                                         DSN     01981
1993          XLA=(FG(IGP)+QG(IGP))/E1                                         DSN     01982
1994          IF (IGM.NE.0) GO TO 150                                          DSN     01983
1995          IF (FG(IGP).LE.0.0) GO TO 220                                    DSN     01984
1996          IF (IABS(IEVT).NE.1) GO TO 150                                   DSN     01985
1997          UH=1./XLA                                                        DSN     01986
1998          DO 130 J=1,IGP                                                   DSN     01987
1999          FG(J)=UH*FG(J)                                                   DSN     01988
2000     130  XKE(J)=UH*XKE(J)                                                 DSN     01989
2001          IF (ITH.LE.0) GO TO 150                                          DSN     01990
2002          DO 140 I=1,IM                                                    DSN     01991
2003     140  F(I)=UH*F(I)                                                     DSN     01992
2004     150  NEW=0                                                            DSN     01993
2005          IF (IGM.EQ.0) GO TO 170                                          DSN     01994
2006     160  EPS=10.0**(IGP+FG(IGP))*0.*EPS/FLOAT(IGM+3)                     DSN     01995
2007          RETURN                                                           DSN     01996
2008     170  IF (XNF.LE.0.0) GO TO 160                                        DSN     01997
2009          E1=XNF/FG(IGP)                                                   DSN     01998
2010          FG(IGP)=XNF                                                      DSN     01999
2011          DO 180 J=1,IGM                                                   DSN     02000
2012          FG(J)=E1*FG(J)                                                   DSN     02001
2013          DO 180 I=1,IM                                                    DSN     02002
2014          XN(I,J)=E1*XN(I,J)                                               DSN     02003
2015          DO 180 N=1,NM                                                    DSN     02004
2016     180  XJ(J,I,N)=XJ(J,I,N)*E1                                           DSN     02005
2017          DO 190 I=1,IM                                                    DSN     02006
2018     190  F(I)=E1*F(I)                                                     DSN     02007
2019          IF (IABS(IEVT).EQ.1) GO TO 160                                   DSN     02008
2020          DO 200 J=1,IGM                                                   DSN     02009
2021          DO 200 M=1,MM                                                    DSN     02010
2022     200  AJ(J,M)=AJ(J,M)*E1                                               DSN     02011
2023          GO TO 160                                                        DSN     02012
2024     210  WRITE (9,240)                                                    DSN     02013
2025          GO TO 230                                                        DSN     02014
2026     220  WRITE (9,250)                                                    DSN     02015
2027     230  IEVT=1                                                           DSN     02016
2028          RETURN                                                           DSN     02017
2029     240  FORMAT (46H0ZERO DISTRIBUTED SOURCE OR FISSION SOURCE//)         DSN     02018
2030     250  FORMAT (18H0ZERO FISSION SOURCE//)                               DSN     02019
2031          END                                                              DSN     02020
2032          SUBROUTINE TOTGP (SNG,SCG,XNL,AG,SDG,RL,XNM,IGP,FNG,XNG,XNOG,QG,FG DSN     02021
2033         1,XKE,XKI)                                                        DSN     02022
2034     C    TOTAL GROUP SUMS, FISSION AND CONVERGENCE NUMBER CALCULATION     DSN     02023
2035          COMMON /ALPHA/ LOAFH,TAMA,SCATT,SCATTP,BAL,XLAMAX,XLAMIN,EVMAX,EVM ALPHA  00002
2036         1IN,IPPE,FSUM,INEG,KK                                             ALPHA   00003
2037     C                                                                     ALPHA   0000*
2038          DIMENSION SNG(IGP), SCG(IGP), XNL(IGP), AG(IGP), SDG(IGP), RL(IGP DSN     02025
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2039          1, XNH(IGP), FNG(IGP), XNG(IGP) XNUG(IGP), QG(TGP), FG(IGP)) XKE(1 DSN     02026
2040          2GP), XKI(IGP)                                                      DSN     02027
2041           COMMON IA(10000),A(10000)                                          DSN     02028
2042           EQUIVALENCE (IC,IA(47)), (ICC,IA(33)), (XLA,A(16)), (XLAR,A(27)),  DSN     02029
2043          1(JN,IA(5H)), (JC,IA(62)), (JX,IA(75)), (FV,A(1)), (JB,IA(76)), (IM DSN     02030
2044          2,IA(9)), (IHM,IA(15)), (MT,IA(19)), (IGM,IA(2)), (NM,IA(35)), (MM DSN     02031
2045          3,IA(6)), (IEVT,IA(11)), (ICVT,IA(39)), (XLAP,A(30)), (EQ,A(32)),  DSN     02032
2046          A(EQP,A(3)), (EVP,IA(33)), (EPS,A(3)), (E1,A(34)), (E2,A(35)) (JF DSN     02033
2047          5,IA(57)), (KHA,IA(10H)), (KHZ,IA(109)), (JV,IA(68)) IZM)IA(8))    DSN     02034
2048          6(IIL,IA(30)), (IIM,IA(2)), (JDF,IA(50))                           DSN     02035
2049           SNG(IGP)=0.0                                                      DSN     02036
2050           SCG(IGP)=0.0                                                      DSN     02037
2051           XNL(IGP)=0.0                                                      DSN     02038
2052           AG(IGP)=0.0                                                       DSN     02039
2053           SDG(IGP)=0.0                                                      DSN     020A0
2054           RL(IGP)=0.0                                                       DSN     020A1
2055           XNR(IGP)=0.0                                                      DSN     020A2
2056           DO 10 J=1,IGM                                                     DSN     020A3
2057           SNG(IGP)=SNG(IGP)+SNG(J)                                          DSN     020A4
2058           SCG(IGP)=SCG(IGP)+SCG(J)                                          DSN     020A5
2059           XNL(IGP)=XNL(IGP)+XNL(J)                                          DSN     020A6
2060           AG(IGP)=AG(IGP)+AG(J)                                             DSN     020A7
2061           SDG(IGP)=SDG(IGP)+SDG(J)                                          DSN     020A8
2062           RL(IGP)=RL(IGP)+RL(J)                                             DSN     020A9
2063    10     XNR(IGP)=XNR(IGP)+XNR(J)                                          DSN     020B0
2064           RAL=ABS(XNR(IGP))                                                 DSN     020B1
2065           IF (ICVT.EQ.0) GO TO 50                                           DSN     020B2
2066           IF (IPRE.EQ.1.OR.IPRE.EQ.2) GO TO 50                              DSN     020B3
2067           FNG(IGP)=0.0                                                      DSN     020BA
2068           XNG(IGP)=0.0                                                      DSN     020B5
2069           XNDG(IGP)=0.0                                                     DSN     020B6
2070           DO 20 J=1,IGM                                                     DSN     020B7
2071           FNG(IGP)=FNG(IGP)+FNG(J)                                          DSN     020B8
2072           XNG(IGP)=XNG(IGP)+XNG(J)                                          DSN     020B9
2073    20     XNDG(IGP)=XNDG(IGP)+XNDG(J)                                       DSN     020C0
2074           WRITE (99,30) (I,JG(I),FG(I),SNG(I),SCG(I),SDG(I),XNL(I),I=1,IGP  DSN     020C1
2075           WRITE (99,40) (I,AG(I),XNR(I),RL(I),FNG(I),XNDG(I),XNG(I),I=1,IGP DSN     020C2
2076    30     FORMAT (///,13X,7H SOURCE,5X,15HFISSION SOURCE,1UX,10HIN SCATTER,8 DSN     020C3
2077          1X,12HSELF SCATTER,9X,11HOUT SCATTER,9X,11HNET LEAKAGE,/(1A,1PE16.7 DSN     020C4
2078          2,1P5E20.7))                                                      DSN     020C5
2079    40     FORMAT (///,9X,11H ABSORPTION,5X,15HNEUTRON BALANCE,7X,13HRIGHT LE DSN     020C6
2080          1AKAGE,4X,16HFISSION NEUTRONS,5X,15HNEUTRON DENSITY,8X,12HNEUTRON F DSN     020C7
2081          2LUX,/(1X,1PE16.7,1P5E20.7))                                      DSN     020C8
2082    50     ICC=ILC+1                                                         DSN     020C9
2083           IPRT=IPRE-2                                                       DSN     020D0
2084           IF (IPRT) 60,120,A0                                               DSN     020D1
2085    60     CONTINUE                                                          DSN     020D2
2086           XLAM=XLA                                                          DSN     020D3
2087    C      FISSION CALCULATION                                               DSN     020D4
2088           CALL FISSN (A(JN),A(JC),A(JX),A(JB),IGM,IM,IHM,M7,NM,MM,FG,IGP,A(J DSN     020D5
2089          1F),AKE,IA(KMA),IA(KM7),IZM,A(JV),QG,A(JDF))                       DSN     020D6
2090    C      CONVERGENCE NUMBERS                                               DSN     020D7
2091           E1=1.-XLA                                                         DSN     020D8
2092           E2=ABS(E1)                                                        DSN     020D9
2093           IF (E2.LE.10.*EPS) IIL=IIM                                        DSN     020E0
2094           E3=ABS(XLAM-XLA)                                                  DSN     020E1
2095           IF (IABS(IA(21)).GT.0) GO TO 80                                   DSN     020E2
2096           IF (IABS(IEVT).GT.1) GO TO 70                                     DSN     020E3
2097           EV=AKI(IGP)/ANE(IGP)                                              DSN     020E4
2098           GO TO 80                                                          DSN     020E5
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2049    70    IA(38)=3                                                        DSN     02086
2100          RETURN                                                          DSN     02087
2101    80    IF (ICVT.EQ.0) GO TO 90                                         DSN     02088
2102          IA(38)=1                                                        DSN     02089
2103          RETURN                                                          DSN     02090
2104    90    IF (E2.LE.EPS) GO TO 110                                        DSN     02091
2105          CALL SSWTCH (4,K00DFX)                                          DSN     02092
2106          GO TO 110,100), K00DFX                                          DSN     02093
2107   100    IA(38)=2                                                        DSN     02094
2108          RETURN                                                          DSN     02095
2109   110    ICVT=1                                                          DSN     02096
2110          IF ( IEVT .LT. 0 ) ICVT = 0                                     DSN     02097
2111          GO TO 120                                                       DSN     02098
2112   120    CONTINUE                                                        DSN     02099
2113          IA(38)=4                                                        DSN     02100
2114          RETURN                                                          DSN     02101
2115          END                                                             DSN     02102
2116          SUBROUTINE UPSET (IP,MM,IGM,XNO)                                DSN     02103
2117          DIMENSION XNO(IP,MM)                                            DSN     02104
2118          REWIND 3                                                        DSN     02105
2119          DO 20 M=1,MM                                                    DSN     02106
2120          DO 10 I=1,IP                                                    DSN     02107
2121    10    XNO(I,M)=1.                                                     DSN     02108
2122    20    CONTINUE                                                        DSN     02109
2123          DO 30 I=1,IGM                                                   DSN     02110
2124    30    WRITE (3)XNO                                                    DSN     02111
2125          RETURN                                                          DSN     02112
2126          END                                                             DSN     02113
2127          SUBROUTINE INPUT(IM,IP,IGM,IZM,MM,MZ,VE,V,AFR,AFA,W,GZ,IGP,IZP,MR DSN     02114
2128         1,TF,TS,TT,IMM,DT,MZZ,F,DF,C,XKI,AA,DI                           DSN     02115
2129          DIMENSION W(MM), V(IP), VE(IGP), AFR(IP,MM), AFA(IP,MM), MZ(IM), G DSN     02116
2130         1Z(IGP,IZP), DR(MM), MZZ(IZM), F(IM), DF(IM), C(IMM,IGM,MT), XKI(IG DSN     02117
2131         2P), AA(IP), DI(MM), TF(IM), TS(IM), TT(IM)                      DSN     02118
2132          COMMON /A/A(10000),A(10000)                                     DSN     02119
2133          EQUIVALENCE (ITH,IA(2)), (IGM,IA(21)), (IEVT,IA(111)), (IMT,IA(13)) DSN     02120
2134         1                                                                DSN     02121
2135          IF (IIH.EQ.0) RETURN                                            DSN     02122
2136          IMS=TABS(IA(14))                                                DSN     02123
2137    C     DO THE THE I/V INTEGRAL                                         DSN     02124
2138          DO 20 IG=1,IGP                                                  DSN     02125
2139          DO 10 I=1,IZP                                                   DSN     02126
2140    10    G(IG,I)=0.                                                      DSN     02127
2141    20    CONTINUE                                                        DSN     02128
2142          REWIND 3                                                        DSN     02129
2143          REWIND 2                                                        DSN     02130
2144          DO 70 IG=1,IGM                                                  DSN     02131
2145          IF (MOD(IG,2).EQ.0) GO TO 30                                    DSN     02132
2146          READ (2)AFR                                                     DSN     02133
2147          READ (3)AFA                                                     DSN     02134
2148          GO TO 40                                                        DSN     02135
2149    30    READ (3)AFA                                                     DSN     02136
2150          READ (2)AFR                                                     DSN     02137
2151    40    IDLE=IGP-IG                                                     DSN     02138
2152          IF (ITH.EQ.0) IDLE=IG                                           DSN     02139
2153          DO 60 I=1,IM                                                    DSN     02140
2154          IZ=MZ(I)                                                        DSN     02141
2155          TI=0.                                                           DSN     02142
2156          DO 50 M=1,MM                                                    DSN     02143
2157          MA=MR(M)                                                        DSN     02144
2158    50    TI=TI+(AFR(I,M)+AFR(I,M))*(AFA(I,MA)+AFA(I,MA))*W(M)            DSN     02145
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2159    60      GZ(IG,IZ)=GZ(IG,IZ)+T)*V(1)/(A,*VE(IDLE))                      DSN     02146
2160    70      CONTINUE                                                        DSN     02147
2161            WRITE (9,760)                                                   DSN     02148
2162            ASSIGN 80 TO L                                                  DSN     02149
2163            GO TO 500                                                       DSN     02150
2164    C       DO THE SURFACE INTEGRAL                                         DSN     02151
2165    80      TIN=GZ(IGP,IZP)                                                 DSN     02152
2166            DO 100 IG=1,IGP                                                 DSN     02153
2167            DO 90 IZ=1,IZP                                                  DSN     02154
2168    90      GZ(IG,IZ)=0.                                                    DSN     02155
2169    100     CONTINUE                                                        DSN     02156
2170            REWIND 2                                                        DSN     02157
2171            DO 130 IG=1,IGM                                                 DSN     02158
2172            READ (2)AFA                                                     DSN     02159
2173            IDLE=IG                                                         DSN     02160
2174            IF (ITH.EQ.1) IDLE=IGP-IG                                       DSN     02161
2175            DO 120 I=1,IM                                                   DSN     02162
2176            IZ=MZ(I)                                                        DSN     02163
2177            TI=0.                                                           DSN     02164
2178            DO 110 M=1,MM                                                   DSN     02165
2179    110     TI=TI+W(M)*(AFA(I,M)+AFA(I+1,M))                                DSN     02166
2180    120     GZ(I,IZ)=GZ(I,IZ)+.5*V(I)*TI/(VE(IDLE)*TIN)                    DSN     02167
2181    130     CONTINUE                                                        DSN     02168
2182            IF (IZ*.LE.1) GO TO 150                                         DSN     02169
2183            DO 140 IZ=2,IZM                                                 DSN     02170
2184    140     GZ(1,IZ)=GZ(1,IZ)+GZ(1,IZ-1)                                    DSN     02171
2185    150     DO 170 IZ=1,IZM                                                 DSN     02172
2186            DO 160 IG=2,IGP                                                 DSN     02173
2187    160     GZ(IG,IZ)=GZ(I,IZ)                                              DSN     02174
2188    170     CONTINUE                                                        DSN     02175
2189            REWIND 1                                                        DSN     02176
2190            T2=0.                                                           DSN     02177
2191            DO 200 IG=1,IGM                                                 DSN     02178
2192            READ (3)AFA                                                     DSN     02179
2193            TI=0.                                                           DSN     02180
2194            IDLE=IG                                                         DSN     02181
2195            IF (ITH.EQ.1) IDLE=IGP-IG                                       DSN     02182
2196            DO 180 M=1,MM                                                   DSN     02183
2197    180     TI=TI+(W(M)*0.5)*AFA(IP,M)*AA(IP)                               DSN     02184
2198            T2=T2+TI*AA(IDLE)                                               DSN     02185
2199            DO 190 IZ=1,IZM                                                 DSN     02186
2200    190     GZ(IG,IZ)=GZ(IG,IZ)*TI                                          DSN     02187
2201    200     CONTINUE                                                        DSN     02188
2202            DO 210 IZ=1,IZM                                                 DSN     02189
2203    210     GZ(IGP,IZ)=GZ(IGP,IZ)*T2                                        DSN     02190
2204            ASSIGN 230 TO L                                                 DSN     02191
2205            WRITE (9,220)                                                   DSN     02192
2206    220     FORMAT (1H0///18H  ACCEPTANCE AREAS)                            DSN     02193
2207            KA=1                                                            DSN     02194
2208            KB=8                                                            DSN     02195
2209            GO TO 550                                                       DSN     02196
2210    230     REWIND 3                                                        DSN     02197
2211            DO 240 I=1,IM                                                   DSN     02198
2212    240     F(I)=0.                                                         DSN     02199
2213            DO 270 IG=1,IGM                                                 DSN     02200
2214            READ (3)AFA                                                     DSN     02201
2215            IDLE=IGP-IG                                                     DSN     02202
2216            IF (ITH.EQ.0) IDLE=IG                                           DSN     02203
2217            DO 260 I=1,IM                                                   DSN     0220A
2218            TI=0.                                                           DSN     0220S
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      DO 250 M=1,MM                                                     DSN  02206
  250 TI=TI+(AFA(I+1,M)+AFA(I,M))*W(M)                                  DSN  02207
  260 F(I)=F(I)+XKI(IDLE)*TI*.5                                         DSN  02208
  270 CONTINUE                                                          DSN  02209
      IF (IABS(IEVT).LT.1.OR.IABS(IEVT).GT.2) GO TO 280                 DSN  02210
      IF (IA(2)).NE.2) GO TO 280                                        DSN  02211
      REWIND 4                                                          DSN  02212
      READ (4)C                                                         DSN  02213
  280 REWIND 2                                                          DSN  02214
      DO 300 IG=1,IGP                                                   DSN  02215
      DO 290 IZ=1,IZP                                                   DSN  02216
  290 GZ(IG,IZ)=0.                                                      DSN  02217
  300 CONTINUE                                                          DSN  02218
      IMF=IA((3)-1                                                      DSN  02219
      DO 330 IG=1,IGM                                                   DSN  02220
      READ (2)AFR                                                       DSN  02221
      IDLE=IGP-IG                                                       DSN  02222
      IF (ITM.EQ.0) IDLE=IG                                             DSN  02223
      DO 320 I=1,IM                                                     DSN  02224
      IZ=MZ(I)                                                          DSN  02225
      IX=IABS(MZZ(IZ))                                                  DSN  02226
      TI=0.                                                             DSN  02227
      DO 310 M=1,MM                                                     DSN  02228
  310 TI=TI+(AFR(I+1,M)+AFR(I,M))*W(M)                                  DSN  02229
  320 GZ(IG,IZ)=GZ(IG,IZ)+F(I)*DF(I)*C(IMF,IDLE,IX)*V(I)*.5*TI          DSN  02230
  330 CONTINUE                                                          DSN  02231
      WRITE (3,780)                                                     DSN  02232
      ASSIGN 340 TO L                                                   DSN  02233
      GO TO 500                                                         DSN  02234
  340 DO 360 IG=1,IGP                                                   DSN  02235
      DO 350 IZ=1,IZP                                                   DSN  02236
  350 GZ(IG,IZ)=0.                                                      DSN  02237
  360 CONTINUE                                                          DSN  02238
      REWIND 3                                                          DSN  02239
      REWIND 2                                                          DSN  02240
      DO 410 IG=1,IGM                                                   DSN  02241
      IF (MOD(IG,2).EQ.0) GO TO 370                                     DSN  02242
      READ (2)AFR                                                       DSN  02243
      READ (3)AFA                                                       DSN  02244
      GO TO 380                                                         DSN  02245
  370 READ (3)AFA                                                       DSN  02246
      READ (2)AFR                                                       DSN  02247
  380 IDLE=IGP-IG                                                       DSN  02248
      IF (ITM.EQ.0) IDLE=IG                                             DSN  02249
      DO 400 I=1,IM                                                     DSN  02250
      IZ=MZ(I)                                                          DSN  02251
      IX=IABS(MZZ(IZ))                                                  DSN  02252
      TI=0.                                                             DSN  02253
      DO 390 M=1,MM                                                     DSN  02254
      MA=MR(M)                                                          DSN  02255
  390 TI=TI+(AFR(I+1,M)+AFR(I,M))*(AFA(I+1,MA)+AFA(I,MA))*W(M)          DSN  02256
  400 GZ(IG,IZ)=GZ(IG,IZ)+TI*C(IMT,IDLE,IX)*DF(I)*.25*V(I)              DSN  02257
  410 CONTINUE                                                          DSN  02258
      WRITE (9,800)                                                     DSN  02259
      ASSIGN 420 TO L                                                   DSN  02260
      GO TO 500                                                         DSN  02261
  420 REWIND 2                                                          DSN  02262
      DO 440 IG=1,IGP                                                   DSN  02263
      DO 430 IZ=1,IZP                                                   DSN  02264
  430 GZ(IG,IZ)=0.                                                      DSN  02265
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2274    AA0     CONTINUE                                                        DSN     02246
2280            DO A90 IG=1,IGM                                                 DSN     02267
2281            READ (2)AFR                                                     DSN     02268
2282            REWIND 3                                                        DSN     02269
2283            IMF=MIN0(IMM,IMS+IGM-IG)                                        DSN     02270
2284            IDLE=IG-1                                                       DSN     02271
2285            IF (IDLE.EQ.0) GO TO 460                                        DSN     02272
2286            DO 450 I=1,TIDF                                                 DSN     02273
2287    A50     READ (3)AFA                                                     DSN     0227A
2288    A60     DO 480 IM=IMS,IMF                                               DSN     02275
2289            READ (3)AFA                                                     DSN     02276
2290            DO 480 I=1,IM                                                   DSN     02277
2291            IZ=MZ(I)                                                        DSN     02278
2292            IX=IABS(MZZ(IZ))                                                DSN     02279
2293            IDLE=IG+IM-IMS                                                  DSN     02280
2294            IF (ITH.EQ.1) IDLE=IGP-IG                                       DSN     02281
2295            IF (C(IH+IDLE+IX),EQ.0.) GO TO A80                              DSN     02282
2296            T1=0.                                                           DSN     02283
2297            T2=0.                                                           DSN     02284
2298            DO A70 J=1,MM                                                   DSN     02285
2299            T1=T1+AFN(I+(J+M)+AFR(I+M))*W(M)                                DSN     02286
2300    A70     T2=T2+AFA(I+J+M)+AFA(I+M))*W(M)                                 DSN     02287
2301            GZ(IG+IZ)=GZ(IG+IZ)+.25*T1*T2*DF(I)*V(I)*C(IM+IDLE+IX)          DSN     02288
2302    A80     CONTINUE                                                        DSN     02289
2303    A90     CONTINUE                                                        DSN     02290
2304            WRITE (9)MIG)                                                   DSN     02291
2305            ASSIGN 570 TO L                                                 DSN     02292
2306    500     DO 520 IG=1,IGM                                                 DSN     02293
2307            DO 510 IZ=1,IZM                                                 DSN     0229A
2308    510     GZ(IG+IZP)=GZ(IG+IZR)+GZ(IG+IZ)                                 DSN     02295
2309    520     CONTINUE                                                        DSN     02296
2310            DO 540 IZ=1,IZP                                                 DSN     02297
2311            DO 530 IG=1,IGM                                                 DSN     02298
2312    530     GZ(IGP+IZ)=GZ(IGP+IZ)+GZ(IG+IZ)                                 DSN     02299
2313    540     CONTINUE                                                        DSN     02300
2314            KA=1                                                            DSN     02301
2315            KB=M                                                            DSN     02302
2316    550     KC=MIN0(KM+IZP)                                                 DSN     02303
2317            WRITE (9+770)K+K=KA+KC)                                         DSN     02304
2318            DO 560 J=1,IGP                                                  DSN     02305
2319    560     WRITE (9+790)J+(GZ(J+IZ)+IZ=KA+KC)                              DSN     02306
2320            KA=KA+M                                                         DSN     02307
2321            KM=KB+M                                                         DSN     02308
2322            IF (KA.LE.IZP) GO TO 550                                        DSN     02309
2323            GO TO L+ (80,230,3A0,420,570)                                   DSN     02310
2324    570     DO 540 I=1,IM                                                   DSN     02311
2325            F(I)=0.                                                         DSN     02312
2326            TF(I)=0.                                                        DSN     02313
2327            TS(I)=0.                                                        DSN     0231A
2328    580     TT(I)=0.                                                        DSN     02315
2329            REWIND 3                                                        DSN     02316
2330            DO 630 IGA=1,IGM                                                DSN     02317
2331            READ (3)AFA                                                     DSN     02318
2332            REWIND 2                                                        DSN     02319
2333            DO 620 IGR=1,IGA                                                DSN     02320
2334            READ (2)AFR                                                     DSN     02321
2335            IM=IMS+IGA-IGR                                                  DSN     02322
2336            IF (IM.GT.IMM) GO TO 620                                        DSN     02323
2337            IDLE=IGA                                                        DSN     02324
2338            IF (ITH.EQ.1) IDLE=IGP-IGR                                      DSN     02325
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      DO 610 I=1,IM                                                  DSN  02326
      T1=0.                                                          DSN  02327
      T2=0.                                                          DSN  02328
      DO 590 M=1,MM                                                  DSN  02329
      T1=T1+W(M)*(AFR(I,M)+AFR(I+1,M))                               DSN  02330
  590 T2=T2+W(M)*(AFA(I,M)+AFA(I+1,M))                               DSN  02331
      T1=.5*T1                                                       DSN  02332
      T2=.5*T2                                                       DSN  02333
      IZ=MZ(I)                                                       DSN  02334
      IX=IABS(MZZ(IZ))                                               DSN  02335
      TS(I)=TS(I)+T1+T2*C(IH,IDLE,IX)                                DSN  02336
      IF (IGR.LT.IGA) GO TO 610                                      DSN  02337
      F(I)=F(I)+T1*C(IHT-1,IDLE,IX)                                  DSN  02338
      TF(I)=TF(I)+T2*XKI(IDLE)                                       DSN  02339
      T1=0.                                                          DSN  02340
      DO 600 M=1,MM                                                  DSN  02341
      MA=MR(M)                                                       DSN  02342
  600 T1=T1+W(M)*(AFR(I,M)+AFR(I+1,M))*(AFA(I,MA)+AFA(I+1,MA))       DSN  02343
      TT(I)=TT(I)+.25*C(IH,IDLE,IX)*T1                               DSN  02344
  610 CONTINUE                                                       DSN  02345
  620 CONTINUE                                                       DSN  02346
  630 CONTINUE                                                       DSN  02347
      OK=1.                                                          DSN  02348
      IF (IABS(IEVT).EQ.1) OK=1./A(1)                                DSN  02349
      WRITE (9,640)                                                  DSN  02350
  640 FORMAT (1H0///40H  I, IZ, IX, R, RA, VOL, MAS, WV, WM, WT,/)   DSN  02351
      VOL=0.                                                         DSN  02352
      XM=0.                                                          DSN  02353
      WT=0.                                                          DSN  02354
      TV=0.                                                          DSN  02355
      TM=0.                                                          DSN  02356
      K=IA(5)                                                        DSN  02357
      J=IA(5)                                                        DSN  02358
      DO 650 I=1,IM                                                  DSN  02359
      VOL=VOL+TV                                                     DSN  02360
      TV=.5*V(I)                                                     DSN  02361
      VOL=VOL+TV                                                     DSN  02362
      XM=XM+TM                                                       DSN  02363
      TM=TV*RF(I)                                                    DSN  02364
      XM=XM+TM                                                       DSN  02365
      T1=(OK*F(I)*TF(I)+TS(I)-TT(I))/TNN                             DSN  02366
      T2=T1*DF(I)                                                    DSN  02367
      WT=WT+T2*V(I)                                                  DSN  02368
      RA=(.5*(A(K)**J+A(K+1)**J))**(1./FLOAT(J))                     DSN  02369
      IZ=MZ(I)                                                       DSN  02370
      IX=MZZ(IZ)                                                     DSN  02371
      WRITE (9,660)I,IZ,IX,A(K),RA,VOL,XM,T2,T1,WT                   DSN  02372
  650 K=K+1                                                          DSN  02373
  660 FORMAT (3I4,1P7E13.5)                                          DSN  02374
      DO 740 N=1,MI                                                  DSN  02375
      RE=IND 1                                                       DSN  02376
      DO 670 I=1,IM                                                  DSN  02377
      F(I)=0.                                                        DSN  02378
      TF(I)=0.                                                       DSN  02379
      TS(I)=0.                                                       DSN  02380
  670 TT(I)=0.                                                       DSN  02381
      DO 720 IGA=1,IGM                                               DSN  02382
      READ (3)AFA                                                    DSN  02383
      RE=IND 2                                                       DSN  02384
      DO 710 IDR=1,IGA                                               DSN  02385
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      READ (2)AFR                                                       DSN  02386
      IM=IM5+IGA-IGR                                                    DSN  02387
      IF (IM.GT.IMM) GO TO 710                                          DSN  02388
      IDLE=IGA                                                          DSN  02389
      IF (IIM.EQ.1) IDLE=IGP-IGR                                        DSN  02390
      DO 700 I=1,IM                                                     DSN  02391
      T1=0.                                                             DSN  02392
      T2=0.                                                             DSN  02393
      DO 680 M=1,MM                                                     DSN  02394
      T1=T1+W(M)*(AFR(I,M)+AFR(I+1,M))                                  DSN  02395
  680 T2=T2+W(M)*(AFA(I,M)+AFA(I+1,M))                                  DSN  02396
      T1=.5*T1                                                          DSN  02397
      T2=.5*T2                                                          DSN  02398
      TS(I)=TS(I)+T1*T2*C(IH,IDLE,K)                                    DSN  02399
      IF (IGR.LT.IGA) GO TO 700                                         DSN  02400
      F(I)=F(I)+T1*C(IHT-1,IDLE,K)                                      DSN  02401
      TF(I)=TF(I)+T2*XKI(IDLE)                                          DSN  02402
      T1=0.                                                             DSN  02403
      DO 690 M=1,MM                                                     DSN  02404
      MA=MR(M)                                                          DSN  02405
  690 T1=T1+W(M)*(AFR(I,M)+AFR(I+1,M))*(AFA(I,MA)+AFA(I+1,MA))          DSN  02406
      TT(I)=TT(I)+.25*C(IHT,IDLE,K)*T1                                  DSN  02407
  700 CONTINUE                                                          DSN  02408
  710 CONTINUE                                                          DSN  02409
  720 CONTINUE                                                          DSN  02410
      DO 730 I=1,IM                                                     DSN  02411
  730 F(I)=(CK*F(I)*TF(I)+(S(I)-TT(I)))/TNN                             DSN  02412
      WRITE (9,750)K,(F(I),I=1,IM)                                      DSN  02413
  740 CONTINUE                                                          DSN  02414
  750 FORMAT (10H0 MATERIAL,I4,/(1P10E12.5))                            DSN  02415
      RETURN                                                            DSN  02416
  760 FORMAT (1H0///36H  N* N/V INTEGRAL BY GROUP AND ZONE )            DSN  02417
  770 FORMAT (1H0,5X,8(2X,4HZONE,I3,4X))                                DSN  02418
  780 FORMAT (1H0///34H  FISSION INTEGRAL BY GROUP AND ZONE)            DSN  02419
  790 FORMAT (I4,1P8E13.5)                                              DSN  02420
  800 FORMAT (1H0///38H  TRANSPORT INTEGRAL BY GROUP AND ZONE)          DSN  02421
  810 FORMAT (1H0///44H  N(G)*C(G,GP)*N*(GP) INTEGRAL BY G AND ZONE)    DSN  02422
      END                                                               DSN  02423
      SUBROUTINE PASS2 (V,C,Q,F,XN,DF,XNO,MA,MZ,IMM,IGM,IM,IP,IGP,XKE,FG DSN  02424
     1,NGI                                                              DSN  02425
      COMMON /ALPHA/ LOAFR,TAUA,SCATI,SCATTP,BAL,XLAMAX,XLAMIN,EVMAX,EVM ALPHA 00002
     1IN,IPHE,FSUM,INEG,KK                                              ALPHA 00003
C                                                                       ALPHA 00004
      COMMON IA(1000),A(10000)                                          DSN  02427
      DIMENSION C(IMM,IGM,1), Q(IM,1), XN(IM,1), XNO(IP,1), V(1), F(1)  DSN  02428
     1DF(1), MA(1), MZ(1), CHI(4), XKF(1), FG(1), QG(1)                 DSN  02429
      EQUIVALENCE (IA(3),ISCT), (IA(8),IZM), (IA(13),IHT), (IA(32),LC)  DSN  02430
     1(IA(33),ICC), (IA(39),TCVT), (IA(41),MM), (A(1),EV), (A(3),EPS), ( DSN  02431
     2A(11),XLAL), (A(16),XLA), (A(17),EPG)) (IA(27),ICM)               DSN  02432
      EQUIVALENCE (IA(21),IOM)                                          DSN  02433
C                                                                       DSN  02434
      COMPLEX ALA,RLA,TLA                                               DSN  02435
      DIMENSION ALA(5), RLA(5), TLA(5), SLA(14)                         DSN  02436
C     PHASE A                                                           DSN  02437
      NM=IA(106)+IGM                                                    DSN  02438
      H=0.0                                                             DSN  02439
      ICT=0                                                             DSN  02440
      IF (IPPE.GT.1) GO TO 50                                           DSN  02441
      IF (EV.LT.1.0) GO TO 230                                          DSN  02442
      FTOP=0.0                                                          DSN  02443
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```
      DO 10 I=1,IM
   10 FTMP=FTMP+F(I)*V(I)
      FAC=EV/FTMP
      DO 30 I=1,IM
      DO 20 J=1,IGM
   20 XN(I,J)=XN(I,J)/FTMP
   30 F(I)=FAC*F(I)
      XKT = 0
      DO 34 I = 1, IGM
   34 XKT = XKT + XKE (I)
      XKT = 1.0 / XKT
      DO 36 I = 1, IGM
   36 XKE (I) = XKE (I) * XKT
      IPRE=2
      IUM=1
      ICVT=0
C
      EPSX=EPS
      XLA=1.0
      FSUM=FTMP/EV
      PRINT 40
   40 FORMAT ('1 IC          XLA              EV              F-OLD
     1F-NEW            H               Q              CHI              REAL
     2 IMAG'/)
      GO TO 80
C
C     FIND SCALING PARAMETER
C
C     COMPUTE NEW F (I), EV, FSUM - TEST FOR CONVERGENCE - SET ICVT
   50 CONTINUE
      FTMP=0
      DO 70 I=1,IM
      FI=0.0
      DO 60 IG=1,IGM
      FI=FI+XKE(IG)*XN(I,IG)
   60 CONTINUE
      F(I)=FI
      FTMP=FTMP+FI*V(I)
   70 CONTINUE
C
C     TEST FOR CONVERGENCE
   80 CONTINUE
      EV=FTMP/FSUM
      EVT=ABS(EV-1.0)
      IF (EVT.LT.EPS) ICVT=1
C     COMPUTE CHI (K) FOR K = 2, 5
      KSN=-1
      DO 110 K=2,5
      KK=K-1
      KSN=KSN*(-1)
      CHIK=0.0
      DO 100 I=1,IM
      L=MA(I)
      L=IABS(MZ(L))
      FF=F(I)**K
      VI=V(I)
      DFI=DF(I)
      DO 90 IG=1,IGM
   90 CHIK=CHIK+(KSN*VI*DFI*FF*C(KK,IG,L))
  100 CONTINUE
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      CHI(KK)=CHIK                                           DSN   02504
  110 CONTINUE                                               DSN   02505
C                                                            DSN   02506
C     COMPUTE B FROM EV,F(I), Q(I,G), V (I), C (F,G,L)       DSN   02507
      B1=0                                                   DSN   02508
      B2=0                                                   DSN   02509
      IM=IMT-1                                               DSN   02510
      DO 130 I=1,IM                                          DSN   02511
      L=IIA(I)                                               DSN   02512
      L=IABS(NZ(L))                                          DSN   02513
      VI=V(I)                                                DSN   02514
      DFI=DF(I)                                              DSN   02515
      FF=F(I)                                                DSN   02516
      DO 120 IG=1,IGM                                        DSN   02517
      B1=B1+VI*FF*DFI*C(IM,IG,L)                             DSN   02518
      KSN = 1                                                DSN   02519
      QIG = 0.0                                              DSN   02520
      FI = FF                                                DSN   02521
      DO 115 K = 1, A                                        DSN   02522
      KSN = -1 * KSN                                         DSN   02523
      FI = FI * FF                                           DSN   02524
      QIG = QIG + KSN * FI * C (K,IG,L) * DFI                DSN   02525
  115 CONTINUE                                               DSN   02526
      B2 = B2 + VI * QIG                                     DSN   02527
  120 CONTINUE                                               DSN   02528
  130 CONTINUE                                               DSN   02529
      B=(1.0/EV-1.0)*B1+B2                                   DSN   02530
      LE=1                                                   DSN   02531
      M=5                                                    DSN   02532
      N=M-1                                                  DSN   02533
      ALA(M)=B                                               DSN   02534
      DO 140 J=1,N                                           DSN   02535
      I=M-J                                                  DSN   02536
      ALA(I)=CHI(J)                                          DSN   02537
  140 CONTINUE                                               DSN   02538
      CALL NEWPOL (N,ALA,RLA,TLA,LE,SLA)                     DSN   02539
      IF (LE.EQ.0) GO TO 250                                 DSN   02540
      EPT=1.0E-10                                            DSN   02541
      DO 150 I=1,N                                           DSN   02542
      J=I+N                                                  DSN   02543
      SLA(I)=AIMAG(RLA(I))                                   DSN   02544
      SLA(J)=REAL(RLA(I))                                    DSN   02545
      DEL=ABS(SLA(I)/SLA(J))                                 DSN   02546
      IF (SLA(I).NE.0.0.AND.DEL.GT.EPT) SLA(J)=0.0           DSN   02547
      SLA(J)=AMAX1(SLA(J),0.0)                               DSN   02548
      SLA(I)=ABS(SLA(J)-1.0)                                 DSN   02549
      IF (SLA(J).LT.1.0) SLA(I)=SLA(I)/(SLA(J)+.000001)      DSN   02550
  150 CONTINUE                                               DSN   02551
      DEL=SLA(1)                                             DSN   02552
      XLA=SLA(M)                                             DSN   02553
      DO 160 I=1,N                                           DSN   02554
      J=I+N                                                  DSN   02555
      IF (SLA(I).GE.DEL) GO TO 160                           DSN   02556
      XLA=SLA(J)                                             DSN   02557
      DEL=SLA(I)                                             DSN   02558
  160 CONTINUE                                               DSN   02559
C                                                            DSN   02560
C     SCALE F (I),XN(I,G),(XND(I,G,M) - IF(ISCT.GT.0))       DSN   02561
      CALL SCALE (F,XLA,IM)                                  DSN   02562
      II=IM*IGM                                              DSN   02563
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2579          CALL SCALE (XN,XLA,IT)                                          DSN     02560
2580          IT=IP*MM                                                        DSN     02565
2581          IF ((SCT.GT.0) CALL SCALE (XNN,XLA,IT)                          DSN     02566
2582          PRINT 170, ICC,XLA,EV,FSUM,FTMP,M,M2,(CMI(I),RLA(II,I=1,A)      DSN     02567
2583    170   FORMAT (15,1P6E15.6,1P3E12.4,/3(95X,1P5E12.4,/))                DSN     02568
2584    C                                                                     DSN     02569
2585    C     COMPUTE SOURCE TERM Q (I,G)                                     DSN     02570
2586          FGG=0.0                                                         DSN     02571
2587          QGG=0.0                                                         DSN     02572
2588          IM=IM1-1                                                        DSN     02573
2589          DO 180 I=1,IGM                                                  DSN     02574
2590          FG(I)=0.0                                                       DSN     02575
2591    180   QG(I)=0.0                                                       DSN     02576
2592          FSUM=0.0                                                        DSN     02577
2593          DO 210 I=1,IM                                                   DSN     02578
2594          DFI=DF(I)                                                       DSN     02579
2595          FIX=F(I)                                                        DSN     02580
2596          L=MA(I)                                                         DSN     02581
2597          L=IABS(MZ(L))                                                   DSN     02582
2598          VI=V(I)                                                         DSN     02583
2599          FGT=VI*FIX*DFI                                                  DSN     02584
2600          FSUM=FSUM+VI*FIX                                                DSN     02585
2601          DO 200 IG=1,IGM                                                 DSN     02586
2602          KSN=1                                                           DSN     02587
2603          QIG=0.0                                                         DSN     02588
2604          FI=FIX                                                          DSN     02589
2605          DO 190 K=2,S                                                    DSN     02590
2606          KK=K-1                                                          DSN     02591
2607          KSN=-1*KSN                                                      DSN     02592
2608          FI=FI*FIX                                                       DSN     02593
2609          QIG=QIG+KSN*FI*C(KK,IG,L)*DFI                                   DSN     02594
2610    190   CONTINUE                                                        DSN     02595
2611          Q(I,IG)=QIG                                                     DSN     02596
2612          QG(IG)=QG(IG)+QIG*VI                                            DSN     02597
2613          QGG=QGG+QIG*VI                                                  DSN     02598
2614          FG(IG)=FG(IG)+FGT*C(IM,IG,L)                                    DSN     02599
2615          FGG=FGG+FGT*C(IM,IG,L)                                          DSN     02600
2616    200   CONTINUE                                                        DSN     02601
2617    210   CONTINUE                                                        DSN     02602
2618          IGM=IGM+1                                                       DSN     02603
2619          QG(IGP)=QGG                                                     DSN     02604
2620          FG(IGP)=FGG                                                     DSN     02605
2621          IF (ICC.GE.ICM) GO TO 220                                       DSN     02606
2622          EPS=(QGG+FGG)*4*EPSI/(IGM+3)                                    DSN     02607
2623          XLT=ABS(XLA-1.0)                                                DSN     02608
2624          IF (ICVT.GT.0.AND.XLT.LT.EPS) GO TO 220                         DSN     02609
2625          RETURN                                                          DSN     02610
2626    C                                                                     DSN     02611
2627    C     CONVERGED - FINAL PRINT - RETURN                                DSN     02612
2628    220   CONTINUE                                                        DSN     02613
2629          IPRE=3                                                          DSN     02614
2630          RETURN                                                          DSN     02615
2631    C                                                                     DSN     02616
2632    C     EV .LT. 1.0                                                     DSN     02617
2633    230   CONTINUE                                                        DSN     02618
2634          WRITE (6,240)EV                                                 DSN     02619
2635    240   FORMAT (1H0    ' ' EIGENVALUE IS LESS THAN 1.0 - NO PRE-INIT.CALC. D DSN     02620
2636         1ONE - EV = ',1PE20.6)                                           DSN     02621
2637          IPRE=3                                                          DSN     02622
2638          RETURN                                                          DSN     02623
```

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2639   250   CONTINUE                                                          DSN    02624
2640         PRINT 260, LE                                                     DSN    02625
2641   260   FORMAT (*0    FROM NEWPOL, (F= *16*   NO CONVERGENCE OR A0=0*I    DSN    02626
2642         RETURN                                                            DSN    02627
2643         END                                                               DSN    02628
2644         SUBROUTINE NEWPOL (IN,A,R,T,LE,S)                                 DSN    02629
2645         DIMENSION A(1), AN(2), BN(2), CN(2), S(1)                         DSN    02630
2646         COMPLEX R(1),T(1),PN(2),Z(2),ON,DU1A,CZ                           DSN    02631
2647         EQUIVALENCE (AN,PN), (BN,ON), (CN,Z)                              DSN    02632
2648         N=IN                                                              DSN    02633
2649   10    NI=N+1                                                            DSN    02634
2650         IF (REAL(A(NI)),NE,0.,OR,AIMAG(A(NI)),NE,0.) GO TO 30             DSN    02635
2651         R(NI)=0.                                                          DSN    02636
2652         S(NI)=0.                                                          DSN    02637
2653         N=N-1                                                             DSN    02638
2654         IF (N,NE,1) GO TO 10                                              DSN    02639
2655   20    S(1)=0.                                                           DSN    02640
2656         R(1)=-A(2)/A(1)                                                   DSN    02641
2657         RETURN                                                            DSN    02642
2658   30    IF (N,EQ,1) GO TO 20                                              DSN    02643
2659         IF (REAL(A(1)),EQ,0.,AND,AIMAG(A(1)),EQ,0.) GO TO 160             DSN    02644
2660         NP=NI+1                                                           DSN    02645
2661         NI=2*N                                                            DSN    02646
2662         NI=0                                                              DSN    02647
2663         IF (LE,GT,0) GO TO 50                                             DSN    02648
2664         DO 40 I=1,N                                                       DSN    02649
2665   40    T(I)=R(I)                                                         DSN    02650
2666         GO TO 100                                                         DSN    02651
2667   50    CZ=-A(2)/A(1)/N                                                   DSN    02652
2668         CALL SCPTACD (N,N,A,CZ,R,T)                                       DSN    02653
2669         X=0.                                                              DSN    02654
2670         DO 60 I=1,N                                                       DSN    02655
2671         V=CABS(R(I))                                                      DSN    02656
2672         T(NP-I)=-V                                                        DSN    02657
2673   60    IF (V,GT,X) X=V                                                   DSN    02658
2674         T(I)=Z=CABS(R(N))                                                 DSN    02659
2675         Z=X/CN                                                            DSN    02660
2676         CALL SCPTACD (N,0,T,Z,PN,DN)                                      DSN    02661
2677         IF (AN,LE,0.) GO TO 80                                            DSN    02662
2678         Z(2)=1.1*Z(1)                                                     DSN    02663
2679         I=2                                                               DSN    02664
2680   70    CALL SCPTACD (N,0,T,Z(I),PN(I),DN)                                DSN    02665
2681         I=I                                                               DSN    02666
2682         X=CN(3)-CN(1)                                                     DSN    02667
2683         IF (ABS(X),LE,,01*CN) GO TO 80                                    DSN    02668
2684         X=CN(3)-AN(3)*X/(AN(1)-AN(3))                                     DSN    02669
2685         CN(3)=CN(1)                                                       DSN    02670
2686         CN(1)=X                                                           DSN    02671
2687         AN(3)=AN(1)                                                       DSN    02672
2688         GO TO 70                                                          DSN    02673
2689   80    U=CN                                                              DSN    02674
2690         V=1.E-14*CABS(CZ)                                                 DSN    02675
2691         IF (U,LT,V) U=V                                                   DSN    02676
2692         Y=1.570R/N                                                        DSN    02677
2693         DO 90 I=1,N                                                       DSN    02678
2694         X=(I-1)/N*6.2832*Y                                                DSN    02679
2695         R(I)=1.                                                           DSN    02680
2696         T(I)=U*(CMPLX(COS(X),SIN(X)))*CZ                                  DSN    02681
2697   90    CONTINUE                                                          DSN    02682
2698   100   X=1.                                                              DSN    02683
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2699            NX=0                                                    DSN     02684
2700            DO 140 NR=1,N                                           DSN     02685
2701            IF (R(NR).EQ.0.) GO TO 110                              DSN     02686
2702            CALL SCPTACD (N,0.,A,T(NR),PN,ON)                       DSN     02687
2703            Y=ABS(AN(1))+ABS(AN(2))                                 DSN     02688
2704            V=ABS(RN(1))+ABS(ON(2))                                 DSN     02689
2705            IF (Y.GT.V) GO TO 120                                   DSN     02690
2706    110     PN=0.                                                   DSN     02691
2707            NX=NX+1                                                 DSN     02692
2708            GO TO 140                                               DSN     02693
2709    120     CONTINUE                                                DSN     02694
2710            DN=AN(1)                                                DSN     02695
2711            Z=T(NR)                                                 DSN     02696
2712            DO 130 I=1,N                                            DSN     02697
2713            IF (I.EQ.NR) GO TO 130                                  DSN     02698
2714            DN=DN*(Z-T(I))                                          DSN     02699
2715    130     CONTINUE                                                DSN     02700
2716            PN=PN/DN                                                DSN     02701
2717    140     R(NR)=PN                                                DSN     02702
2718            IF (NX.EQ.N) GO TO 170                                  DSN     02703
2719            DO 150 I=1,N                                            DSN     02704
2720    150     T(I)=T(I)-R(I)                                          DSN     02705
2721            NI=NI+1                                                 DSN     02706
2722            IF (NI.LE.MT) GO TO 100                                 DSN     02707
2723    160     LE=2                                                    DSN     02708
2724            RETURN                                                  DSN     02709
2725    170     DO 180 I=1,N                                            DSN     02710
2726    180     R(I)=T(I)                                               DSN     02711
2727            IF (IABS(LE).GT.1) GO TO 220                            DSN     02712
2728            DO 210 NR=1,N                                           DSN     02713
2729            CALL SCPTACD (N,0.,A,R(NR),S(NI),T)                     DSN     02714
2730            Z=T                                                     DSN     02715
2731            RN(I)=ABS(S(NI))*CN(I)                                  DSN     02716
2732            RN(2)=ABS(S(NI+1))*CN(2)                                DSN     02717
2733            X=CABS(RN)*N                                            DSN     02718
2734            U=0.                                                    DSN     02719
2735            IF (A.EQ.0.) GO TO 200                                  DSN     02720
2736            DO 190 I=2,NI                                           DSN     02721
2737            NI=N+1-I                                                DSN     02722
2738            Z=CMPLX(ABS(S(NI-1)),ABS(S(NI)))                        DSN     02723
2739            Z=(Z-T(I))/X                                            DSN     02724
2740            IF (CN(1).LE.0.) CN(1)=0.                               DSN     02725
2741            IF (CN(2).LE.0.) CN(2)=0.                               DSN     02726
2742            W=CABS(Z)                                               DSN     02727
2743            IF (W.EQ.0.) GO TO 190                                  DSN     02728
2744            W=EXP(ALOG(W)/(I-1))                                    DSN     02729
2745            IF (W.GT.U) U=W                                         DSN     02730
2746    190     X=X*(N-I)/I                                             DSN     02731
2747    200     CONTINUE                                                DSN     02732
2748            S(NM)=0.                                                DSN     02733
2749            IF (U.EQ.0.) GO TO 210                                  DSN     02734
2750            S(NR)=1./U                                              DSN     02735
2751    210     CONTINUE                                                DSN     02736
2752    220     IF (N.EQ.IN) RETURN                                     DSN     02737
2753            DO 230 I=NI,IN                                          DSN     02738
2754            R(I)=0.                                                 DSN     02739
2755    230     S(I)=0.                                                 DSN     02740
2756            RETURN                                                  DSN     02741
2757            END                                                     DSN     02742
2758            SUBROUTINE SCPTACD (N,M,A,Z,C,E)                        DSN     02743
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      DIMENSION EM1(5), EM2(5), A(1), Z(1), C(1), E(1)                  DSN   02744
      DATA EM1/50H SCPTACO CALLED WITH N=                      /        DSN   02745
      DATA EM2/50H SCPTACO CALLED WITH M=                      /        DSN   02746
      DATA DEL1,DEL2,DEL3/16+140000000000000008,16A2600000000000000024,17 DSN   02747
     12H400000000000000108/                                             DSN   02748
      IF (N.LT.0.OR.N.GT.1000.OR.M.LT.0.OR.M.GT.N) GO TO 50            DSN   02749
      I=M+M+1                                                          DSN   02750
      DO 10 J=1,I,2                                                    DSN   02751
      C(J)=A(1)                                                        DSN   02752
      E(J)=0.0                                                         DSN   02753
      C(J+1)=A(2)                                                      DSN   02754
   10 E(J+1)=0.0                                                       DSN   02755
      X=Z(1)                                                           DSN   02756
      Y=Z(2)                                                           DSN   02757
      AX=ABS(X)                                                        DSN   02758
      AY=ABS(Y)                                                        DSN   02759
      IF (N.EQ.0) GO TO 40                                             DSN   02760
      DO 30 K=1,N                                                      DSN   02761
      JMAX=MIN0(2*(N-K)+1,2*M+1)                                       DSN   02762
      T1=C(1)                                                          DSN   02763
      T2=C(2)                                                          DSN   02764
      V1=E(1)                                                          DSN   02765
      V2=E(2)                                                          DSN   02766
      C(1)=X*T1-Y*T2+A(2*K+1)                                          DSN   02767
      C(2)=Y*T1+X*T2+A(2*K+2)                                          DSN   02768
      E(1)=DEL3*(AX*V1+AY*V2+DEL1*ABS(A(2*K+1))+DEL2*(AX*ABS(T1)+AY*ABS( DSN   02769
     1T2)))                                                            DSN   02770
      E(2)=DEL3*((AY*V1+AX*V2)+DEL1*ABS(A(2*K+2))+DEL2*(AY*ABS(T1)+AX*AB DSN   02771
     1S(T2)))                                                          DSN   02772
      IF (JMAX.LT.3) GO TO 30                                          DSN   02773
      DO 20 J=3,JMAX,2                                                 DSN   02774
      T1=C(J)                                                          DSN   02775
      T2=C(J+1)                                                        DSN   02776
      V1=E(J)                                                          DSN   02777
      V2=E(J+1)                                                        DSN   02778
      C(J)=X*T1-Y*T2+C(J-2)                                            DSN   02779
      C(J+1)=Y*T1+X*T2+C(J-1)                                          DSN   02780
      E(J)=DEL3*((AX*V1+AY*V2)+(E(J-2)+DEL1*ABS(C(J-2))))+DEL2*(AX*ABS( DSN   02781
     1T1)+AY*ABS(T2)))                                                 DSN   02782
      E(J+1)=DEL3*(((AY*V1+AX*V2)+(E(J-1)+DEL1*ABS(C(J-1)))))+DEL2*(AY*AB DSN   02783
     1S(T1)+AX*ABS(T2)))                                               DSN   02784
   20 CONTINUE                                                         DSN   02785
   30 CONTINUE                                                         DSN   02786
   40 RETURN                                                           DSN   02787
   50 CALL LABRT (1,EM1,N)                                             DSN   02788
      CALL LABRT (A)                                                   DSN   02789
      CALL LABRT (1,EM2,M)                                             DSN   02790
      END                                                              DSN   02791
      SUBROUTINE SCALE (A,B,I)                                         DSN   02792
      DIMENSION A(1)                                                   DSN   02793
      DO 10 K=1,I                                                      DSN   02794
      A(K)=B*A(K)                                                      DSN   02795
   10 CONTINUE                                                         DSN   02796
      RETURN                                                           DSN   02797
      END                                                              DSN   02798
      SUBROUTINE FINPR (XN,X1,T3,T5,C,IGM,IM,NM,ID3,IZP,IMM,MT,XNB,IGP,M DSN   02799
     1E,RA,RAV,V,F,IP,KM3,KM4,JJ3,JJ4,MZ,IZM,XMU,MS,MF,MG,DF,VE,Q,SPI  DSN   02800
C                                                                      DSN   02801
C     FINAL PRINTS                                                     DSN   02802
      COMMON /ALPHA/ LOAFU,TABA,SCATT,SCATTP,BAL,XLAMAX,XLAMIN,EVMAX,EVM ALPHA 00002
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        1(N),IPRE,FSUM,INEG,KK                                          ALPHA   00003
C                                                                       ALPHA   00004
        DIMENSION XN(IM,IGM), XJ(IGM,IM,NM), T3(ID3,IZP), TS(ID3,IM), C(IM DSN  02804
       1M,IGM,MT), XMM(IGP), ME(IM), RA(IP), RAV(IP), V(IP), F(IM), KM3(JJ DSN  02805
       24), KM4(JJ4), MZ(IZM), XMD(MS), MF(MS), MG(MS), OF(IM), VE(I)   DSN     02806
        DIMENSION SP (IM,I), D (IM,I)                                   DSN     02807
        COMMON IA(1000),A(10000)                                        DSN     02808
        EQUIVALENCE (IA(1),IO), (IA(33),ICC), (IA(32),LC), (JN,IA(58)), (A DSN  02809
       1(3),EPS), (EV,A(1)), (XLA,A(6)), (IG,IA(43)), (IA(31),ISCT), (IO4, DSN  02810
       2IA(56)), (EO,A(32)), (ITM,IA(2))                                DSN     02811
        EQUIVALENCE (IA(13),IMT)                                        DSN     02812
10      FORMAT (1H1,I5,2X,IM,4X,I8,4X,4F(5,8//)                         DSN     02813
        WRITE (9,20)(I,ME(I),RA(I),RAV(I),F(I),V(I),I=1,IP)             DSN     02814
20      FORMAT (1H0,5X,4HZONE,5X,11HFINAL RADII,3X,13HAVERAGE RADII,8X,8HF DSN  02815
       1ISSIONS,10X,6HVOLUME,/,(2I5,4E16.7))                            DSN     02816
        WRITE (9,30)                                                    DSN     02817
30      FORMAT (30H1FLUX BY GROUP AND SPACE POINT///)                   DSN     02818
        MA=1                                                            DSN     02819
        MB=7                                                            DSN     02820
40      MC=MIN0(MB,IGM)                                                 DSN     02821
        WRITE (9,60)(I,I=MA,MC)                                         DSN     02822
        WRITE (9,70)                                                    DSN     02823
        DO 50 I=1,IM                                                    DSN     02824
50      WRITE (9,80)I,ME(I),RAV(I),(XN(I,J),J=MA,MC)                    DSN     02825
        MA=MA+7                                                         DSN     02826
        MB=MB+7                                                         DSN     02827
        IF (MA.LE.IGM) GO TO 40                                         DSN     02828
60      FORMAT (1H0,4X,17H ZONE  AVG RADIUS,7(3X,5HGROUP,I3,3X))        DSN     02829
70      FORMAT (1H0)                                                    DSN     02830
80      FORMAT (2I5,1PE12.5,1P7E18.5)                                   DSN     02831
        IF (ISCT.LT.1) GO TO 130                                        DSN     02832
        DO 110 N=1,NM                                                   DSN     02833
        WRITE (9,120)N                                                  DSN     02834
        MA=1                                                            DSN     02835
        MB=7                                                            DSN     02836
90      MC=MIN0(MB,IGM)                                                 DSN     02837
        WRITE (9,60)(I,I=MA,MC)                                         DSN     02838
        WRITE (9,70)                                                    DSN     02839
        DO 100 I=1,IM                                                   DSN     02840
100     WRITE (9,80)I,ME(I),RAV(I),(XJ(J,I,N),J=MA,MC)                  DSN     02841
        MA=MA+7                                                         DSN     02842
        MB=MB+7                                                         DSN     02843
        IF (MA.LE.IGM) GO TO 90                                         DSN     02844
110     CONTINUE                                                        DSN     02845
120     FORMAT (15H1CURRENT NUMBER,I3,25H BY GROUP AND SPACE POINT///)  DSN     02846
C       DUMP FLUXES                                                     DSN     02847
130     CALL SSWTCH (5,ISW5)                                            DSN     02848
        IF (ISW5.EQ.1) PUNCH 140, ID,IG                                 DSN     02849
140     FORMAT (18H FLUX DUMP PROBLEM,I8,4X,I6,7H FLUXES,29X,8H ID CARD) DSN    02850
        IF (ITM.EQ.0) GO TO 180                                         DSN     02851
        ASSIGN 180 TO L                                                 DSN     02852
150     KB=IGM/2                                                        DSN     02853
        DO 170 KA=1,KB                                                  DSN     02854
        KC=IGP-KA                                                       DSN     02855
        DO 160 I=1,IM                                                   DSN     02856
        TEMP=XN(I,KA)                                                   DSN     02857
        XN(I,KA)=XN(I,KC)                                               DSN     02858
160     XN(I,KC)=TEMP                                                   DSN     02859
170     CONTINUE                                                        DSN     02860
        GO TO L, (180,200)                                              DSN     02861
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180   KA=(IG+5)/6
      KC=JM
      KD=KC+5
      DO 190 K=1,KA
      IF (ISW5.EQ.1) PUNCH 210, (A(I),I=KC,KD),K
      KC=KC+6
190   KD=KD+6
      REWIND 6
      WRITE (6)XN
      REWIND 6
      ASSIGN 200 TO L
      IF (IT7.EQ.1) GO TO 150
200   CONTINUE
210   FORMAT (1P6E12.2,4HF) UX,IA)
      IF (ID3.EQ.0) GO TO 450
      CALL REAI (KM3,ID3,6HACT MA,6HT NO,S)
      CALL REAI (KM4,ID3,6HACT CX,6H POS, I
      DO 230 I=1,ID3
      DO 220 J=1,IZP
220   T3(I,J)=0.0
      DO 230 J=1,ID
230   T5(I,J)=0.0
      DO 350 IG=1,JJM
      DO 350 JJ=1,ID3
      IF (JJ.EQ.1) GO TO 240
      IF (KM3(JJ).EQ.KM3(JJ-1)) GO TO 330
240   IE=KM3(JJ)
      DO 320 I=1,IM
      IE)=ME(I)
      IFI=IABS(NZ(IE))
      E2=0.0
      IF (IE.NE.IFI) GO TO 260
      E2=1.0
250   RA(I)=E2*XN(I,IG)
      RAV(I)=RA(I)*V(I)
      GO TO 320
260   DO 310 J=1,MS
      IF (IE).NE.MG(J)) GO TO 310
      IF (XMO(J).EQ.0.0) GO TO 270
      IF (MF(J).EQ.0) GO TO 290
      IF (MT(J)-IE) 310,300,310
270   IF (MF(J).NE.2) GO TO 280
      E2=0.0
      GO TO 310
280   E2=E2*FV
      GO TO 310
290   E2=E2*XMO(J)
      GO TO 310
300   E2=E2*ANO(J)
310   CONTINUE
      GO TO 250
320   CONTINUE
330   N=KM4(JJ)
      DO 340 I=1,ID
      J=ME(I)
      T3(JJ,J)=T3(JJ,J)+RAV(I)*C(N,IG,IE)*DF(I)
      IF (ID4.NE.0) T5(JJ,I)=T5(JJ,I)+RA(I)*C(N,IG,IE)*DF(I)
340   CONTINUE
350   CONTINUE
      DO 360 L=1,ID3
```

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                T3(L,I7P)=0.0                                        DSN   02922
                DO 360 I=1,I7H                                       DSN   02923
        360     T3(L,I7P)=T3(L,I7P)+T3(L,I)                          DSN   02924
                MA=1                                                 DSN   02925
                MB=8                                                 DSN   02926
        370     MC=MIN0(MB,I03)                                      DSN   02927
                WRITE (9,410)(I,I=MA,MC)                             DSN   02928
                WRITE (9,420)                                        DSN   02929
                DO 380 J=1,I7P                                       DSN   02930
        380     WRITE (9,430)J,(T3(I,J),I=MA,MC)                     DSN   02931
                IF (ID4.EQ.0) GO TO 400                              DSN   02932
                WRITE (9,440)(I,I=MA,MC)                             DSN   02933
                WRITE (9,420)                                        DSN   02934
                DO 390 J=1,IH                                        DSN   02935
        390     WRITE (9,430)J,(T5(I,J),I=MA,MC)                     DSN   02936
        400     MA=MA+8                                              DSN   02937
                MB=MB+8                                              DSN   02938
                IF (MA.LE.I03) GO TO 370                             DSN   02939
        410     FORMAT (7H0  ZONE,5X,8(10H  MATERIAL,I3))            DSN   02940
        420     FORMAT (1H0)                                         DSN   02941
        430     FORMAT (1X,I6,3X,1P8E13.5)                           DSN   02942
        440     FORMAT (12H0SPACE POINT,8(10H  MATERIAL,I3))         DSN   02943
        450     CONTINUE                                             DSN   02944
        C                                                            DSN   02945
        C       PRINT MATERIAL TABLES                                DSN   02946
                WRITE (9,460)                                        DSN   02947
        460     FORMAT (-2H1        MATERIAL TABLES/)                DSN   02948
                DO 580 M=1,MT                                        DSN   02949
                SUM=0.0                                              DSN   02950
                DO 470 I=1,IM                                        DSN   02951
                L=ME(I)                                              DSN   02952
                L=IABS(MZ(L))                                        DSN   02953
                IF ( L .EQ. M ) SUM = SUM + OF (I) * V (I)           DSN   02954
        470     CONTINUE                                             DSN   02955
                IF (SUM.LE.0) GO TO 580                              DSN   02956
                WRITE (9,480)M,SUM                                   DSN   02957
        480     FORMAT (///20X,*MATERIAL*,I4,10X,*MASS =*1PE18.6/)   DSN   02958
                K=IHT+1                                              DSN   02959
                DO 490 I=1,K                                         DSN   02960
                RAV(I)=0.0                                           DSN   02961
                DO 490 IG=1,IGM                                      DSN   02962
                XJ(IG,I)=0.0                                         DSN   02963
        490     CONTINUE                                             DSN   02964
                DO 520 IG=1,IGM                                      DSN   02965
                VEG = 1.0 / VE (IG)                                  DSN   02966
                XJ1=0.0                                              DSN   02967
                DO 510 I=1,IM                                        DSN   02968
                L=ME(I)                                              DSN   02969
                L=IABS(MZ(L))                                        DSN   02970
                VI=V(I)                                              DSN   02971
                DFI=DF(I)                                            DSN   02972
                IF ( L .NE. M ) GO TO 510                            DSN   02973
                XNG=XN(I,IG)                                         DSN   02974
                TEMP = DFI * XNG * VI * VEG                          DSN   02975
                XJ1 = XJ1 + TEMP                                     DSN   02976
                RAV (1) = RAV (1) + TEMP                             DSN   02977
                DO 500 K=1,IHT                                       DSN   02978
                J=K+1                                                DSN   02979
                TEMP = XNG * VI * DFI * C (K,IG,L)                   DSN   02980
                XJ (IG,J) = XJ (IG,J) + TEMP                         DSN   02981
```

```
2999          RAV (J) = RAV (J) + TEMP                                        DSN     02982
3000    500   CONTINUE                                                        DSN     02983
3001    510   CONTINUE                                                        DSN     02984
3002          ADJIG(I)=XJI                                                    DSN     02985
3003    520   CONTINUE                                                        DSN     02986
300A    C                                                                     DSN     02987
3005    C     PRINT BLOCK FOR MATERIAL M                                      DSN     02988
3006          JM=0                                                            DSN     02989
3007          MA=1                                                            DSN     02990
300A          MM=7                                                            DSN     02991
3009    530   MC=MIN0(MM,1MT)                                                 DSN     02992
3010          IF (MC.GT.MM) WRITE (9,540)(MM,(I,I=MA,MC))                     DSN     02993
3011    540   FORMAT (*0  64,M(5X,*SIGMA*,I3,2X))                            DSN     02994
3012          IF (MC.LE.MM) WRITE (9,550)MM                                   DSN     02995
3013    550   FORMAT (*0  M*,54,*S(G)A*,I3)                                   DSN     02996
3014          JM=JG+1                                                         DSN     02997
3015          DO 570 G=1,JM                                                   DSN     02998
3016          WRITE (9,560)IG,(XJ(IG,K),K=MA,MM)                              DSN     02999
3017    560   FORMAT (I4,1P10E15.5)                                           DSN     03000
301A    570   CONTINUE                                                        DSN     03001
3019          WRITE (9,560)(GP,(RAV(K),K=MA,MM)                               DSN     03002
3020          IF (MM.GT.INT) GO TO 580                                        DSN     03003
3021          MA=MM+1                                                         DSN     03004
3022          MB=MC+4                                                         DSN     03005
3023          GO TO 530                                                       DSN     03006
302A    580   CONTINUE                                                        DSN     03007
3025    C                                                                     DSN     03008
3026    C     ADDITIONAL OUTPUT FOR PIP                                       DSN     03009
3027          IF (IPRC.LE.0) RETURN                                           DSN     03010
3028          PIP=0.)                                                         DSN     03011
3029          DO 610 I=1,IM                                                   DSN     03012
3030          L=ME(I)                                                         DSN     03013
3031          L=IABS(MZ(L))                                                   DSN     03014
3032          DFI=DF(I)                                                       DSN     03015
3033          VI=V(I)                                                         DSN     03016
3034          DO 600 IG=1,IGM                                                 DSN     03017
3035          SP(I,IG)=C(5,IG,L)*DFI*XN(I,IG)                                 DSN     03018
3036          PIP = PIP + VI * SP (I,IG)                                      DSN     03019
3037    600   CONTINUE                                                        DSN     03020
3038    610   CONTINUE                                                        DSN     03021
3039          PI = PIP                                                        DSN     03022
303A          PIP = 1.0 - EXP (PI)                                            DSN     03023
303B          WRITE ( 9, 620 ) PI, PIP                                        DSN     03024
303C    620 FORMAT ( /// *5H0 * * * FINAL VALUES FOR ALL GROUPS * * *       // DSN     03025
303D       1 20X, *PI =* (PE20.6, 10X, *PIP =* 1PE20.6 )                      DSN     03026
303E          RETURN                                                          DSN     03027
303F          END                                                             DSN     03028
3040          SUBROUTINE PRNT (P,I1,I2,LL,A)                                  DSN     03029
3041          DIMENSION P(LL,1)                                               DSN     03030
3042    C                                                                     DSN     03031
3043    C     P         BLOCK TO BE PRINTED                                   DSN     03032
3044    C     I1        INITIAL INDEX (GROUP)                                 DSN     03033
3045    C     I2        FINAL INDEX (GROUP)                                   DSN     03034
3046    C     LL        LENGTH OF FIRST DIMENSION OF BLOCK                    DSN     03035
3047    C     A         HOLLERITH TITLE TO PRINT                              DSN     03036
3048    C                                                                     DSN     03037
3049          L1=I1                                                           DSN     03038
304A          L2=I1+7                                                         DSN     03039
304B    10    L2=MIN0(L2,I2)                                                  DSN     03040
304C          IM=I2-L2                                                        DSN     03041
```

```
3059              WRITE (9,20)(A,L,L=L1,L2)                              DSN    03042
3060     20       FORMAT (*0    I*,8(5X,A5,I3,2X)/)                      DSN    03043
3061              DO 30 I=1,L1                                           DSN    03044
3062              WRITE (9,50)I,(P(I,L),L=L1,L2)                         DSN    03045
3063     30       CONTINUE                                               DSN    03046
3064              L1=L2+1                                                DSN    03047
3065              L2=L2+4                                                DSN    03048
3066              IF (IM.LE.0) GO TO 40                                  DSN    03049
3067              GO TO 10                                               DSN    03050
3068     40       CONTINUE                                               DSN    03051
3069              RETURN                                                 DSN    03052
3070          50 FORMAT ( I5, 1P8E15.5 )                                 DSN    03053
3071              END                                                    DSN    03054
* * * NO FURTHER INFORMATION ON INPUT ( FSET(0) * * *

ERROR SUMMARY
      ERROR    TIMES
     0065       0001
```

APPENDIX B

INPUT SUMMARY AND SAMPLE PROBLEM

The input required for DSN is very similar to that of the original DTF-IV as described in LA-3573.[4] The changes that have been made are indicated.

I. TITLE CARD (12A6) Format — Any desired BCD data for problem description.

II. INTEGER PARAMETERS Card Format (12I6)

Name	Description	Values and Notes
ID	Problem Identification Number	
ITH	Theory to be used	0/1/2/3 = Regular/Adjoint/Worth/Probability
ISCT	Scattering Degree	0/N = Isotropic/Nth Order Anisotropic
ISN	Quadrature Order	Even - See Sec. III
IGE	Geometry	1/2/3 = Plane/Cylinder/Sphere - See Sec. III
IBL	Left Boundary Condition	0/1/2 = Vacuum/Reflective/Periodic
IBR	Right Boundary Condition	0/1/2 = Vacuum/Reflective/Periodic
IZM	Number of Zones	
IM	Number of Intervals	
IFN	Input Flux Guess	See Sec. III
IEVT	Eigenvalue Type	0/1/2/3/4/5 = Source/k/Alpha/Concentration/Delta/Radius
IGM	Number of Energy Groups	
IHT	Position of Total Cross Section in Table	
IHS	Position of Self-Scatter Cross Section	Prints Suppressed if < 0
IHM	Cross Section Table Length to be Used	
MS	Number of Specifications for Mixtures	
MCR	Number of Materials to be Input from Cards	See Sec. III
MTP	Number of Materials to be Input from Library	See Sec. III
MT	Total Number of Materials to be Used (Including Mixtures)	
IPVT	Parametric Eigenvalue Type	
IQM	Type of Source Input	See Sec. III
IIM	Maximum Inner Iterations per Group	
ID1	Print Angular Fluxes	0/1 = No/Yes
ID2	Print Balance Tables by Group	0/1 = No/Yes
ID3	Print Activities by Zone	0/N = No/Number of Activities to Print
ID4	Print Activities by Radius	0/1 = No/Yes
ICM	Maximum Outer Iterations	
IDT	Diffusion Theory Option	0/1 = No/Yes - Enter Applicable Groups after Cross Sections
IC	Iteration Count for Problem Starting from Flux Dump	Otherwise Zero
IIL	Limit on Inner Iterations until $\|1-\lambda\| \leq 10*EPS$	
IXS	Cross-Section Group Limitation	0/1 = Floor/Truncate

III. FLOATING POINT PARAMETERS Card Format (6E12.5)

Name	Description
EV	Initial Eigenvalue Try
EVM	Eigenvalue Modifier
EPS	Convergence Criterion
EPSA	Special Convergence Criterion (only used if non-zero)
BF	Buckling Factor
DY	Buckling Height
DZ	Buckling Depth
XNF	Normalization Factor
PV	Parametric Eigenvalue
XEPS	Relaxation Factor
XLAL	Inside or Lower Limit on $\|1.0-\lambda\|$
XLAH	Outside or Higher Limit on $\|1.0-\lambda\|$
XNPM	New Parameter Modifier

IV. DATA INPUT

As in DTF-IV the input data blocks are read by REAI and REAG but the possible options and formats required are as follows:

	REAI	REAG
Reads	Integer Values	Floating Point Values
by Format	(6(I1,I2,I9))	(6(I1,I2,E9.4))
into Values	K_i, IN_i, IV_i	I_i, IN_i, V_i for i=1,6

OPTIONS for the K_i	REAI Modifications	REAG
0	None	None
1	Repeat Value IV_i, IN_i times	Same for V_i
2	Error - Interpolation on Integers not Allowed	Place IN_i interpolants between V_i and V_{i+1}
3	End of Data Block	Same
4	Not Allowed	Place IN_i interpolants with constant ratio between V_i and V_{i+1}

V. ORDER OF DATA BLOCKS

REQUIRED DATA

Block	Format*	Length	Description and Notes
R	E	IP	Radii IP=IM+1
DF	E	IM	Densities
MA	I	IM	Zone Numbers
MZ	I	IZM	Material Numbers

The data blocks listed as Optional Data may or may not be required from cards depending on the parameters but certain ones must be input from tape if not from cards and others must be input in one form or another. These are: Fission Fractions, Velocities, some sort of Initial Flux Guess and Cross Sections. Others, such as Mix Specifications, Radial Modifiers and Sources are problem dependent. The Weights and Directions can be taken from data internal to the code (see parameter ISN description).

OPTIONAL DATA

Block	Format*	Length	Description and Notes
KI	E	IGM	Fission Fractions
VE	E	IGM	Velocities for Energy Groups
W	E	MM	Weights (MM=|ISN|+1) except for IGE = 2 when MM = $\frac{\|ISN\|*(\|ISN\|+4)}{4}$
D	E	MM	Directions (MM=|ISN|+1) except for IGE = 2 when MM = $\frac{\|ISN\|*(\|ISN\|+4)}{4}$
F	E	IM	Fissions - on IFN
N	E	IG	Initial Fluxes - on IFN, IG = IM*IGM
MB	I	MS	Mix Numbers (only for MS > 0)
MC	I	MS	Mix Commands (only for MS > 0)
MD	E	MS	Mix Densities (only for MS > 0)
RM	E	IZM	Radial Modifiers - for IEVT = 4
Q	E	IG	Distributed Source - on IQM
Q	E	MG	Surface Source - on IQM, MG = MM*IGM
RS	E	IGM	Source Spectrum - on IQM
Q	E	J1	Source Distribution - on IQM, J1 = MM except J1 = IM if IQM = 1
MT	I	MTP	Number of Materials from Library
C	E	LEN	Cross Sections LEN = IHM*IGM*MCR

*I = Integer and is read by REAI; E = Floating Point and is read by REAG.

```
   USN - TEST PROBLEM - MATL 43

  ID  IDENTIFICATION NUMBER                                                    1
 ITH  THEORY (0/1=REGULAR/ADJOINT)                                             3
ISCT  SCATTERING (0/N=(N+1)TH ORDER ANISOTROPIC)                               0
 ISN  QUADRATURE (SN= N=1, N=2-1, ETC.)                                       -A
 IGE  GEOMETRY (1/2/3=SLAB/CYLINDER/SPHERE)                                    3
IBL/IBR LEFT/RIGHT BOUNDARY CONDITION (0/1/2=VACUUM/REFLECTIVE/PERIODIC)   1      0
 IZM  NUMBER OF ZONES                                                         1
  IM  NUMBER OF INTERVALS                                                    30
 IFM  INPUT GUESS (0/1=FISSION/FLUX)                                         -1
IEVT  EIGENVALUE TYPE (0/1/2/3/4/5=SOURCE/K/ALPHA/CONCENTRATION/DELTA/RADIUS)  1
 IGM  NUMBER OF GROUPS                                                        10
 IMT  POSITION OF TOTAL CROSS SECTION IN TABLE                                 8
 IMS  POSITION OF SELF-SCATTER CROSS SECTION IN TABLE                          9
 IMM  CROSS SECTION TABLE LENGTH                                              18
  MS  NUMBER OF MIXTURE SPECIFICATIONS                                         0
MLB/MTP NUMBER OF MATERIAL CROSS SECTIONS READ FROM CARDS/DISK              1      0
  MT  TOTAL NUMBER OF MATERIALS                                                1
IPVT  PARAMETRIC EIGENVALUE TYPE (0/1/2=NONE/K/ALPHA)                          0
 IGM  DISTRIBUTED SOURCE INDICATOR (0/1/2=NONE/REGULAR/FIRST COLLISION)        0
 IIM  INNER ITERATION MAXIMUM (PER GROUP)                                    100
 ID1  PRINT ANGULAR FLUX (0/1=NO/YES)                                          0
 ID2  PRINT BALANCE TABLES BY GROUP (0/1=NO/YES)                               0
 ID3  PRINT ACTIVITIES BY ZONE (0/N=NO/YES-LENGTH OF J3)                      -0
 ID4  PRINT ACTIVITIES BY RADIUS (0/1=NO/YES)                                  0
 ICM  OUTER ITERATION MAXIMUM                                                100
 IDI  DIFFUSION THEORY OPTION (0/1=NO/YES-ENTER APPLICABLE GROUPS-AFTER CROSS SECTIONS)  0
  IC  ITERATION COUNT (NON-ZERO ONLY FOR PROBLEM STARTING FROM FLUX DUMP)      0
 IIL  INNER ITERATION LIMIT USED UNTIL ONE MINUS LAMBDA IS WITHIN TEN**EPS     5
 IXS  FLOOR CROSS SECTIONS IF ZERO/TRUNCATE IF NON-ZERO                       1


  EV  EIGENVALUE TRY                                                  0.
 EVM  EIGENVALUE MODIFIER                                             0.
 EPS  CONVERGENCE CRITERION                                           1.0000000E-0A
EPSA  SPECIAL CONVERGENCE CRITERION-USED ONLY IF NON-ZERO             0.
  WF  BUCKLING FACTOR                                                 0.
DY/DZ BUCKLING HEIGHT/DEPTH                          0.              0.
 ANF  NORMALIZATION FACTOR                                           1.0000000E+00
  PV  PARAMETRIC EIGENVALUE                                          0.
XEPS  RELAXATION FACTOR                                              1.0000000E-03
XLAL/XLAM LAMBDA LOWER/HIGHER LIMIT  1.0000000E+02                   5.0000000E-01
XNPM  NEW PARAMETER MODIFIER                                         1.0000000E+00


INTEGER STORAGE=  246
FLOATING POINT STORAGE= 3172
TOTAL DATA STORAGE=  3.18 WORDS

    1     1     0    -4     3     1     0     1    30    -1     1    10
    8     9    18     0     1     0     1     0     0   100     0     0
   -0     0   100     0     0     5     1     0     0     0     1     0
    0     0     0   180     5    50   300    31   155     2    11     1
    0   201   231   262   273   284   289   294   299   330   630   630
  630   930  1110  1115  1124  1137  1168  1199  1230  1261  1414  1571
 1726  1881  1891  2191  2191  2202  2212  2242  2253  226A  229A  232A
```

```
 2324  2474  2504  2534  2539  2550  2561  2716  2746  2776  2926  2931
 2936  2966  2996  3001  3012  3023  3034  3045  3056  3067  3079   200
  230   231   231   231   231   241  3108  3108  3140  3150  3172  3172
  230   261   272   283   288   293   298   329   629   629   629   929
 1149  1114  1125  1136  1167  1198  1229  1260  1415  1570  1725  1880
 1990  2140  2190  2201  2211  2241  2252  2283  2293  2323  2323  2473
 2503  2533  2538  2549  2560  2715  2745  2775  2925  2930  2935  2965
 2995  3000  3011  3022  3033  3044  3055  3066  3077   199   229   230
  230   230   230   240  3107  3107  3139  3155  3171  3171     0     0

RADII          31
0.          3.04720E-01 6.09440E-01 9.14160E-01 1.21889E+00 1.52360E+00 1.82832E+00 2.13304E+00 2.43776E+00 2.74248E+00
3.04720E+00 3.35192E+00 3.65664E+00 3.96136E+00 4.26608E+00 4.57080E+00 4.87552E+00 5.18024E+00 5.48496E+00 5.78968E+00
6.09440E+00 6.39912E+00 6.70384E+00 7.00856E+00 7.31328E+00 7.61800E+00 7.92272E+00 8.22744E+00 8.53216E+00 8.83688E+00
9.14160E+00

DENSITIES      30
1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01
1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01
1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01 1.87500E+01

ZONE NUMBERS   30
          1           1           1           1           1           1           1           1           1           1
          1           1           1           1           1           1           1           1           1           1
          1           1           1           1           1           1           1           1           1           1

MATERIAL NO.    1
          1

FISSION FRAC   10
1.00000E-03 2.10000E-02 3.04560E-01 2.27040E-01 1.02600E-01 1.06820E-01 2.82800E-02 6.50000E-03 2.20000E-03 0.

VELOCITIES     10
5.19300E+01 3.70400E+01 2.38880E+01 1.80100E+01 1.24000E+01 7.5220E+00 4.56200E+00 2.77200E+00 1.67700E+00 3.71000E-01

WEIGHTS         5
0.          2.50000E-01 2.50000E-01 2.50000E-01 2.50000E-01

DIRECTIONS      5
1.00000E+00-7.74597E-01-2.58199E-01 2.58199E-01 7.74597E-01

INITIAL FLUX  300
1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03
1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03
1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03 1.00000E-03
2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02
2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02
2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02 2.10000E-02
3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01
3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01
3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01 3.04560E-01
2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01
2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01
2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01 2.27040E-01
3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01
3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01
3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01 3.02600E-01
1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01
1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01
1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01 1.06820E-01
```

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2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02
2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02
2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02 2.82800E-02
6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03
6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03
6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03 6.50000E-03
2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03
2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03
2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03 2.20000E-03
0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
    TEST CROSS SECTION - MAIL A3

IN MATERIAL  1,GROUP  1. SIG(G,GP) HAS BEEN TRUNCATED

IN MATERIAL  1,GROUP  2. STG(G,GP) HAS BEEN TRUNCATED

IN MATERIAL  1,GROUP  3. SIG(G,GP) HAS BEEN TRUNCATED

IN MATERIAL  1,GROUP  4. SIGIG,GP) HAS BEEN TRUNCATED

IN MATERIAL  1,GROUP  5. SIG(G,GP) HAS BEEN TRUNCATED

IN MATERIAL  1,GROUP  6. SIG(G,GP) HAS BEEN TRUNCATED

IN MATERIAL  1,GROUP  7. SIG(G,GP) HAS BEEN TRUNCATED

IN MATERIAL  1,GROUP  8. SIG(G,GP) HAS BEEN TRUNCATED

IN MATERIAL  1,GROUP  9. SIGIG,GP) HAS BEEN TRUNCATED

IN MATERIAL  1,GROUP 10. SIG(G,GP) HAS BEEN TRUNCATED

DIRECTION NO.  REFLECTED DIRECTION NO.     WEIGHT          DIRECTION COSINE    WEIGHT X DIRECTION

      1                5                0.                -1.0000000E+00      -0.
      2                5                2.5000000E-01     -7.7459700E-01      -1.9364925E-01
      3                4                2.5000000E-01     -2.5819900E-01      -6.4549750E-02
      4                3                2.5000000E-01      2.5819900E-01       6.4549750E-02
      5                2                2.5000000E-01      7.7459700E-01       1.9364925E-01

      CHI            CHI/PV          VELOCITIES   GROUP

  0.              0.              3.7100000E-01    1
  2.2000000E-03   2.2000000E-03   1.6770000E+00    2
  6.5000000E-03   6.5000000E-03   2.7720000E+00    3
  2.8280000E-02   2.8280000E-02   4.5620000E+00    4
  1.0682000E-01   1.0682000E-01   7.5220000E+00    5
  3.0240000E-01   3.0240000E-01   1.2400000E+01    6
  2.2704000E-01   2.2704000E-01   1.8000000E+01    7
  3.0456000E-01   3.0456000E-01   2.3888000E+01    8
  2.1000000E-02   2.1000000E-02   3.7040000E+01    9
  1.0000000E-03   1.0000000E-03   5.1929990E+01   10
  1.0000000E+00   1.0000000E+00   0.              11
```

CROSS SECTION OF MATERIAL 1

	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7	GROUP 8
1	4.79257E-02	1.75[illegible]E-02	1.29109E-02	9.67335E-03	7.34291E-03	7.12319E-03	8.48002E-03	9.41119E-03
2	2.33434E-02	8.54195E-03	6.28762E-03	4.41092E-03	3.55497E-03	3.58156E-03	4.43907E-03	5.39690E-03
3	5.71009E-03	2.08656E-03	1.53698E-03	1.12711E-03	8.87625E-04	9.39955E-04	1.22927E-03	1.65404E-03
4	5.96160E-04	2.14245E-04	1.58355E-04	1.21095E-04	1.02665E-04	8.54145E-04	1.62995E-04	2.88315E-04
5	0.	4.20670E-06	1.34338E-05	5.33769E-05	2.02533E-04	5.74481E-04	4.30745E-04	5.77803E-04
6	3.11114E-02	1.08656E-02	7.52515E-03	5.14783E-03	3.71578E-03	3.19711E-03	3.28402E-03	3.03877E-03
7	4.96639E-02	1.81707E-02	1.33768E-02	9.81951E-03	7.57226E-03	7.15819E-03	8.15845E-03	8.34514E-03
8	6.04702E-02	3.30400E-02	3.02229E-02	2.70548E-02	1.84505E-02	1.25684E-02	1.11112E-02	1.07652E-02
9	2.93569E-02	2.22526E-02	2.26948E-02	1.83493E-02	1.41233E-02	7.80491E-03	3.83122E-03	2.70412E-03
10	0.	1.76907E-06	2.35528E-06	1.56777E-04	4.8879BE-04	1.16820E-03	2.93852E-03	1.92089E-03
11	0.	0.	0.	8.67350E-08	8.88181E-05	2.98646E-04	8.78864E-04	2.20288E-03
12	0.	0.	0.	0.	3.42801E-05	7.64364E-05	2.52105E-04	6.50192E-04
13	0.	0.	0.	0.	0.	2.31070E-05	1.22487E-04	2.52254E-04
14	0.	0.	0.	0.	0.	0.	0.	9.00000E-08
15	0.	0.	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.

	GROUP 9	GROUP 10	GROUP
1	1.83571E-02	4.03827E-02	
2	1.30830E-02	3.89751E-02	
3	5.11703E-03	2.17[illegible]E-02	
4	1.14[illegible]E-03	7.27177E-03	
5	3.97252E-05	2.00520E-04	
6	2.99736E-03	3.94[illegible]E-03	
7	1.35110[illegible]E-02	2.27419E-02	
8	9.57075E-03	8.36[illegible]E-03	
9	1.96845E-03	1.61[illegible]E-03	
10	6.9673[illegible]E-04	4.70[illegible]E-05	
11	1.08577E-03	3.45[illegible]E-04	
12	1.98[illegible]E-03	6.[illegible]E-04	
13	6.95075E-04	1.42610E-03	
14	1.39[illegible]E-04	6.17[illegible]E-04	
15	1.55596E-05	1.40[illegible]E-04	
16	0.	1.79147E-05	
17	0.	0.	
18	0.	0.	

AVG RADIUS	RADIUS	VOLUME	AREA	
1.52360[illegible]E-01	0.	1.18519[illegible]E-01	0.	1
4.57080[illegible]E-01	3.04[illegible]E-01	8.24639[illegible]E-01	1.16684[illegible]E+00	2
7.61[illegible]E-01	6.09[illegible]E-01	2.25[illegible]E+00	4.66[illegible]E+00	3
1.06652[illegible]E+00	9.1[illegible]E-01	4.39523[illegible]E+00	1.05015[illegible]E+01	4
1.37124[illegible]E+00	1.21[illegible]E+00	7.22971[illegible]E+00	1.86[illegible]E+01	5
1.67596[illegible]E+00	1.52[illegible]E+00	1.07[illegible]E+01	2.91[illegible]E+01	6
1.98068[illegible]E+00	1.82[illegible]E+00	1.50520[illegible]E+01	4.20[illegible]E+01	7
2.28540[illegible]E+00	2.13[illegible]E+00	2.00298[illegible]E+01	5.71752[illegible]E+01	8
2.59012[illegible]E+00	2.43[illegible]E+00	2.57[illegible]E+01	7.46[illegible]E+01	9
2.89484[illegible]E+00	2.74[illegible]E+00	3.21[illegible]E+01	9.45[illegible]E+01	10

3.1995600E+00	3.0472000E+00	3.9230106E+01	1.1684613E+02	11
3.5042800E+00	3.3519200E+00	4.7052423E+01	1.4114779E+02	12
3.8090000E+00	3.6566400E+00	5.5285849E+01	1.6802514E+02	13
4.1137200E+00	3.9613600E+00	6.4830417E+01	1.9719818E+02	14
4.4184400E+00	4.2660800E+00	7.4786993E+01	2.2870884E+02	15
4.7231600E+00	4.5708000E+00	8.5052884E+01	2.6253929E+02	16
5.0278800E+00	4.8755200E+00	9.6830905E+01	2.9871137E+02	17
5.3326000E+00	5.1802400E+00	1.0991948E+02	3.3721713E+02	18
5.6373200E+00	5.4849600E+00	1.2172000E+02	3.7805657E+02	19
5.9420400E+00	5.7896800E+00	1.3523127E+02	4.2122970E+02	20
6.2467600E+00	6.0944000E+00	1.4965367E+02	4.6673651E+02	21
6.5514800E+00	6.3991200E+00	1.6503471AE+02	5.1457700E+02	22
6.8562000E+00	6.7038400E+00	1.8003182E+02	5.6475118E+02	23
7.1609200E+00	7.0085600E+00	1.9631757E+02	6.1726903E+02	24
7.4656400E+00	7.3132800E+00	2.1365444E+02	6.7210057E+02	25
7.7703600E+00	7.6180000E+00	2.3123244E+02	7.2927580E+02	26
8.0750800E+00	7.9227200E+00	2.4972155E+02	7.8878470E+02	27
8.3798000E+00	8.2274400E+00	2.6896217E+02	8.5062729E+02	28
8.6845200E+00	8.5321600E+00	2.8883314E+02	9.1480756E+02	29
8.9892400E+00	8.8368800E+00	3.0945561E+02	9.8131151E+02	30
0.	9.1416000E+00	0.	1.0501571E+03	31

ITERATION COUNT EPS= 1.00000000E-04 EPSA= 0.

PROBLEM ID	OUTER ITERATIONS	INNER ITERATIONS	NEUTRON BALANCE	EIGENVALUE	EIGENVALUE SLOPE	LAMBDA
1	0	0	0.	0.	0.	0.
1	1	52	4.9925065E-14	9.2126566E-01	0.	9.2126566E-01
1	2	101	9.7617A262E-14	9.8728579E-01	0.	1.0714621AE+00
1	3	147	9.1704421AE-14	1.0118A051E+00	0.	1.0248411AE+00
1	4	193	9.9031A938E-14	1.0210160A0E+00	0.	1.0094A826AE+00
1	5	237	1.0125234DE-13	1.0260772AE+00	0.	1.0041266AE+00
1	6	273	1.0435936AE-13	1.0278733AE+00	0.	1.0017505DE+00
1	7	302	1.0791367AE-13	1.0286903AE+00	0.	1.0007948AE+00
1	8	323	9.6367358AE-14	1.0290169AE+00	0.	1.0003194DE+00
1	9	338	1.0302A697E-13	1.0291913AE+00	0.	1.0001675DE+00
1	10	349	1.0125234DE-13	1.0292900AE+00	0.	1.0000959DE+00

ICT	XLA	EV	F-OLD	F-NEW	B	Q	CHI	REAL	IMAG
11	6.883485E+01	1.029351E+00	3.267507E-01	3.363411E-01	-8.857551F-02	-1.3104A3E-03	1.3103E-03	5.3050E+03	-1.2645E-14
							-3.5374E-07	1.2648E+03	5.3713E+03
							6.2952E-11	6.8835E+01	-8.3477E-15
							+7.9651E-15	1.2648E+03	-5.3715E+03
12	9.930086E+01	9.998070E+01	7.085521E+01	7.084118E+01	-6.035604E+00	+6.077317E+00	6.1903E+00	7.7569E+01	-1.7829E-16
							-1.1437E+01	1.8568E+01	7.8549E+01
							1.3916E-03	9.9301E-01	-1.0907E-16
							-1.2028E-05	1.8568E+01	+7.8543E+01
13	9.704524E-01	9.991818E+01	7.034590E+01	7.028834E+01	+5.805582E+00	-5.976711F+00	6.0867E+00	7.9403E+01	+1.7831E-16
							+1.1134E-01	1.8800E+01	7.9384E+01
							1.3404E-03	9.7085E-01	-1.0669E-16
							-1.1459E-05	1.8800E+01	-7.9384E+01
14	9.899523E-01	9.997266E-01	6.823961E+01	6.822091E+01	-5.575600E+00	-5.633192E+00	5.7317E+00	8.0854E+01	+1.9526E-16
							-1.0169E-01	1.9400E+01	8.1868E+01
							1.1872E-03	9.8995E-01	-1.1683E-16
							-9.8405E-06	1.9400E+01	+8.1864E+01
15	9.955304E+01	9.999793E-01	6.753545E+01	6.752730E+01	-5.493097E+00	-5.517328E+00	5.6149E+00	8.1720E+01	-2.0717E-16
							+9.8570E-02	1.9613E+01	8.2743E+01
							1.1365E-03	9.9553E-01	-1.2202E-16
							-9.3375E-06	1.9613E+01	+8.2743E+01
16	9.975544E-01	9.999343E+01	6.722549E+01	6.722106E+01	+5.454213E+00	+5.467352E+00	5.5635E+00	8.2110E+01	+2.1404E-16
							+9.7216E-02	1.9704E+01	8.3134E+01
							1.1176E-03	9.9755E-01	-1.2490E-16
							-9.1211E-06	1.9704E+01	-8.3134E+01
17	9.986191E+01	9.999630E-01	6.705867E+01	6.705418E+01	-5.432831E+00	-5.440214E+00	5.5350E+00	8.2325E+01	-2.1814E-16
							-9.6481E-02	1.9762E+01	8.3353E+01
							1.1062E-03	9.9862E-01	-1.2863E-16
							-9.0049E-06	1.9762E+01	-8.3353E+01
18	9.992046E-01	9.999787E+01	6.696159E+01	6.696018E+01	-5.420712E+00	-5.424952E+00	5.5199E+00	8.2446E+01	-2.2090E-16
							-9.6064E-02	1.9792E+01	8.3473E+01
							1.0999E-03	9.9920E-01	+1.2766E-16
							+8.9400E-06	1.9792E+01	+8.3473E+01
19	9.995350E-01	9.999876E+01	6.690690E+01	6.690607E+01	-5.413707E+00	-5.416182E+00	5.5109E+00	8.2516E+01	+2.2243E-16
							+9.5831E+02	1.9810E+01	8.3519E+01
							1.0962E-03	9.9954E-01	-1.2827E-16
							+8.9028E-06	1.9810E+01	-8.3549E+01
20	9.997252E+01	9.999927E-01	6.687496E+01	6.687446E+01	-5.409599E+00	+5.411061E+00	5.5057E+00	8.2557E+01	+2.2335E+16
							+9.5692E-02	1.9820E+01	8.3590E+01
							1.0941E-03	9.9973E-01	-1.2863E+16

								-8.8811E-06	1.9820E-01 -8.3590E-01
21	9.998363E-01	9.999956E-01	6.685604E-01	6.685580E-01	-5.407167E-00	-5.408037E-00	5.5026E-00	8.2581E-01 -2.2384E-16	
							-9.5611E-02	1.9826E-01 8.3615E-01	
							1.0924E-03	9.9944E-01 -1.2885E-16	
							-8.8683E-06	1.9826E-01 -8.3615E-01	
22	9.999019E-01	9.999974E-01	6.684485E-01	6.684468E-01	-5.405715E-00	-5.406236E-00	5.5007E-00	8.2596E-01 -2.2422E-16	
							-9.5562E-02	1.9830E-01 8.3629E-01	
							1.0921E-03	9.9940E-01 -1.2895E-16	
							-8.8607E-06	1.9830E-01 -8.3629E-01	

	SOURCE	FISSION SOURCE	IN SCATTER	SELF SCATTER	OUT SCATTER	NET LEAKAGE
1	-1.453446E-00	6.2239494E-01	-2.2737368E-13	5.3230152E-01	-2.2737368E-13	4.3839987E-00
2	-5.3180282E-01	2.2771739E-01	9.2074670E-03	3.5826424E-01	2.8507304E-03	4.7493334E-00
3	-3.9164410E-01	1.6766547E-01	4.7622440E-03	3.5200961E-01	4.5834142E-03	4.7047408E-00
4	-2.8734116E-01	1.2305953E-01	2.4330610E-01	2.5871940E-01	2.2116997E-01	4.7836040E-00
5	-2.2274907E-01	9.4896741E-00	8.8156390E-01	1.7644441E-01	7.6394619E-01	4.7432437E-00
6	-2.1594125E-01	8.9707505E-00	2.0363210E-00	9.1538008E-00	1.8370971E-00	5.2051940E-00
7	-2.5694435E-01	1.0224285E-01	5.0498011E-00	4.5134565E-00	5.2104532E-00	5.7607529E-00
8	-2.8461149E-01	1.0458251E-01	6.1392971E-00	3.4536026E-00	6.4289393E-00	5.9980342E-00
9	-5.5340530E-01	1.6931520E-01	5.6535331E-00	3.4775154E-00	8.1492004E-00	8.6071272E-00
10	-1.2065407E-00	2.4543045E-01	3.9659393E-00	4.2697038E-00	8.5046502E-00	1.3442510E-01
11	-5.4051H-3E-00	1.9872126E-02	2.4017732E-01	1.4264200E-02	3.1127491E-01	6.2378539E-01

	ABSORPTION	NEUTRON BALANCE	WIGHT LEAKAGE	FISSION NEUTRONS	NEUTRON DENSITY	NEUTRON FLUX
1	5.6407422E-01	3.1832315E-12	4.3839987E-00	9.0044890E-01	2.6006136E-02	9.6697945E-01
2	1.7493146E-01	2.2737368E-12	4.7493334E-00	2.9240813E-01	5.1248134E-01	8.5943127E-01
3	1.1871945E-01	2.1600449E-12	4.7047408E-00	2.0751329E-01	2.9842368E-01	8.2723045E-01
4	7.2582855E-00	1.9326762E-12	4.7836040E-00	1.3845216E-01	1.6483651E-01	7.5198417E-01
5	4.6421895E-00	1.6446591E-12	4.7432437E-00	9.4601659E-00	8.8580545E-00	6.6630286E-01
6	3.7499424E-00	1.1937118E-12	5.2051940E-00	6.3953130E-00	5.0444132E-00	6.2550724E-01
7	4.0063704E-00	1.8149894E-12	5.7607529E-00	1.0140606E-01	3.6828386E-00	6.6291095E-01
8	3.8867587E-00	1.2505552E-12	5.9980342E-00	1.0473906E-01	2.8556746E-00	6.8216355E-01
9	5.2763132E-00	1.5916157E-12	8.6071272E-00	2.3861865E-01	2.5434897E-00	9.4196043E-01
10	9.3729109E-00	3.7510656E-12	1.3442510E-01	6.0330212E-01	2.7185438E-00	1.6117395E-02
11	1.2384629E-02	2.0804691E-11	6.2378539E-01	2.7678432E-02	3.8391813E-02	8.3962099E-02

	ZONE	FINAL RADII	AVERAGE RADII	FISSIONS	VOLUME
1	1	0-	.1523600E-00	.4286481E-01	.1185200E-00
2	1	.3047200E-00	.4570800E-00	.4295948E-01	.8236797E-00
3	1	.6094400E-00	.7618000E-00	.4282826E-01	.2251879E-01
4	1	.9141600E-00	.1066520E-01	.4257527E-01	.4385218E-01
5	1	.1218880E-01	.1371240E-01	.4220095E-01	.7229717E-01
6	1	.1523600E-01	.1675960E-01	.4172260E-01	.1078532E-02
7	1	.1828320E-01	.1980680E-01	.4116114E-01	.1595203E-02
8	1	.2133040E-01	.2285400E-01	.4046213E-01	.2002987E-02
9	1	.2437760E-01	.2590120E-01	.3968930E-01	.2571883E-02
10	1	.2742480E-01	.2894840E-01	.3882666E-01	.3211891E-02
11	1	.3047200E-01	.3199560E-01	.3787826E-01	.3923011E-02
12	1	.3351920E-01	.3504280E-01	.3684827E-01	.4705242E-02
13	1	.3656640E-01	.3809000E-01	.3574899E-01	.5558596E-02

14	1	.3961360E+01	.4113729E+01	.3456093E-01	.5443042E+02
15	1	.4266080E+01	.4414409E+01	.3331275E-01	.7478699E+02
16	1	.4570800E+01	.4723105E+01	.3200130E-01	.8543249E+02
17	1	.4875520E+01	.5027890E+01	.3063158E-01	.9633081E+02
18	1	.5180240E+01	.5332650E+01	.2920877E-01	.1049198E+03
19	1	.5484960E+01	.5637329E+01	.2773819E-01	.1217200E+03
20	1	.5789680E+01	.5941894E+01	.2622524E-01	.1323113E+03
21	1	.6094400E+01	.6246325E+01	.2467536E-01	.1474537E+03
22	1	.6399120E+01	.6550598E+01	.2309391E-01	.1643072E+03
23	1	.6703840E+01	.6854689E+01	.2148594E-01	.1814319E+03
24	1	.7008560E+01	.7158577E+01	.1985573E-01	.1991876E+03
25	1	.7313280E+01	.7462240E+01	.1820595E-01	.2174544E+03
26	1	.7618000E+01	.7765650E+01	.1653615E-01	.2362724E+03
27	1	.7922720E+01	.8068780E+01	.1483970E-01	.2497216E+03
28	1	.8227440E+01	.8371600E+01	.1309847E-01	.2649218E+03
29	1	.8532160E+01	.8674080E+01	.1127271E-01	.2848331E+03
30	1	.8836880E+01	.8976240E+01	.9282758E-02	.3044556E+03
31	1	.9141600E+01	0.	0.	0.

FLUX BY GROUP AND SPACE POINT

ZONE		AVG RADIUS	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5	GROUP 6	GROUP 7
1	1	1.52360E-01	6.36634E-02	5.81134E-02	5.64083E-02	5.09086E-02	4.43466E-02	4.01921E-02	4.21240E-02
2	1	4.57080E-01	6.36134E-02	5.81011E-02	5.64046E-02	5.09324E-02	4.43956E-02	4.02797E-02	4.22302E-02
3	1	7.61800E-01	6.33744E-02	5.78716E-02	5.61789E-02	5.07352E-02	4.42350E-02	4.01554E-02	4.21074E-02
4	1	1.06652E+00	6.29771E-02	5.74901E-02	5.58014E-02	5.03988E-02	4.39505E-02	3.99167E-02	4.18643E-02
5	1	1.37124E+00	6.24261E-02	5.69621E-02	5.52012E-02	4.99253E-02	4.35436E-02	3.95640E-02	4.15008E-02
6	1	1.67596E+00	6.17102E-02	5.62977E-02	5.46253E-02	4.93291E-02	4.30290E-02	3.91137E-02	4.10350E-02
7	1	1.98068E+00	6.09913E-02	5.54992E-02	5.38171E-02	4.86116E-02	4.24078E-02	3.85644E-02	4.04677E-02
8	1	2.28540E+00	5.99144E-02	5.45711E-02	5.29217E-02	4.77780E-02	4.16850E-02	3.79276E-02	3.98145E-02
9	1	2.59012E+00	5.88031E-02	5.35171E-02	5.18820E-02	4.68318E-02	4.08643E-02	3.72007E-02	3.90491E-02
10	1	2.89484E+00	5.75621E-02	5.23421E-02	5.07218E-02	4.57772E-02	3.99494E-02	3.63894E-02	3.82160E-02
11	1	3.19956E+00	5.61961E-02	5.10484E-02	4.94496E-02	4.46183E-02	3.89443E-02	3.54977E-02	3.72768E-02
12	1	3.50428E+00	5.47015E-02	4.96421E-02	4.80651E-02	4.33591E-02	3.78528E-02	3.45294E-02	3.62114E-02
13	1	3.80900E+00	5.31077E-02	4.81264E-02	4.65724E-02	4.20049E-02	3.66794E-02	3.34885E-02	3.51394E-02
14	1	4.11372E+00	5.13953E-02	4.65064E-02	4.49788E-02	4.05598E-02	3.54284E-02	3.23745E-02	3.40360E-02
15	1	4.41844E+00	4.95791E-02	4.47474E-02	4.32840E-02	3.90289E-02	3.41044E-02	3.12055E-02	3.28164E-02
16	1	4.72316E+00	4.70646E-02	4.29741E-02	4.14070E-02	3.74176E-02	3.27123E-02	2.99743E-02	3.15353E-02
17	1	5.02788E+00	4.56561E-02	4.10711E-02	3.96193E-02	3.57312E-02	3.12571E-02	2.86876E-02	3.01977E-02
18	1	5.33260E+00	4.35603E-02	3.90854E-02	3.76910E-02	3.39753E-02	2.97434E-02	2.73512E-02	2.88088E-02
19	1	5.63732E+00	4.13814E-02	3.70206E-02	3.56678E-02	3.21555E-02	2.81780E-02	2.59701E-02	2.73740E-02
20	1	5.94204E+00	3.91247E-02	3.40822E-02	3.35752E-02	3.02777E-02	2.65649E-02	2.45496E-02	2.58960E-02
21	1	6.24676E+00	3.67931E-02	3.26752E-02	3.14188E-02	2.83477E-02	2.49100E-02	2.30946E-02	2.43880E-02
22	1	6.55148E+00	3.43895E-02	3.04042E-02	2.92038E-02	2.63713E-02	2.32189E-02	2.16104E-02	2.28475E-02
23	1	6.85620E+00	3.19100E-02	2.80731E-02	2.69154E-02	2.43542E-02	2.14968E-02	2.01018E-02	2.12822E-02
24	1	7.16092E+00	2.93521E-02	2.56851E-02	2.46179E-02	2.23014E-02	1.97483E-02	1.85726E-02	1.96963E-02
25	1	7.46564E+00	2.67062E-02	2.32417E-02	2.22554E-02	2.02167E-02	1.79768E-02	1.70257E-02	1.80923E-02
26	1	7.77036E+00	2.39513E-02	2.07411E-02	1.98450E-02	1.81008E-02	1.61826E-02	1.54604E-02	1.64697E-02
27	1	8.07508E+00	2.10563E-02	1.81711E-02	1.73125E-02	1.59470E-02	1.43592E-02	1.38705E-02	1.48219E-02
28	1	8.37980E+00	1.79651E-02	1.55091E-02	1.46397E-02	1.37315E-02	1.24861E-02	1.22387E-02	1.31317E-02
29	1	8.68452E+00	1.45375E-02	1.26521E-02	1.21150E-02	1.13889E-02	1.05128E-02	1.05275E-02	1.13630E-02
30	1	8.98924E+00	9.98134E-03	9.31964E-03	9.03403E-03	8.75606E-03	8.12628E-03	8.64354E-03	9.44738E-03

ZONE		AVG RADIUS	GROUP 8	GROUP 9	GROUP 10	GROUP
1	1	1.52360E-01	4.31597E-02	5.88572E-02	8.68436E-02	
2	1	4.57080E-01	4.32721E-02	5.90291E-02	8.71273E-02	
3	1	7.61800E-01	4.31471E-02	5.88721E-02	8.69154E-02	
4	1	1.06652E+00	4.29025E-02	5.85475E-02	8.64575E-02	
5	1	1.37124E+00	4.25327E-02	5.80544E-02	8.57521E-02	
6	1	1.67596E+00	4.20583E-02	5.74194E-02	8.48393E-02	
7	1	1.98068E+00	4.14803E-02	5.66435E-02	8.37202E-02	
8	1	2.28540E+00	4.08037E-02	5.57346E-02	8.24008E-02	
9	1	2.59012E+00	4.00333E-02	5.46982E-02	8.09059E-02	
10	1	2.89484E+00	3.91730E-02	5.35398E-02	7.92287E-02	
11	1	3.19956E+00	3.82269E-02	5.22652E-02	7.73805E-02	
12	1	3.50428E+00	3.71993E-02	5.08901E-02	7.53706E-02	
13	1	3.80900E+00	3.60946E-02	4.93906E-02	7.32077E-02	
14	1	4.11372E+00	3.49174E-02	4.78024E-02	7.09038E-02	
15	1	4.41844E+00	3.36725E-02	4.61234E-02	6.84591E-02	
16	1	4.72316E+00	3.23648E-02	4.43587E-02	6.58924E-02	
17	1	5.02788E+00	3.09995E-02	4.25159E-02	6.32105E-02	

18	I	5.33280E+00	2.95814E-02	[illegible]	6.04237E-02
19	I	[illegible]	2.81172E-02	[illegible]	[illegible]
20	I	5.94204E+00	2.66311E-02	3.65904E-02	5.45783E-02
21	I	6.24670E+00	2.50694E-02	3.45176E-02	5.13512E-02
22	I	6.55148E+00	2.14964E-02	3.23837E-02	4.84420E-02
23	I	6.85620E+00	2.18984E-02	3.02244E-02	4.52905E-02
24	I	7.16092E+00	2.02791E-02	2.80361E-02	4.20947E-02
25	I	7.46564E+00	1.86412E-02	2.58226E-02	3.08592E-02
26	I	7.77036E+00	1.69834E-02	2.35819E-02	3.55820E-02
27	I	8.07508E+00	1.53004E-02	2.13052E-02	3.22502E-02
28	I	8.37980E+00	1.35724E-02	1.89697E-02	2.88316E-02
29	I	8.68452E+00	1.17648E-02	1.65289E-02	2.52614E-02
30	I	8.98924E+00	9.80656E-03	1.38981E-02	2.14343E-02

MATERIAL TABLES

MATERIAL 1 MASS = 6.000073E+04

G	SIGMA 0	SIGMA 1	SIGMA 2	SIGMA 3	SIGMA 4	SIGMA 5	SIGMA 6	SIGMA 7
1	4.88655E+03	8.88849E+01	4.23194E+01	1.03519E+01	1.08078E+00	0.	5.64321E+01	9.00361E+01
2	9.60134E+02	2.82470E+01	1.37633E+01	3.36202E+00	3.45208E-01	6.77815E-03	1.74114E+01	2.92779E+01
3	5.59419E+02	2.00231E+01	9.75151E+00	2.18370E+00	2.45594E-01	1.92836E-02	1.16708E+01	2.07493E+01
4	3.09034E+02	1.33558E+01	6.50063E+00	1.58904E+00	1.70724E-01	7.52525E-02	7.25757E+00	1.38439E+01
5	1.66072E+02	9.17272E+00	4.44078E+00	1.10882E+00	1.28247E-01	2.53004E-01	4.64173E+00	9.45924E+00
6	9.45735E+01	8.35344E+00	4.20014E+00	1.10230E+00	5.32581E-01	6.73700E-01	3.74128E+00	8.39449E+00
7	6.90465E+01	1.15393E+01	2.51784E+00	1.52777E+00	2.02576E-01	5.35346E-01	4.08547E+00	1.01396E+01
8	5.35145E+01	1.20363E+01	4.90226E+00	2.11873E+00	3.68735E-01	7.38971E-01	3.88638E+00	1.06729E+01
9	4.76743E+01	3.24187E+01	2.31047E+01	9.03670E+00	2.01950E+00	7.01619E-02	5.27640E+00	2.38595E+01
10	5.09577E+01	1.06071E+02	1.03025E+02	5.74633E+01	1.92624E+01	5.30727E-03	9.37200E+00	6.03243E+01
11	7.19775E+03	1.27702E+02	2.19525E+02	9.00442E+01	2.43564E+01	2.37780E+00	1.23434E+02	2.76757E+02

G	SIGMA 8
1	1.09027E+02
2	5.33172E+01
3	4.08721E+01
4	3.33481E+01
5	2.30483E+01
6	1.47391E+01
7	1.38095E+01
8	1.37683E+01
9	1.69020E+01
10	2.21501E+01
11	3.47542E+02

• • • FINAL VALUES FOR ALL GROUPS • • •

PI = -2.37780AE+00 PIP = 9.072A59E-01

CARD READ - 001111 301