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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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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

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

where

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

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

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

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

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

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

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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APPENDIX A

DSN PROGRAM LISTING

```
      PROGRAM MOTF (INP,OUT,FSET10=INP,FSET9=OUT,FSET2,FSET3,FSET4,FSET5
     1,FSET6,PUNCH)
C           MAIN CODE
      COMMON IA (10000), A (34700)
      DATA ANEXT/10HNEXT JOB  /
   10 CALL DTP
   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.ANEXT) GO TO 20
      GO TO 10
   60 CALL EXIT
      END
      SUBROUTINE DTP
      COMMON /ALPHA/ LOAFM,TAMA,SCATT,SCATTP,BAL,XLAMAX,XLAMIN,EVMAX,EVM
     1IN,IPR,FSUM,INEG,KK
C
      COMMON IA(10000),A(10000)
      DIMENSION SNM(84), SMD(84)
      EQUIVALENCE (IN,IA(1)), (ITH,IA(2)), (ISCT,IA(3)), (ISN,IA(4)), (I
     1GE,IA(5)), (IML,IA(6)), (IBR,IA(7)), (IZN,IA(8)), (IM,IA(9)), (IFN
     2,IA(10)), (IEVT,IA(11)), (IGM,IA(12)), (IHT,IA(13)), (IHS,IA(14)),
     3 (IHM,IA(15)), (MS,IA(16)), (MCP,IA(17)), (MTP,IA(18)), (MT,IA(19)
     4), (IPVT,IA(20)), (IVM,IA(21)), (IIM,IA(22)), (ID1,IA(23)), (ID2,I
     5A(24)), (ID3,IA(25)), (ID4,IA(26)), (ICM,IA(27)), (IDT,IA(28)), (I
     6C,IA(29)), (IA(31),KSN52), (IA(34),LC), (IA(35),ICC), (IA(36),NFN)
     7, (IA(37),NM), (IA(38),IG), (IA(39),IIC), (IA(40),KSN51), (IA(39)
     8,ICVT), (IA(41),IMG), (IA(42),IM), (IA(42),JG), (IA(43),IG), (IA(4
     96),IP), (IA(45),MI), (IA(46),IZP), (IA(47),IGP), (IA(48),ML)
      EQUIVALENCE (IA(50),JNF)
      EQUIVALENCE (IA(51),JR), (IA(52),JKT), (IA(53),JVE), (IA(54),JW),
     1(IA(55),JD), (IA(56),JWD), (IA(57),JF), (IA(58),JN), (IA(59),JMD),
     2 (IA(60),JRM), (IA(61),JQ), (IA(62),JC), (IA(63),JL), (IA(64),JQQ)
     3, (IA(65),JKE), (IA(66),JRA), (IA(67),JA), (IA(68),JV), (IA(69),JA
     4V), (IA(70),JDA), (IA(71),JQR), (IA(72),JQC), (IA(73),JDS), (IA(74
     51),JHS), (IA(75),JX), (IA(76),JH), (IA(77),JFG), (IA(78),JTR), (IA(
     679),JSN), (IA(80),JSG), (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
     801), (IA(89),JNL), (IA(90),JRL), (IA(91),JAF), (IA(92),JST), (IA(93
     9),JNA), (IA(94),JAT), (IA(95),JN1), (IA(96),JIO), (IA(97),JNF), (I
     1A(98),JR), (IA(99),JOB)
      EQUIVALENCE (IA(100),JSC), (IA(101),JAG), (IA(102),JNG), (IA(103),
     1JPN), (IA(104),JDG), (IA(105),JSO), (IA(106),JNB), (IA(107),JCA),
     2(IA(108),KMA), (IA(109),KMZ), (IA(110),KMN), (IA(111),KMC), (IA(11
     32),KMT), (IA(113),KGT), (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(4),EVM), (A(3),EPS), (A(4),EPSA), (A(5),BF), (A(6),DY), (
     6A(7),DZ), (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(
     8193),KMM), (IIL,IA(33)), (A(34),EQ)
      EQUIVALENCE (IA(191),IER)
      EQUIVALENCE (IA(195),ISF)
      IEM=0
C     TO PREVENT TRUNCATION CHANGE THIS VALUE AND LENGTH OF COMMON A
      IAA = 34700
      TREQ=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 (10,20)(A(I),I=1,12)                                         DSN     00063
      IF (EOF,10) 31,40                                                 DSN     00064
40    CONTINUE                                                          DSN     00065
      WRITE (9,20)(A(I),I=1,12)                                         DSN     00066
50    FORMAT (12I6)                                                     DSN     00067
      READ (10,50)(IA(I),I=1,31)                                        DSN     00068
60    FORMAT (6E12.5)                                                   DSN     00069
      READ (10,60)(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  IDENTIFICATION NUMBER,60X,I8/35H  ITH  THEORY DSN     00075
     1 (0/1=REGULAR/ADJOINT),53X,I8/45H ISCT  SCATTERING (0/N=ISOTROPIC/ DSN     00076
     2NTH ORDER ANISOTROPIC),33X,I4/43H  ISN  QUADRATURE (SN, PN=1, DPN/ DSN     00077
     32=1, ETC.),45X,I8/45H  IGE  GEOMETRY (1/2/3=PLANE/CYLINDER/SPHERE) DSN     00078
     4,43X,I8/73H IBL/IBR LEFT/RIGHT BOUNDARY CONDITION (0/1/2=VACUUM/RE DSN     00079
     5FLECTIVE/PERIODIC),17X,I8/22H  IZM  NUMBER OF ZONES,46X,I8/26H  IM DSN     00080
     6  NUMBER OF INTERVALS,42X,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  IMT  POSITION OF TOTAL CROSS SECTION IN TABLE,41X,I8)      DSN     00084
80    FORMAT (54H  IMS  POSITION OF SELF-SCATTER CROSS SECTION IN TABLE, DSN     00085
     134X,I8/33H  IXM  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/DISK,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),44X,I8/72H  IDM  DISTRIBUTED SOURCE INDICATOR (0/1/2=N DSN     00090
     6ONE/REGULAR/FIRST COLLISION),18X,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
     4QX,I8)                                                            DSN     00093
90    FORMAT (44H  ID2  PRINT BALANCE TABLES BY GROUP (0/1=NO/YES),39X,I DSN     00094
     18/57H  ID3  PRINT ACTIVITIES BY ZONE (0/N=NO/YES-LENGTH OF J3),31X DSN     00095
     2,I8/46H  ID4  PRINT ACTIVITIES BY RADIUS (0/1=NO/YES),42X,I8/30H   DSN     00096
     3IOM  OUTER ITERATION MAXIMUM,58X,I8/8H  IDT  DIFFUSION THEORY OPT DSN     00097
     4ION (0/1=NO/YES-ENTER APPLICABLE GROUPS-AFTER CROSS SECTIONS),I8/7 DSN     00098
     554H  IC  ITERATION COUNT (NON-ZERO ONLY FOR PROBLEM STARTING FROM  DSN     00099
     6FLUX DUMP),14X,I8/76H  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  ,20X,I8//)                        DSN     00102
100   FORMAT (21H  EV  EIGENVALUE TRY,57X,1PE13.7/2AH  EVM  EIGENVALUE  DSN     00103
     1 GUESS,52X,E13.7/20H  EPS  CONVERGENCE CRITERION,50X,E13.7/5AH E  DSN     00104
     2PSA  SPECIAL CONVERGENCE CRITERION-USED ONLY IF NON-ZERO,20X,E13.7 DSN     00105
     3/22H  BK  BUCKLING FACTOR,56X,E13.7/28H BY/BZ BUCKLING HEIGHT/DEP DSN     00106
     4TH,36X,2E13.7/2H  XNF  NORMALIZATION FACTOR,51X,E13.7/2H  PV  P    DSN     00107
     5ARAMETRIC EIGENVALUE,59X,E13.7/2H XEPS  RELAXATION FACTOR,54X,E13 DSN     00108
     6.7/3AH XLAI/XLAM LAMBDA LOWER/HIGHER LIMIT,28X,2E13.7/2H XNPM  NE DSN     00109
     7W PARAMETER MODIFIER,44X,E13.7//)                                 DSN     00110
C      COMPUTE INITIAL VALUES                                           DSN     00111
      A(21)=1.0                                                         DSN     00112
      A(22)=6.2831853                                                   DSN     00113
      A(23)=12.566 3706                                                 DSN     00114
      A(24)=1.0                                                         DSN     00115
      A(25)=.5                                                          DSN     00116
      A(26)=.333333333                                                  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=IMM*IGM                                            DSN     00133
      BAL=0.0                                                DSN     00134
      MM=IABS(ISN)+1                                         DSN     00135
      IF (IGE.EQ.2) MM=(IABS(ISN)*(IABS(ISN)+4))/4           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 (IGE.EQ.2) NM=(NM*(NM+4))/4                         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+MI                                               DSN     00155
      JWU=JU+MM                                              DSN     00156
      JF=JWU+MM                                              DSN     00157
      JN=JF+IP                                               DSN     00158
      JMU=JN+IG                                              DSN     00159
      JRM=JMU+MS                                             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+IMM*IGM*MT                                       DSN     00168
      JNG=JL+IM*NM                                           DSN     00169
      JKE=JNG+IGP                                            DSN     00170
      JRA=JKE+IGP                                            DSN     00171
      JA=JRA+IP                                              DSN     00172
      JV=JA+IP                                               DSN     00173
      JAV=JV+IP                                              DSN     00174
      JDA=JAV+IP                                             DSN     00175
      JDB=JDA+MI                                             DSN     00176
      JDC=JDB+MI                                             DSN     00177
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      JDS=JUC+MI                                                        DSN 00178
      JRS=JDS+MI                                                        DSN 00179
      JX=JRS+IGM                                                        DSN 00180
      JH=JX+IG*NM                                                       DSN 00181
      JFG=JG                                                            DSN 00182
      IF (IHR.EQ.1) JFG=JH+MG                                           DSN 00183
      JTR=JFG+IGP                                                       DSN 00184
      JSP=JTR+IGM                                                       DSN 00185
      JSG=JSP+IM                                                        DSN 00186
      JSN=JSG+IGP                                                       DSN 00187
      JCT=JSN+IGP                                                       DSN 00188
      JCS=JCT+IM                                                        DSN 00189
      JCH=JCS+IM                                                        DSN 00190
      JSA=JCH+IM*ISCT                                                   DSN 00191
      JNN=JSA+IM*MM                                                     DSN 00192
      JJJ=JNN+IM                                                        DSN 00193
      JNO=JJJ+IM*NM                                                     DSN 00194
      JNL=JNO+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
      JNI=JAT+IM*MM                                                     DSN 00201
      JIO=JNI+MM                                                        DSN 00202
      JNE=JIO+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
      JDG=JFN+IGP                                                       DSN 00210
      JSD=JDG+IGP                                                       DSN 00211
      JNR=JSD+IGP                                                       DSN 00212
      JCA=JNR+IGP                                                       DSN 00213
      KMA=200                                                           DSN 00214
      KMZ=KMA+IM                                                        DSN 00215
      KMR=KMZ+IZM                                                       DSN 00216
      KMC=KMR+MS                                                        DSN 00217
      KMT=KMC+MS                                                        DSN 00218
      KGT=KMT+MTP                                                       DSN 00219
      KMO=KGT+IGM                                                       DSN 00220
      KM3=KMO+MM                                                        DSN 00221
      KM4=KM3+ID3                                                       DSN 00222
      KQ=JCA+IM                                                         DSN 00223
      JT=KQ                                                             DSN 00224
      IF (IABS(IOM).EQ.2) JT=KQ+MM                                      DSN 00225
      JSM=JT+IZP*(NM+15)                                                DSN 00226
      JSZ=JSM+(NM+15)                                                   DSN 00227
      JT3=JSZ+(NM+15)                                                   DSN 00228
      JT5=JT3+ID3*IZP                                                   DSN 00229
      JFIN=JT5+ID3*IM                                                   DSN 00230
      IF (ISIGN(1,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                                                  DSN    00238
       DO 160 I=1,70                                                     DSN    00239
160    IA(I+120)=IA(I+50)-1                                              DSN    00240
       JTOTI=KM4*ID3                                                     DSN    00241
       JTOTAL=JFIN+JTOTI                                                 DSN    00242
       WRITE (9,170)JTOTI,JFIN,JTOTAL                                    DSN    00243
       WRITE (9,50)(IA(I),I=1,192)                                       DSN    00244
       IF (JFIN.GT.IMA) RETURN                                           DSN    00245
170    FORMAT (1H0,INTEGER STORAGE=I5/24H FLOATING POINT STORAGE=I5/20H T DSN    00246
      1OTAL DATA STORAGE=I6,6H WORDS*//)                                 DSN    00247
       DO 180 I=51,JFIN                                                  DSN    00248
180    A(I)=0.                                                           DSN    00249
C      READ RADII                                                        DSN    00250
       CALL REAG (A(JR),IP,6HRADII ,6H      )                            DSN    00251
C      READ DENSITIES                                                    DSN    00252
       CALL REAG (A(JDF),IM,6HDENSIT,6HIES   )                           DSN    00253
C      READ ZONE NUMBERS                                                 DSN    00254
       CALL REAT (IA(KMA),IM,4HZONE N,6HUMBERS)                          DSN    00255
C      READ MATERIAL NUMBERS                                             DSN    00256
       CALL REAT (IA(KMZ),IM,6HMATERI,6HAL NO.)                          DSN    00257
       IF (IER.GT.0) RETURN                                              DSN    00258
       IF (MTP.GT.0) GO TO 190                                           DSN    00259
C      READ FISSION FRACTIONS AND VELOCITIES                             DSN    00260
       CALL REAG (A(JKI),IGM,6HFISSIO,6HN FRAC)                          DSN    00261
       CALL REAG (A(JVE),IGM,6HVELOCI,6HTIES  )                          DSN    00262
       IF (IER.GT.0) RETURN                                              DSN    00263
C      READ QUADRATURE COEFFICIENTS                                      DSN    00264
C      CHECK FOR INTERNAL SN CONSTANTS                                   DSN    00265
190    IF (ISN.LT.0) GO TO 210                                           DSN    00266
       IF (IGE.NE.2) GO TO 200                                           DSN    00267
       J=ISN/2-1                                                         DSN    00268
       L=(J*(J+1)*(2*J+7)/6+35                                           DSN    00269
       GO TO 250                                                         DSN    00270
200    L=1                                                               DSN    00271
       IF (ISN.EQ.2) GO TO 250                                           DSN    00272
       IF (ISN.EQ.4) GO TO 240                                           DSN    00273
       IF (ISN.EQ.8) GO TO 230                                           DSN    00274
       IF (ISN.EQ.16) GO TO 220                                          DSN    00275
210    CALL REAG (A(JW),MM,6H WEIGH,6HTS     )                           DSN    00276
       CALL REAG (A(JD),MM,6H DIREC,6HTIONS )                            DSN    00277
       IF (IER.GT.0) RETURN                                              DSN    00278
       GO TO 270                                                         DSN    00279
C      LOAD STANDARD SN CONSTANTS FROM INTERNAL TABLES                   DSN    00280
220    L=L+9                                                             DSN    00281
230    L=L+5                                                             DSN    00282
240    L=L+3                                                             DSN    00283
250    J=J4                                                              DSN    00284
       K=JD                                                              DSN    00285
       M=L+MM-1                                                          DSN    00286
       DO 260 I=L,M                                                      DSN    00287
       A(J)=SNW(I)                                                       DSN    00288
       A(K)=SND(I)                                                       DSN    00289
       J=J+1                                                             DSN    00290
260    K=K+1                                                             DSN    00291
270    IF (ISIGN(1,ILVT).EQ.-1) CALL UPSET (IP,MM,IGM,A(JAF))            DSN    00292
C      DONE WITH UNCONDITIONAL INPUT****                                 DSN    00293
C      TEST FOR FISSION OR FLUX INPUT                                    DSN    00294
       IF (IABS(IFN).EQ.0.AND.ISIGN(1,IFN).EQ.-1) CALL REAG (A(JF),IM,6HF DSN    00295
      1ISSIO,4HNS    )                                                  DSN    00296
       IF (IFN.EQ.-1) CALL REAG (A(JN),IG,6HINITIA,6HL FLUX)             DSN    00297
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      IF (IER.GT.0) RETURN                                                    DSN  00298
      J=JMD+1                                                                 DSN  00299
      IF (IFN.EQ.-2) REWIND 4                                                 DSN  00300
      IF (IFN.EQ.-2) READ (4)(A(I),I=JN,J)                                    DSN  00301
      IF (IFN.EQ.-2) REWIND 4                                                 DSN  00302
      IF (ISIGN(1,IFN).EQ.-1) GO TO 290                                       DSN  00303
      H=1./FLOAT(IM)                                                          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 READ (IA(KMB),MS,6HMIX NU,6HMBER  )                                DSN  00317
      CALL READ (IA(KMC),MS,6HMIX CO,6HMMAND )                                DSN  00318
      CALL READ (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 READ (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 READ (A(JQ),IG,6HDIST. ,6HSOURCE)                   DSN  00328
      IF (IQM.EQ.-2) CALL READ (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 READ (A(JRS),IGM,6HSOURC      DSN  00333
     1E,6H SPECT)                                                             DSN  00334
      J1=MM                                                                   DSN  00335
      IF (IQM.EQ.1) J1=IM                                                     DSN  00336
      CALL READ (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 ANDCARDS                         DSN  00351
340   MTPA=IABS(MTP)                                                          DSN  00352
      IF (MTPA.EQ.0) GO TO 350                                                DSN  00353
      CALL READ (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 STORAGE                                                 DSN     00358
  360 360   CALL SECOND (TSEG)                                                DSN     00359
            J1=JKE                                                            DSN     00360
            J2=J1+MM                                                          DSN     00361
            J3=J2+MM                                                          DSN     00362
            J4=J3+MM                                                          DSN     00363
            KA=ISCT+1                                                         DSN     00364
            KB=KA+ISCT                                                        DSN     00365
            J5=J4+KM                                                          DSN     00366
            J6=J5+MM*KA*KA                                                    DSN     00367
            CALL SNCM (A(JM1)+A(JD)+A(JMD)+A(JL)+IA(KMR)+A(J1)+A(J2)+A(J3)+A(J4 DSN     00368
           1)+A(J5)+MM+NM+KA+KM)                                              DSN     00369
            IF (IER.GT.0) RETURN                                              DSN     00370
      C     ZERO TEMPORARY STORAGE                                            DSN     00371
            DO 370 K=J1+J6                                                    DSN     00372
  370 370   A(K)=0.0                                                          DSN     00373
      C     TEST FOR ADJOINT PROBLEM                                          DSN     00374
            IF (ITH.NE.1) GO TO 380                                           DSN     00375
      C     COMPUTE ADJOINT REVERSALS AND CROSS SECTIONS                      DSN     00376
            CALL ADJREV (A(JKI)+A(JVE)+A(JQ)+A(JN)+IQM+IFN+IGM+IM+IC+A(JC)+IMM DSN     00377
           1+MT+ML+IHT)                                                       DSN     00378
      C     COMPUTE INITIAL FUNCTIONS                                         DSN     00379
  380 380   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
  390 390   IF (IAHS(IEVT).NE.3) GO TO 410                                    DSN     00384
  400 400   CALL MIXCX (A(JC)+IA(KMB)+IA(KMC)+A(JMD)+IMM+IGM+MT+MS+EV+IEVT+ICC DSN     00385
           1)                                                                 DSN     00386
  410 410   NFN=1                                                             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(JM)+ DSN     00389
           1A(JD)+A(JDA)+A(JDB)+A(JDC)+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 430              DSN     00393
            IF (IQM.EQ.2) GO TO 420                                           DSN     00394
      C     DISTRIBUTED SOURCE                                                DSN     00395
            CALL DSOUR (A(JD)+A(JQG)+A(JV)+IM+IGM+IGP+IP+XNF+A(JVE)+IQM+IPRE) DSN     00396
            IF (IER.GT.0) RETURN                                              DSN     00397
            GO TO 430                                                         DSN     00398
      C     FIRST COLLISION SOURCE                                            DSN     00399
  420 420   CALL FCSOUR (A(JD)+A(JQG)+A(JRS)+A(JM)+A(JQ)+A(JA)+XNF+MM+IGM+IGP+ DSN     00400
           1IG2+IP+ISN)                                                       DSN     00401
      C     FISSION CALCULATIONS AND NORMALIZATIONS                           DSN     00402
  430 430   CALL FISSN (A(JN)+A(JC)+A(JX)+A(JR)+IGM+IM+IHM+MT+NM+MM+A(JFG)+IGP DSN     00403
           1+A(JF)+A(JKE)+IA(KMA)+IA(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
  440 440   FORMAT (1H0//16H ITERATION COUNT,7X,4HEPS=1PE16.8,5X,5HEPSA=F16.8/ DSN     00409
           1//6H PROBLEM,4X,5HOUTER,7X,5HINNER,7X,7HNEUTRON,7X,10HEIGENVALUE,5 DSN     00410
           2X,10HEIGENVALUE,7X,6HLAMBDA/5H    ID,4X,10HITERATIONS,2X,10HITERATI DSN     00411
           3ONS,5X,7HBALANCE,24X,5HSLOPE/)                                    DSN     00412
            JNBG=JNB+IGM                                                      DSN     00413
  450 450   WRITE (9,460) ID,ICC,C,A(JNBG),EV,EQ,XLA                          DSN     00414
  460 460   FORMAT (I5,3X,I8,4X,1H,4X,1P4E15.8)                               DSN     00415
            IF (ICC.LT.1) GO TO 490                                           DSN     00416
            CALL SECOND (TIME)                                                DSN     00417
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419           TEXT=TIME-TREG+1.5*(TIME-TREG)/FLOAT(ICC)                          DSN     00418
420           IF (TEXT.GT.0.) WRITE (9,470)                                      DSN     00419
421     470   FORMAT (31H0 PROBLEM ABORTED ON TIME LIMIT)                        DSN     00420
422           IF (TEXT.GT.0.) GO TO 530                                          DSN     00421
423           IF (ICC.LE.IC4) GO TO 490                                          DSN     00422
424     C     FLUX DUMP                                                          DSN     00423
425           WRITE (9,480)                                                      DSN     00424
426           GO TO 530                                                          DSN     00425
427     480   FORMAT (40H0TOO MANY OUTER ITERATIONS-FLUXES DUMPED)               DSN     00426
428     C     ALPHA OPTION                                                       DSN     00427
429     490   E1=0.0                                                             DSN     00428
430           IF (IAMS(IEVT).EQ.2) E1=EV                                         DSN     00429
431           IF (IPVT.EQ.2) E1=E1+PV                                            DSN     00430
432           DO 500 I=1,IGM                                                     DSN     00431
433           JTHI=JTH+I-1                                                       DSN     00432
434           JVEI=JVE+I-1                                                       DSN     00433
435     500   A(JTHI)=E1/A(JVEI)                                                 DSN     00434
436     C     BEGIN GROUP LOOP                                                   DSN     00435
437           IS=IM                                                              DSN     00436
438           IF (IQM.EQ.2) IS=MM                                                DSN     00437
439           IT=15*MM                                                           DSN     00438
440           CALL OUTER (A(JC)*A(JSA)*A(JL)*A(JN)*A(JX)*A(JCM)*A(JQ)*A(JB)*A(JA DSN     00439
441          1F)*A(JJJ)*A(JT)*A(JS4)*A(JSZ)*IHM*IGM*MT*IM*MM*NM*ISCT*IT*IP*IZP*I DSN     00440
442          2S*IA(KMA)*IA(KMZ)*IZ4*A(JF)*A(JCS)*A(JV)*A(JSR)*A(JCT)*A(JCA)*A(JN DSN     00441
443          3N)*A(JHO)*A(JST)*A(JNR)*A(JM)*A(JRS)*A(KQ)*A(JRA)*A(JO)*A(JA)*A(JW DSN     00442
444          4D)*A(JOF)*A(JA)*IA(KAT))                                          DSN     00443
445     C     TOTAL GROUP, FISSION, AND CONVERGENCE NUMBERS CALCULATIONS         DSN     00444
446     510   CONTINUE                                                           DSN     00445
447           CALL TOTGP (A(JSN)*A(JSC)*A(JNL)*A(JAG)*A(JSD)*A(JRL)*A(JNH)*IGP*A DSN     00446
448          1(JFN)*A(JNG)*A(JOG)*A(JOG)*A(JFG)*A(JKE)*A(JKI))                  DSN     00447
449           IF (IEP.GT.0) RETURN                                               DSN     00448
450           GO TO (530,450,520,900), KS851                                     DSN     00449
451     C     NEW PARAMETERS FOR IMPLICIT SEARCH                                 DSN     00450
452     520   CALL NF*PAR                                                        DSN     00451
453           GO TO (530,450,390), KS852                                         DSN     00452
454     530   CONTINUE                                                           DSN     00453
455     C     FINAL PRINT                                                        DSN     00454
456           IF (IPRE.EQ.1.OR.IPRE.EQ.2) GO TO 600                              DSN     00455
457           CALL FINPR (A(JN)*A(JX)*A(JT3)*A(JT5)*A(JC)*IGM*IM*NM*ID3*IZP*IHM* DSN     00456
458          1MT*A(JN8)*IGP*IA(KMA)*A(JRA)*A(JAV)*A(JV)*A(JF)*IP*IA(KM3)*IA(KM4) DSN     00457
459          2*JJ3*JJ4*IA(KMZ)*IZM*A(JMO)*MS*IA(KMC)*IA(KMB)*A(JOF)*A(JVE)*A(JO) DSN     00458
460          3*A(JN) )                                                          DSN     00459
461     C     CHECK FOR OVERLAP INTEGRAL                                         DSN     00460
462           IF (ISIGN(1,IPVT).NE.-1) RETURN                                    DSN     00461
463           IF (ITH.EQ.0) GO TO 560                                            DSN     00462
464           REWIND 3                                                           DSN     00463
465           DO 550 I=1,IGM                                                     DSN     00464
466           J=IGP-1                                                            DSN     00465
467           REWIND 4                                                           DSN     00466
468           DO 540 J1=1,J                                                      DSN     00467
469           K=JST-1                                                            DSN     00468
470     540   READ (4)(A(J2),J2=JAF,K)                                           DSN     00469
471     550   WRITE (3)(A(J2),J2=JAF,K)                                          DSN     00470
472     560   CALL INTEG (IM,IP,IGM,IZM,MM,IA(KMA),A(JVE),A(JV),A(JAF),A(JDS),A( DSN     00471
473          1JW),A(JGZ),IGP,IZP,IA(KMR),A(JTF),A(JTS),A(JTT),IHM,MT,IA(KMZ),A(J DSN     00472
474          2F),A(JOF),A(JC),A(JKI),A(JA),A(JD))                               DSN     00473
475           IF (IEVT.LE.-1) GO TO 580                                          DSN     00474
476           IF (ITH.EQ.0) RETURN                                               DSN     00475
477           DO 570 L=1,IGM                                                     DSN     00476
478           I=JRS+L                                                            DSN     00477
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            J=I+L                                                       DSN   00478
            A(I)=1.                                                     DSN   00479
      570   A(J)=0.                                                     DSN   00480
      580   IF (INM.EQ.2) RETURN                                        DSN   00481
            IF (IPVT.EQ.1) IPVT=0                                       DSN   00482
            IFN=1                                                       DSN   00483
            ICC=0                                                       DSN   00484
            KSAS1=0                                                     DSN   00485
            KSAS2=0                                                     DSN   00486
            LC=0                                                        DSN   00487
            LCC=0                                                       DSN   00488
            NFN=0                                                       DSN   00489
            IIG=0                                                       DSN   00490
            IIC=0                                                       DSN   00491
            ICVT=0                                                      DSN   00492
            XLAMIN=0.0                                                  DSN   00493
            EVMIN=0.0                                                   DSN   00494
            EVMAX=0.0                                                   DSN   00495
            XLAMAX=1.E+89                                               DSN   00496
            EPSA=0.                                                     DSN   00497
            IF (ITH.EQ.1) RETURN                                        DSN   00498
            ITH=1                                                       DSN   00499
            IF (EV.GT.0.) EQ=0.                                         DSN   00500
            WRITE (9,590)                                               DSN   00501
            GO TO 600                                                   DSN   00502
      590   FORMAT (30H1  ADJOINTED PROBLEMME FOLLOWS)                  DSN   00503
      600   CONTINUE                                                    DSN   00504
            CALL PASS2 (A(JV),A(JC),A(JQ),A(JF),A(JN),A(JDF),A(JAF),IA(KMA),IA DSN   00505
           1(KMZ),IMM,IGM,IM,IP,IGP,A(JKE),A(JFG),A(JQG))               DSN   00506
            IF (IPRE.EQ.3) GO TO 510                                    DSN   00507
            GO TO 690                                                   DSN   00508
            DATA (SNW(I),I=1,84)/0.,2*.5,0.,.16666667,2*.33333333,.16666667,0. DSN   00509
           1.,0533u038,.1011727?,.13775342,.20777348,.20777348,.13775342,.1011 DSN   00510
           27272,.15330038,0.,.0427558,.03977460,.0446AA72,.04596055,.05263464 DSN   00511
           3,.06401735,.09050406,.14266428,.14266428,.09050406,.06401735,.0526 DSN   00512
           43464,.04596055,.04163472,.03977450,.0227358,0.,2*.5,0.,4*.16666667 DSN   00513
           5,0.,2*.16666667,0.,.08043062,.08623604,2*.08043062,.08623604,.080 DSN   00514
           643062,0.,4*.08623605,0.,2*.08043062,0.,.05330038,2*.05058636,4*.05 DSN   00515
           7330038,2*.05058636,.05330038,0.,.05058634,.0365A070,2*.05058636,.0 DSN   00516
           8365807?,.05058636,0.,4*.05058634,0.,2*.05330038/            DSN   00517
            DATA (SNU(I),I=1,84)/-1.,-.57735027,.57735027,-1.,-.88191710,-.333 DSN   00518
           133333,.33333333,.88191710,-1.,-.95118973,-.78679579,-.57735027,-.2 DSN   00519
           2182179?,.21821789,.57735027,.78679579,.95118973,-1.,-.97752522,-.9 DSN   00520
           3067047?,-.82349331,-.74535599,-.64978629,-.53748385,-.39440532,-.1 DSN   00521
           4490712?,.14907120,.39440532,.53748385,.64978629,.74535599,.8290933 DSN   00522
           51,.90576470,.97752522,-.8164966,-.5773503,.5773503,-.3428030,-.881 DSN   00523
           609171,-.3333333,.3333333,.8819171,-.4714045,-.3333333,.3333333,-.96 DSN   00524
           760918,-.9309493,-.6831301,-.2581989,.2581989,.6831301,.9309493,-.7 DSN   00525
           8302967,-.6831301,-.2581989,.2581989,.6831301,-.3651484,-.2581989, DSN   00526
           92581989,-.9759001,-.9511897,-.7867958,-.5773503,-.2182179,.2182179 DSN   00527
           $,.5773503,.7867958,.9511897,-.8164966,-.7867958,-.5773503,-.218217 DSN   00528
           $9,.2182179,.5773503,.7867958,-.6172134,-.5773503,-.2182179,.218217 DSN   00529
           $9,.5773503,-.3086067,-.2182179,.2182179/                    DSN   00530
            END                                                         DSN   00531
            SUBROUTINE RECS (CS,IMM,IGM,MT)                             DSN   00532
            DIMENSION CS(IMM,IGM,MT), AD(12)                            DSN   00533
            COMMON IA(1000),A(10000)                                    DSN   00534
            EQUIVALENCE (KD,IA(112)), (MCR,IA(17)), (JA,IA(52)), (JB,IA(53)), DSN   00535
           1(IA(18),MTP), (IA(48),ML), (IA(13),IMT), (A(3),EPS)         DSN   00536
            EQUIVALENCE ( IA (31), IXS )                                DSN   00537
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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
      IHS=IABS(IA(1+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,IHM),J=1,IGM)                     DSN   00550
   30 CONTINUE                                                         DSN   00551
   40 IF (MTP.EQ.0) GO TO 180                                          DSN   00552
      NT=KD                                                            DSN   00553
      NE=1+MCR                                                         DSN   00554
      MBK=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=(ITG*ITL)/6+MIN0(1,MOD(ITG*ITL,6))                            DSN   00560
      IF (MOD(ITN,100).EQ.0) NR=ITG/3+MIN0(1,MOD(ITG,3))               DSN   00561
      IF (ITN.EQ.100*(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(1)                                                 DSN   00565
      GO TO 60                                                         DSN   00566
   90 IF (MBK.GT.0) GO TO 260                                          DSN   00567
      MBK=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
      MBK=0                                                            DSN   00573
      GO TO 60                                                         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 60                                                         DSN   00589
  140 DO 150 L=1,IGM                                                   DSN   00590
      DO 150 K=1,IHM                                                   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(IHM,ITL).AND.L.LE.MIN0(IGM,ITG)) CS(K,L,NE)=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
      JAH=IHT-2                                                          DSN   00609
      DO 250 I=1,ML                                                      DSN   00610
      IF (CS(IHT-1,I).LE.0.0) GO TO 250                                  DSN   00611
      DO 240 J=1,IGM                                                     DSN   00612
      H=CS(IHT,J,I)-CS(JAH,J,I)                                          DSN   00613
      JC=IHS-J+1                                                         DSN   00614
      JD=1                                                               DSN   00615
  190 IF (JC.GT.IHT) GO TO 200                                           DSN   00616
      JC=JC+1                                                            DSN   00617
      JD=JD+1                                                            DSN   00618
      GO TO 190                                                          DSN   00619
  200 H=H-CS(JC,JD,I)                                                    DSN   00620
      JC=JC+1                                                            DSN   00621
      JD=JD+1                                                            DSN   00622
      IF (JC.LE.IHM.AND.JD.LE.IGM) GO TO 200                             DSN   00623
      IF (H.LE.EPS*ABS(CS(IHT,J,I))) GO TO 240                           DSN   00624
      IF (IAS.LE.0) GO TO 220                                            DSN   00625
      CS(JAH,J,I)=CS(JAH,J,I)+H                                          DSN   00626
      WRITE (9,210)I,J                                                   DSN   00627
  210 FORMAT (12H0IN MATERIAL,I3,6H,GROUP,I3,35H, SIG(G,GP) HAS BEEN TRU DSN   00628
     1NCATED     )                                                       DSN   00629
      GO TO 240                                                          DSN   00630
  220 CONTINUE                                                           DSN   00631
      CS(JC-1,JD-1,I)=CS(JC-1,JD-1,I)+H                                  DSN   00632
      WRITE (9,230)I,J                                                   DSN   00633
  230 FORMAT (12H0IN MATERIAL,I3,6H,GROUP,I3,40H, SIG(G,GP) HAS BEEN FLO DSN   00634
     1OWED           )                                                   DSN   00635
  240 CONTINUE                                                           DSN   00636
  250 CONTINUE                                                           DSN   00637
      IAS=0                                                              DSN   00638
      RETURN                                                             DSN   00639
  260 WRITE (9,270)                                                      DSN   00640
      RETURN                                                             DSN   00641
  270 FORMAT (62H0NUCLIDE REQUESTED NOT ON DISK OR NUCLIDE NUMBERS OUT O DSN   00642
     1F ORDER,6H  RECS)                                                  DSN   00643
  280 FORMAT (3A6,A4,,[2,A4,,I2,2A6,,I6,4A6)                             DSN   00644
  290 FORMAT (6E12.5)                                                    DSN   00645
      END                                                                DSN   00646
      SUBROUTINE READ (IARRAY,NCOUNT,HOL1,HOL2)                          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 (30,40,60,90), L                                            DSN   00658
C     NO MODIFICATION                                                   DSN   00659
30    IARRAY(J)=IV(I)                                                   DSN   00660
      J=J+1                                                             DSN   00661
      GO TO 80                                                          DSN   00662
C     REPEAT                                                            DSN   00663
40    L=IN(I)                                                           DSN   00664
      DO 50 M=1,L                                                       DSN   00665
      IARRAY(J)=IV(I)                                                   DSN   00666
50    J=J+1                                                             DSN   00667
      GO TO 80                                                          DSN   00668
C     INTERPOLATE                                                       DSN   00669
60    WRITE (9,120)HOL1,HOL2                                            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)HOL1,HOL2,J,(IARRAY(I),I=1,NCOUNT)                   DSN   00677
      IF (J-NCOUNT) 100,140,100                                         DSN   00678
100   WRITE (9,130)HOL1,HOL2                                            DSN   00679
      GO TO 70                                                          DSN   00680
110   FORMAT (1H0,2A6,I6/(10I12))                                       DSN   00681
120   FORMAT (44H0ATTEMPTING TO INTERPOLATE BETWEEN INTEGERS ,2A6)      DSN   00682
130   FORMAT (33H0INCORRECT NUMBER OF INPUT ITEMS ,2A6)                 DSN   00683
140   RETURN                                                            DSN   00684
      END                                                               DSN   00685
      SUBROUTINE READ (ARRAY,NCOUNT,HOL1,HOL2)                          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),IER)                                         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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      100   READ (10,40)(K(JJ),IN(JJ),V(JJ),JJ=7,12)                          DSN   00718
            JFLAG=1                                                           DSN   00719
      110   L=IN(I)-1                                                         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 (I.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)HOL1,HOL2,J,(ARRAY(I),I=1,NCOUNT)                    DSN   00746
      190   FORMAT (1HG,2A6,I6/(1P10E12.5))                                   DSN   00747
            IF (J-NCOUNT) 220,220,200                                         DSN   00748
      200   WRITE (9,210)HOL1,HOL2                                            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,MD,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), WO(MM), CL(MM,NM), MR(MM), AF(IFM), AB(MM) DSN   00758
           1, Z(MM), CP(49), CT(MM,ISC,ISC)                                   DSN   00759
            COMMON IA(1000)                                                   DSN   00760
            EQUIVALENCE (IA(191),IFR)                                         DSN   00761
            IS=ISC-1                                                          DSN   00762
      C     FORM RATED DIRECTIONS AND TEST INPUT DATA FOR ERRORS              DSN   00763
            E1=0.0                                                            DSN   00764
            M=MM                                                              DSN   00765
      10    B=W(M)                                                            DSN   00766
            C=D(M)                                                            DSN   00767
            A=M*C                                                             DSN   00768
            WO(M)=A                                                           DSN   00769
            E1=E1+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.-E1).GE.0.0) 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.IS) GO TO 110                                   DSN 00789
C     SPHERES AND SLABS  (IF 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 290                                    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 260                                                 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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839           CT(M,N+1,J)=(C*Z(M)*CT(M,N,J)-A*CT(M,N-1,J))/B                    DSN   00838
840     180   CONTINUE                                                          DSN   00839
841           AF(1)=1.                                                          DSN   00840
842           DO 190 I=2,IFM                                                    DSN   00841
843     190   AF(I)=FLOAT(I-1)*AF(I-1)                                          DSN   00842
844           DO 200 J=2,ISC                                                    DSN   00843
845           A=J-1                                                             DSN   00844
846           DO 200 N=J,ISC                                                    DSN   00845
847           K=N+J-1                                                           DSN   00846
848           KA=N-J+1                                                          DSN   00847
849           B=SQRT(2.*AF(KA)/AF(K))                                           DSN   00848
850           DO 200 M=1,MM                                                     DSN   00849
851     200   CT(M,N,J)=B*CT(M,N,J)*COS(A*CP(M))                                DSN   00850
852     C     STORE FUNCTIONS IN CL                                             DSN   00851
853           IR=1                                                              DSN   00852
854           DO 220 N=2,ISC                                                    DSN   00853
855           DO 220 J=1,N                                                      DSN   00854
856           K=(N+J)/2                                                         DSN   00855
857           KA=(N+J+1)/2                                                      DSN   00856
858           IF (K.NE.KA) GO TO 220                                            DSN   00857
859           DO 210 M=1,MM                                                     DSN   00858
860     210   CL(M,IR)=CT(M,N,J)                                                DSN   00859
861           IR=IR+1                                                           DSN   00860
862     220   CONTINUE                                                          DSN   00861
863           WRITE (9,390)                                                     DSN   00862
864           DO 250 J=1,ISC                                                    DSN   00863
865           JJ=J-1                                                            DSN   00864
866           NA=1                                                              DSN   00865
867           NB=9                                                              DSN   00866
868     230   NC=MIN0(NB,ISC)                                                   DSN   00867
869           WRITE (9,400)(N,JJ,N=NA,NC)                                       DSN   00868
870           DO 240 M=1,MM                                                     DSN   00869
871     240   WRITE (9,380) M,(CT(M,N,J),N=NA,NC)                               DSN   00870
872           NA=NA+9                                                           DSN   00871
873           NB=NB+9                                                           DSN   00872
874           IF (NA.LE.ISC) GO TO 230                                          DSN   00873
875     250   CONTINUE                                                          DSN   00874
876           GO TO 290                                                         DSN   00875
877     260   NA=1                                                              DSN   00876
878           NB=9                                                              DSN   00877
879     270   NC=MIN0(NB,IS)                                                    DSN   00878
930           WRITE (9,370)(N,N=NA,NC)                                          DSN   00879
941           DO 280 M=1,MM                                                     DSN   00880
942     280   WRITE (9,380) M,(CL(M,N),N=NA,NC)                                 DSN   00881
943           NA=NA+9                                                           DSN   00882
944           NB=NB+9                                                           DSN   00883
945           IF (NA.LE.IS) GO TO 270                                           DSN   00884
946     290   WRITE (9,410)(M,MR(M),W(M),D(M),U(M),M=1,MM)                      DSN   00885
947           RETURN                                                            DSN   00886
948     300   WRITE (9,330)                                                     DSN   00887
949     310   IER=1                                                             DSN   00888
950           RETURN                                                            DSN   00889
951     320   WRITE (9,350)                                                     DSN   00890
952           GO TO 310                                                         DSN   00891
953     330   FORMAT (28H0INCORRECT DIRECTION COSINES)                          DSN   00892
954     340   FORMAT (18H0INCORRECT WEIGHTS)                                    DSN   00893
955     350   FORMAT (28H0ARRAY INDEX EXCEEDS MAXIMUM)                          DSN   00894
956     360   FORMAT (37H0ANISOTROPIC SCATTER-SLAB OR SPHERE  ,27HLEGENDRE POLYN DSN   00895
937           1OMIALS PN(MU))                                                   DSN   00896
958     370   FORMAT (17H0DIRECTION NUMBER,9(3X,2HN=I3,3X))                     DSN   00897
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      380   FORMAT (7X,I5,5X,1P4E11.4)                                        DSN     00948
      390   FORMAT (41H04-ISOTROPIC SCATTER-CYLINDER, ASSOCIATED, 38H LEGENDRE DSN     00949
           1POLYNOMIALS P(N,R)COS(R*PHI)//)                                   DSN     00950
      400   FORMAT (17H0DIRECTION NUMBER,9(1X,2HN=I2,3H R=I2,1X))             DSN     00951
      410   FORMAT (14H0DIRECTION NO.,25H  REFLECTED DIRECTION NO.,5X,6HWEIGHT DSN     00952
           1,7X,20H  DIRECTION COSINE  ,20H WEIGHT X DIRECTION //(5X,I4,13X,I4 DSN     00953
           2,14X,1PE14.7,5X,E14.7,6X,E14.7))                                  DSN     00954
            END                                                               DSN     00955
            SUBROUTINE CLEAR (C,IMT,IHM,IGM,MT)                               DSN     00956
            COMMON [A(1000),A(9000)                                           DSN     00957
            DIMENSION C((HM,IGM,MT)                                           DSN     00958
            REWIND 4                                                          DSN     00959
            WRITE (4)C                                                        DSN     00960
            K=1                                                               DSN     00961
      10    J=1                                                               DSN     00962
      20    I=1                                                               DSN     00963
      30    IF (I.NE.IMT) C(I,J,K)=0.                                         DSN     00964
            IF (I.EQ.IMT-2) C(I,J,K)=C(IMT,J,K)                               DSN     00965
            I=I+1                                                             DSN     00966
            IF (I.LE.IHM) GO TO 30                                            DSN     00967
            J=J+1                                                             DSN     00968
            IF (J.LE.IGM) GO TO 20                                            DSN     00969
            K=K+1                                                             DSN     00970
            IF (K.LE.MT) GO TO 10                                             DSN     00971
            RETURN                                                            DSN     00972
            END                                                               DSN     00973
            SUBROUTINE ADJREV (XKI,VE,Q,XN,IGM,IFN,IHM,IM,LC,C,IHM,MT,NL,IMT) DSN     00974
      C                                                                       DSN     00975
      C     ADJOINT REVERSALS                                                 DSN     00976
            DIMENSION XKI(IGM), VE(IGM), Q(IM,IGM), XN(IM,IGM), C(IHM,IGM,MT) DSN     00977
            COMMON [A(1000)                                                   DSN     00978
            IHS=IABS(IA(14))                                                  DSN     00979
            IG=1                                                              DSN     00980
            K=IGM                                                             DSN     00981
      10    IF (K.LE.IG) GO TO 20                                             DSN     00982
            T=XKI(IG)                                                         DSN     00983
            TA=VE(IG)                                                         DSN     00984
            XKI(IG)=XKI(K)                                                    DSN     00985
            VE(IG)=VE(K)                                                      DSN     00986
            XKI(K)=T                                                          DSN     00987
            VE(K)=TA                                                          DSN     00988
            IG=IG+1                                                           DSN     00989
            K=K-1                                                             DSN     00990
            GO TO 10                                                          DSN     00991
      20    IF (IABS(IGM).NE.1) GO TO 50                                      DSN     00992
            DO 40 I=1,IM                                                      DSN     00993
            IG=1                                                              DSN     00994
            K=IGM                                                             DSN     00995
      30    IF (K.LE.IG) GO TO 40                                             DSN     00996
            T=Q(I,IG)                                                         DSN     00997
            Q(I,IG)=Q(I,K)                                                    DSN     00998
            Q(I,K)=T                                                          DSN     00999
            K=K-1                                                             DSN     01000
            IG=IG+1                                                           DSN     01001
            GO TO 30                                                          DSN     01002
      40    CONTINUE                                                          DSN     01003
      50    IF (LC.GE.IABS(IFN)) GO TO 80                                     DSN     01004
            DO 70 I=1,IM                                                      DSN     01005
            IG=1                                                              DSN     01006
            K=IGM                                                             DSN     01007
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      60    IF (K.LE.IG) GO TO 70                                          DSN   00958
            T=XN(I,IG)                                                     DSN   00959
            XN(I,IG)=XN(I,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=4,IHM                                                DSN   00967
            J=IHM+1-JJ                                                     DSN   00968
            IG=1                                                           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+1                                                         DSN   00974
            GO TO 100                                                      DSN   00975
      90    L=L+IGM                                                        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                                                        DSN   00983
            K=K-1                                                          DSN   00984
            GO TO 100                                                      DSN   00985
     110    CONTINUE                                                       DSN   00986
            RETURN                                                         DSN   00987
            END                                                            DSN   00988
            SUBROUTINE IFUNC (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 (IGM.EQ.0.AND.IABS(IEVT).LE.0) GO TO 40                     DSN   00996
            IF (IPVT.NE.1) GO TO 20                                        DSN   00997
            IF (PV.EQ.0.0) GO TO 40                                        DSN   00998
            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)=T                                                     DSN   01008
            WRITE (6,80) (XKI(I),XKE(I),VE(I),I,I=1,IGP)                   DSN   01009
            RETURN                                                         DSN   01010
     40     WRITE (6,90)                                                   DSN   01011
     50     IER=1                                                          DSN   01012
            RETURN                                                         DSN   01013
     60     WRITE (6,100)                                                  DSN   01014
            GO TO 50                                                       DSN   01015
     70     WRITE (6,110)I                                                 DSN   01016
            GO TO 50                                                       DSN   01017
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1019    80    FORMAT (1H0/8X,3HCMI,12X,6HCMI/PV,7X,12H VELOCITIES ,7H  GROUP//(1 DSN     01018
1020         1P3E16.7,15))                                                      DSN     01019
1021    90    FORMAT (34HOND DISTRIBUTED SOURCE SPECIFIED FOR SOURCE ,12HTYPE PR DSN     01020
1022         1OBLEM,//)                                                         DSN     01021
1023   100    FORMAT (17HOPV=0 WHEN IPVT=1,//)                                   DSN     01022
1024   110    FORMAT (24HOZERO VELOCITY, GROUP=,I4,//)                           DSN     01023
1025          END                                                                DSN     01024
1026    C     MODIFY RADII-COMPUTE ,PRINT AREAS AND VOLUMES-GEOMETRIC FUNCTIONS  DSN     01025
1027          SUBROUTINE RHAVGF (RA,AA,R,V,RM,RAV,MA,M,D,DA,DB,DC,DS,IP,IM,IZM,M DSN     01026
1028         1M)                                                                 DSN     01027
1029          COMMON IA(1000),A(10000)                                           DSN     01028
1030          DIMENSION RA(IP), R(IP), RM(IZM), MA(IM), AA(IP), V(IP), RAV(IP),  DSN     01029
1031         1M(MM), D(MM), DA(IP,MM), DB(IP,MM), DC(IP,MM), DS(IP,MM)           DSN     01030
1032          EQUIVALENCE (IGE,IA(5)), (ICC,IA(33)), (IEVT,IA(11)), (EV,A(1))    DSN     01031
1033          EQUIVALENCE (IA(491),IER)                                          DSN     01032
1034          IF (ICC.NE.0) GO TO 20                                             DSN     01033
1035          DO 10 I=1,IM                                                       DSN     01034
1036          RA(I+1)=R(I+1)                                                     DSN     01035
1037          IF (RA(I+1).LE.0.0) GO TO 70                                       DSN     01036
1038          IF (R(I+1).LE.R(I)) GO TO 80                                       DSN     01037
1039    10    CONTINUE                                                           DSN     01038
1040          RA(1)=0.0                                                          DSN     01039
1041    20    IF (IABS(IEVT)-4) 100,30,50                                        DSN     01040
1042    30    DO 40 I=1,IM                                                       DSN     01041
1043          K=MA(I)                                                            DSN     01042
1044          B=1.+EV*RM(K)                                                      DSN     01043
1045          RA(I+1)=RA(I)+(R(I+1)-R(I))*B                                      DSN     01044
1046          IF (B.LT.0.0) GO TO 90                                             DSN     01045
1047    40    CONTINUE                                                           DSN     01046
1048          GO TO 140                                                          DSN     01047
1049    50    DO 60 J=1,IP                                                       DSN     01048
1050    60    RA(J)=EV*R(J)/R(IP)                                                DSN     01049
1051          GO TO 100                                                          DSN     01050
1052    70    WRITE (9,110)                                                      DSN     01051
1053          GO TO 100                                                          DSN     01052
1054    80    WRITE (9,120)I                                                     DSN     01053
1055          GO TO 100                                                          DSN     01054
1056    90    WRITE (9,130)                                                      DSN     01055
1057   100    IER=1                                                              DSN     01056
1058          RETURN                                                             DSN     01057
1059   110    FORMAT (31H0RADIUS LESS THAN OR EQUAL ZERO)                        DSN     01058
1060   120    FORMAT (31H0R(I+1) LESS THAN OR EQUAL R(I),2HI=I3)                 DSN     01059
1061   130    FORMAT (39H0NEGATIVE FINAL RADIUS FOR DELTA OPTION)                DSN     01060
1062   140    IF (ICC.NE.0.AND.IABS(IEVT).LE.3) GO TO 200                        DSN     01061
1063          IF (IGE.NE.1) GO TO 160                                            DSN     01062
1064          DO 150 J=1,IP                                                      DSN     01063
1065   150    AA(J)=1.0                                                          DSN     01064
1066          GO TO 180                                                          DSN     01065
1067   160    AF=A(IGE+20)                                                       DSN     01066
1068          IM=IGE-1                                                           DSN     01067
1069          DO 170 J=1,IP                                                      DSN     01068
1070   170    AA(J)=AF*RA(J)**IM                                                 DSN     01069
1071   180    VF=A(IGE+23)                                                       DSN     01070
1072          IF (VF.GT.0.0) GO TO 200                                           DSN     01071
1073          WRITE (9,190)                                                      DSN     01072
1074   190    FORMAT (24H0INCORRECT VOLUME FACTOR,//)                            DSN     01073
1075          GO TO 100                                                          DSN     01074
1076   200    DO 210 I=1,IM                                                      DSN     01075
1077          RAV(I)=.5*(RA(I+1)+RA(I))                                          DSN     01076
1078   210    V(I)=VF*(AA(I+1)*RA(I+1)-AA(I)*RA(I))                              DSN     01077
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      IF (ICC.GT.0) GO TO 230                                           DSN   01078
      WRITE (9,220)(RAV(I),AA(I),V(I),AA(I),I,I=1,IP)                   DSN   01079
  220 FORMAT (1H0/6A,10HAVG RADIUS,1X,6HRADIUS,10X,6HVOLUME,12X,4HAREA/ DSN   01080
     1/(1P4E16.7,I5))                                                   DSN   01081
  230 DO 270 M=1,MM                                                     DSN   01082
      AB=U(M)                                                           DSN   01083
      AC=AMS(AB)                                                        DSN   01084
      MO=M(M)                                                           DSN   01085
      AE=AB*AB                                                          DSN   01086
      AF=M(M-1)                                                         DSN   01087
      AG=U(M-1)*AF                                                      DSN   01088
      DO 270 I=1,IM                                                     DSN   01089
      AH=AA(I+1)                                                        DSN   01090
      BC=AA(I)                                                          DSN   01091
      DA(I,M)=AC*(BB*BC)                                                DSN   01092
      IF (AB.LE.0.0) GO TO 240                                          DSN   01093
      DS(I,M)=AH*AC                                                     DSN   01094
      GO TO 250                                                         DSN   01095
  240 DS(I,M)=BC*AC                                                     DSN   01096
  250 IF (AD.NE.0.0) GO TO 260                                          DSN   01097
      DC(I,M)=0.0                                                       DSN   01098
      GO TO 270                                                         DSN   01099
  260 DC(I,M)=((BC-BB1*(AE+AG)+DC(I,M-1)*AF)/AD                         DSN   01100
  270 DH(I,M)=DA(I,M)+DC(I,M)                                           DSN   01101
  280 RETURN                                                            DSN   01102
      END                                                               DSN   01103
      SUBROUTINE MIACX (C,MD,MC,XMD,IMM,IGM,MT,MS,EV,IEVT,ICC)          DSN   01104
C                                                                       DSN   01105
C     MIX AND PRINT CROSS SECTIONS                                      DSN   01106
      DIMENSION C(IMM,IGM,MT), MM(MS), MC(MS), XMD(MS)                  DSN   01107
      COMMON IA(1000)                                                   DSN   01108
      EQUIVALENCE (IMS,IA(1))                                           DSN   01109
      IF (MS.EQ.0) GO TO 60                                             DSN   01110
      DO 50 K=1,MS                                                      DSN   01111
      K=MD(M)                                                           DSN   01112
      L=MC(K)                                                           DSN   01113
      A=XMD(M)                                                          DSN   01114
      DO 50 I=1,IMM                                                     DSN   01115
      DO 50 J=1,IGM                                                     DSN   01116
      IF (L) 20,10,20                                                   DSN   01117
   10 C(I,J,K)=C(I,J,K)*A                                               DSN   01118
      GO TO 50                                                          DSN   01119
   20 IF (A) 30,40,30                                                   DSN   01120
   30 C(I,J,K)=C(I,J,K)+A*C(I,J,L)                                      DSN   01121
      GO TO 50                                                          DSN   01122
   40 C(I,J,K)=C(I,J,K)*EV                                              DSN   01123
   50 CONTINUE                                                          DSN   01124
      IF (IABS(IEVT).EQ.3.AND.ICC.NE.0) GO TO 100                       DSN   01125
      WRITE (9,150)(MM(I),C(I),XMD(I),I,I=1,MS)                         DSN   01126
   60 IF (IA(14).LT.0) GO TO 100                                        DSN   01127
      DO 90 I=1,MT                                                      DSN   01128
      WRITE (9,110)I                                                    DSN   01129
      KA=1                                                              DSN   01130
      KB=8                                                              DSN   01131
   70 KC=MIN0(KB,IGM)                                                   DSN   01132
      WRITE (9,120)(K,K=KA,KC)                                          DSN   01133
      WRITE (9,130)                                                     DSN   01134
      DO 80 J=1,IMM                                                     DSN   01135
   80 WRITE (9,140)J,(C(J,K,I),K=KA,KC)                                 DSN   01136
      KA=KA+8                                                           DSN   01137
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      KH=KB+h                                                           DSN  01138
      IF (KA.LE.IGM) GO TO 70                                           DSN  01139
 90   CONTINUE                                                          DSN  01140
 100  IF (IABS(IEV1).NE.3) MS=0                                         DSN  01141
      RETURN                                                            DSN  01142
 110  FORMAT (1H0///26H CROSS SECTION OF MATERIAL,I3/)                  DSN  01143
 120  FORMAT (1H0,5X,8(2X,5HGROUP,I3,3X))                               DSN  01144
 130  FORMAT (1H0)                                                      DSN  01145
 140  FORMAT (I4,1P8E13.5)                                              DSN  01146
 150  FORMAT (1H0/16H MIXTURE NUMBER ,16H   MIX COMMAND  ,24H MATERIAL A DSN  01147
     1TOMIC DENSITY/(4X,I4,8X,I8,8X,E16.8,8X,I8))                       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/(1P10E12.5))        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//)                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(IGP)=QG(IGP)+QG(IG)                                          DSN     01200
1202            IF (XNF.EQ.0.) GO TO 50                                         DSN     01201
1203            E1=XNF/QG(IGP)                                                  DSN     01202
1204            DO 40 IG=1,IGM                                                  DSN     01203
1205            QG(IG)=E1*QG(IG)                                                DSN     01204
1206            DO 30 M=1,MM                                                    DSN     01205
1207     30     Q(M,IG)=E1*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     SURFACE 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(1000),A(10000)                                        DSN     01227
1229            COMMON /ALPHA/ LOAFH,TABA,SCATT,SCATTP,BAL,XLAMAX,XLAMIN,EVMAX,EVM ALPHA 00002
1230           1IN,IPHE,FSUM,INEG,KK                                            ALPHA   00003
1231     C                                                                      ALPHA   00004
1232            EQUIVALENCE (A(14),ALA), (A(11),XLAL), (A(12),XLAM), (A(13),XNPM), DSN  01229
1233           1 (A(10),EPS), (A(3),EPS), (A(7),XLAR), (A(31),EQP), (A(32),EQ),  DSN  01230
1234           2(A(1),EV), (A(33),EVP), (A(34),E4), (A(35),E2), (IA(39),ICVT), (A( DSN  01231
1235           32),EVP), (IA(31),KSMS2), (IA(11),IFVT), (A(36),EVPP), (A(37),XLAPP DSN  01232
1236           4), (A(30),XLAP), (IA(40),ICNT)                                  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            EQA=((XLAPP-1.)*F*EVP*EV-(XLAP-1.)*E*EV*EVPP+(XLA-1.)*D*EVPP*EVP)/ DSN  01244
1248           1DEN                                                             DSN     01245
1249            EQB=-(XLAPP*F*(EVP*EV1-XLAP*E*(EV*EVPP)+XLA*(EVPP*EVP)*D)/DEN   DSN     01246
1250            EQC=(XLAPP*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 40                                        DSN     01250
1254            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(R))/(2.*EQC)                                    DSN   01256
1260          EV2=(-EQB-SQRT(R))/(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)/(XLAP-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          E1=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+XNPH*FQ*F1                                               DSN   01274
1278    60    IF ((XLAPP-1.)/(XLAP-1.).GT.0.0) GO TO 110                     DSN   01275
1279          H=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    ICNT=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.0.0) 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,K000FX)                                         DSN   01296
1300          GO TO (140,120), K000FX                                        DSN   01297
1301   120    IF (IABS(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 (140,130), 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 A(1000),A(10000)                                        DSN   01315
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      COMMON /ALPHA/ LOAFH,TABA,SCATT,SCATTP,HAL,XLAMAX,XLAMIN,EVMAX,EVM ALPHA   00002
     1IN,IPRE,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),EQ),  DSN    01318
     2(A(1),EV), (A(33),EVP), (A(34),E1), (A(35),E2), (IA(39),ICVT), (A( DSN    01319
     32),EVM), (IA(31),KSHSP), (IA(14),IEVT), (A(36),EVPP), (A(37),XLAPP DSN    01320
     4), (A(30),XLAP), (IA(99),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
      E1=SIGN(XLAM,E1)                                                  DSN    01346
60    EV=EV+XNPM*EQ*E1                                                  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+80                                                    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 (E1.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 ( IABS (IEVT) .EQ. 2 ) GO TO 130                               DSN      01374
C                                                                       DSN      01375
C     MODIFY PARAMETERS                                                 DSN      01376
C                                                                       DSN      01377
      KSA52=3                                                           DSN      01378
      RETURN                                                            DSN      01379
C                                                                       DSN      01380
C     ANOTHER OUTER ITERATION                                           DSN      01381
C                                                                       DSN      01382
130   KSA52=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,XND,XJJ,T,SUMT,SUMZ,IHM,IGM DSN      01390
     1,MT,IM,MM,NM,ISCT,IT,IP,IZ,IS,MA,MZ,IZM,F,CS,V,SR,CT,CA,XNN,XNO,ST DSN      01391
     2,XNR,W,RS,RQ,HA,D,AV,WD,DF,AR,KDT)                                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,IPHF,FSUM,INEG,KK                                              ALPHA    00003
C                                                                       ALPHA    00004
      DIMENSION C(IMM,IGM,MT), SA(IM,MM), CL(MM,NM), XN(IM,IGM), XJ(IGM, DSN      01396
     1IM,NM), CH(IM,ISCT), Q(IS,IGM), B(IGM,MM), XND(IP,MM), XJJ(IM,NM), DSN      01397
     2 T(IZ,IT), SUMT(IT), SUMZ(IT), MA(IM), MZ(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), HA(IP), RS(IM), D(MM), AV(IP), WD(MM), DF(IM), AR(IP), DSN      01400
     5 KDT(IGM)                                                         DSN      01401
      COMMON IA(1000),A(10000)                                          DSN      01402
      EQUIVALENCE (ITH,IA(2)), (IG,IA(36)), (IMT,IA(13)), (IQM,IA(21)),  DSN      01403
     1(HF,A(5)), (DY,A(6)), (DZ,A(7)), (IGE,IA(5)), (IBR,IA(7)), (IDT,IA DSN      01404
     2(29)), (JAT,IA(94)), (JDA,IA(70)), (JDB,IA(71)), (JDC,IA(72)), (JD DSN      01405
     3S,IA(73)), (ICVT,IA(39)), (ID1,IA(23)), (ID2,IA(24)), (JNA,IA(93)) DSN      01406
     4, (JNI,IA(95)), (KMR,IA(114)), (JNE,IA(97)), (JOR,IA(99)), (IIC,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)), (JSDA,IA(175)), (JNBA,IA(176)), (JNLA,IA(159)), (JRLA,IA DSN      01412
     2(160))                                                            DSN      01413
      EQUIVALENCE (IEVT,IA(11))                                         DSN      01414
      IHS=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=JSDA+IG                                                       DSN      01430
      JNB=JNBA+IG                                                       DSN      01431
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      JNL=JNLA+IG                                                       DSN   01432
      JRL=JRLA+IG                                                       DSN   01433
      S=0.0                                                             DSN   01434
      R=0.0                                                             DSN   01435
      TAB=A(JTG)                                                        DSN   01436
      TABA=0.0                                                          DSN   01437
      IF (TAB.GE.0.0) GO TO 20                                          DSN   01438
      TABA=-TAB                                                         DSN   01439
   20 CONTINUE                                                          DSN   01440
C     ISOTROPIC SOURCE NOT INCLUDING SELF SCATTER                       DSN   01441
      IF (ITH.GT.0) IHA=IHT-1                                           DSN   01442
      DO 60 I=1,IM                                                      DSN   01443
      L=HA(I)                                                           DSN   01444
      L=IABS(MZIL(L))                                                   DSN   01445
      AS=0.0                                                            DSN   01446
      IF (IQM.EQ.1) AS=Q(I,IG)                                          DSN   01447
      IF (IPRE.GT.1) 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+1                                                          DSN   01454
      IHX=MIN0(IHM,IHS+IG-1)                                            DSN   01455
   40 K=IS+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+1                                                           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
      SW(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=((HF/(DY*ABS(AT+TAB)+XT))**2)*AT               DSN   01471
      IF (DZ.GT.0.0) SRI=SRI+((BF/(DZ*ABS(AT+TAB)+XT))**2)*AT           DSN   01472
      CT(I)=V(I)*(SRI+AT+TAB)                                           DSN   01473
   60 CA(I)=V(I)*(SRI+AA+TAB)                                           DSN   01474
      A(18)=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=1,IM                                                     DSN   01482
      DO 70 M=1,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=1,MM                                                      DSN   01487
   80 IF (D(M).LE.0.0) AA=AA-WD(M)                                      DSN   01488
      DO 90 M=1,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 160                                          DSN 01504
      AH=FLOAT(N)+.5                                                    DSN 01505
      AA=AH*V(I)*C(IH,IG,J)*DF(I)                                       DSN 01506
      IF (AA.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 IRS=((N+1)*(N+1))/6                                               DSN 01514
      IRT=IRS+(2*N+1)/6                                                 DSN 01515
      DO 150 IR=IRS,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
      XNO(M)=0.0                                                        DSN 01533
      IF (IHM.EQ.2) RO(M)=O(M,IG)                                       DSN 01534
      IF (IHR.GT.0) XNO(M)=H(IG,M)                                      DSN 01535
  210 CONTINUE                                                          DSN 01536
      GO TO 260                                                         DSN 01537
  220 A(JNL)=0.0                                                        DSN 01538
      A(JRL)=0.0                                                        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 XNO(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,XNO,A(JOA),A(JOB),A(JOC),A(JOS),IM DSN 01550
     1,MM,ISCT,NM,IP,A(JNA),XNN,ST,CS,SR,W,D,A(JNI),XNO,IA(KMR),A(JNE),C DSN 01551
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      2T,RS,RQ,W),AV,XNR,A(JOR),A(LOAFR))                               DSN 01552
C     GROUP CODE                                                        DSN 01553
  270 SC=0.0                                                            DSN 01554
      AG=0.0                                                            DSN 01555
      E1=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 E1=E1+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=MA(I)                                                           DSN 01567
      L=IABS(M7(L))                                                     DSN 01568
      FG=FG+V(I)*C(IHT-1,IG+L)*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(JDG)=XG/A(JVE)                                                  DSN 01573
      A(JSD)=E1-SC-AG                                                   DSN 01574
      A(JNH)=A(JOG)+A(JFG)+A(JSN)-A(JNL)-AG-A(JSD)                      DSN 01575
      IF (IHW.EQ.0) GO TO 310                                           DSN 01576
      DO 300 M=1,MM                                                     DSN 01577
  300 J(IG,MM)=XNO(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 350                                          DSN 01581
      DO 330 M=1,MM                                                     DSN 01582
      E1=W(M)                                                           DSN 01583
      DO 330 N=1,NM                                                     DSN 01584
      E2=E1*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)XND                                                  DSN 01600
  380 IF (ID1.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.ID1) 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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      DO 440 I=1,IT                                                     DSN 01612
      IF (IG.EQ.1) SUMT(I)=0.0                                          DSN 01613
  440 SUMZ(I)=0.0                                                       DSN 01614
      DO 540 L=1,IZM                                                    DSN 01615
      DO 450 I=1,IT                                                     DSN 01616
  450 T(L,I)=0.0                                                        DSN 01617
      DO 480 I=1,IM                                                     DSN 01618
      IF (MA(I).NE.L) GO TO 480                                         DSN 01619
      U=V(I)                                                            DSN 01620
      AN=ANN(I)                                                         DSN 01621
C     FIXED SOURCF                                                      DSN 01622
      IF (IABS(IQM).EQ.1) T(L,1)=T(L,1)+U*Q(I,IG)                       DSN 01623
      LA=IABS(MZ(L))                                                    DSN 01624
C     FISSIONS                                                          DSN 01625
      IF (ITH.GT.0) GO TO 460                                           DSN 01626
      T(L,2)=T(L,2)+U*F(I)*A(JKE)                                       DSN 01627
      GO TO 470                                                         DSN 01628
  460 T(L,2)=T(L,2)+U*F(I)*C(IHT-1,IG,LA)*DF(I)                         DSN 01629
  470 T(L,3)=T(L,3)+ST(I)                                               DSN 01630
C     SELF-SCATTER                                                      DSN 01631
      T(L,4)=T(L,4)+CS(I)*AN                                            DSN 01632
      T(L,5)=T(L,5)+CT(I)*AN                                            DSN 01633
C     ABSORPTION                                                        DSN 01634
      T(L,6)=T(L,6)+CA(I)*AN                                            DSN 01635
C     TOTAL FLUX ANU FISSION DENSITY                                    DSN 01636
      T(L,9)=T(L,9)+AN*U                                                DSN 01637
      T(L,15)=T(L,15)+AN*U*C(IHT-1,IG,LA)*DF(I)                         DSN 01638
  480 CONTINUF                                                          DSN 01639
      LMAX=0                                                            DSN 01640
      LMIN=IM+2                                                         DSN 01641
      DO 490 I=1,IM                                                     DSN 01642
      IF (MA(I).NE.L) GO TO 490                                         DSN 01643
      IF (I.GE.LMAX) LMAX=I                                             DSN 01644
      IF (LMIN.GT.I) LMIN=I                                             DSN 01645
  490 CONTINUE                                                          DSN 01646
      DO 520 M=1,MM                                                     DSN 01647
C     LEFT CURRENT                                                      DSN 01648
      T(L,7)=T(L,7)+XND(LMIN,M)*WD(M)                                   DSN 01649
      E1=XND(LMAX+1,M)*W(M)                                             DSN 01650
C     RIGHT FLUX                                                        DSN 01651
      T(L,11)=T(L,11)+E1                                                DSN 01652
      E=D(M)                                                            DSN 01653
      IF (E.LE.0.0) GO TO 500                                           DSN 01654
      IF (E.LE.0.0) GO TO 500                                           DSN 01655
C     RIGHT FLOW                                                        DSN 01656
      T(L,12)=T(L,12)+E*E1                                              DSN 01657
C     RIGHT CURRENTS                                                    DSN 01658
  500 T(L,13)=T(L,13)+E*E1                                              DSN 01659
      IF (ISCT.EQ.0) GO TO 520                                          DSN 01660
      DO 510 N=1,NM                                                     DSN 01661
  510 T(L,N+15)=T(L,N+15)+E1*CL(M,N)                                    DSN 01662
  520 CONTINUE                                                          DSN 01663
C     RIGHT LEAKAGE                                                     DSN 01664
      T(L,14)=T(L,13)*AV(LMAX+1)                                        DSN 01665
C     NET LEAKAGE                                                       DSN 01666
      T(L,7)=T(L,14)-T(L,7)*AV(LMIN)                                    DSN 01667
C     IN SCATTER                                                        DSN 01668
      T(L,3)=T(L,3)-T(L,4)-T(L,2)                                       DSN 01669
C     OUT SCATTER                                                       DSN 01670
      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)/4(JVF)                                              DSN     01675
            DO 330 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 (J,560)(L,(T(L,I),I=1,8),L=1,IZM)                           DSN     01680
            WRITE (J,570)(SUMZ(I),I=1,M)                                      DSN     01681
            WRITE (J,580)(L,(T(L,I),I=9,15),L=1,IZM)                          DSN     01682
            WRITE (J,570)(SUMZ(I),I=9,15)                                     DSN     01683
            IF (ISCT.LE.1) GO TO 550                                          DSN     01684
            WRITE (J,590)((L,(T(L,I),I=16,IT)),L=1,IZM)                       DSN     01685
            WRITE (J,570)(SUMZ(I),I=16,IT)                                    DSN     01686
      550   IF (IG.NE.IGM) GO TO 340                                          DSN     01687
            WRITE (J,600)                                                     DSN     01688
            WRITE (J,560)L,(SUMT(I),I=1,8)                                    DSN     01689
            WRITE (J,580)L,(SUMT(I),I=9,15)                                   DSN     01690
            IF (ISCT.LE.1) GO TO 340                                          DSN     01691
            WRITE (J,590)L,(SUMT(I),I=16,IT)                                  DSN     01692
            GO TO 340                                                         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,1PBE14.6))                  DSN     01696
      570   FORMAT (7H0 TOTAL,1PBE14.6,///)                                   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 DSN     01699
           2SSION DENS //(I4,3X,1P7E14.6))                                    DSN     01700
      590   FORMAT (6H0RIGHT CURRENTS - ANISOTROPIC SCATTERING,22H ISCT GREAT  DSN     01701
           1ER THAN ONE//7H ZONE  /(I4,3X,1PBE14.6))                          DSN     01702
      600   FORMAT (1H0,///,29H TOTAL BALANCE FOR ALL GROUPS,///)             DSN     01703
            END                                                               DSN     01704
            SUBROUTINE INNER (SAT,SA,CH,XJJ,CL,XND,DA,DH,DC,DS,IM,MM,ISCT,NM,I DSN     01705
           1P,XNA,XMN,ST,CS,SR,W,D,XNI,XNO,MM,ANE,CT,RS,RQ,WD,AV,XNR,ANOR,QA) DSN     01706
      C                                                                       DSN     01707
      C     INNER ITERATION LOOP FOR ONE GROUP                                DSN     01708
            COMMON /ALPHA/ LOAFG,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(4000),A(10000)                                          DSN     01711
            DIMENSION SAT(IM,MM), SA(IM,MM), CH(IM,ISCT), XJJ(IM,NM), CL(MM,NM DSN     01712
           1), XND(IP,MM), DA(IP,M), DB(IP,MM), DC(IP,MM), DS(IP,MM), XNA(IM) DSN     01713
           2, XMN(IM), ST(IM), CS(IM), SR(IM), W(MM), D(MM), XNI(MM), XNO(MM), DSN     01714
           3 ANR(MM), XNE(MM), CT(IM), RS(IM), RQ(MM), WD(MM), AV(IP), XNR(IM), DSN     01715
           4 ANOR(M,1), QA(IM,MM)                                             DSN     01716
            EQUIVALENCE (IG,IA(36)), (IGE,IA(5)), (LC,IA(32)), (IBR,IA(7)), (I DSN     01717
           1BL,IA(6)), (EPS,A(17)), (IIC,IA(17)), (XITR,A(18)), (XITA,A(19)), DSN     01718
           2(IIL,IA(30)), (IBM,IA(41)), (EPSA,A(4)), (ICVT,IA(39)), (JNL,A,IA(1 DSN     01719
           359)), (JRL,A,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    QA(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)=XNH(I)                                 DSN  01730
      ST(I)=XNN(I)*CS(I)+SR(I)                      DSN  01731
      XNH(I)=0.0                                    DSN  01732
      IF (ISCT.LT.1) GO TO 80                       DSN  01733
      DO 30 M=1,MM                                  DSN  01734
30    SAT(I,M)=SA(I,M)                              DSN  01735
      DO 70 N=1,ISCT                                DSN  01736
      E1=(FLOAT(N)+.5)*CH(I,N)                      DSN  01737
      IF (IGE.EQ.2) GO TO 50                        DSN  01738
      E2=E1*XJJ(I,N)                                DSN  01739
      DO 40 M=1,MM                                  DSN  01740
40    SAT(I,M)=SAT(I,M)+E2*CL(M,N)                  DSN  01741
      GO TO 70                                      DSN  01742
50    IHS=((N+1)*(N+1))/4                           DSN  01743
      IRT=IHS+(2*N+1)/4                             DSN  01744
      DO 60 IR=IHS,IRT                              DSN  01745
      E2=E1*XJJ(I,IR)                               DSN  01746
      DO 60 M=1,MM                                  DSN  01747
60    SAT(I,M)=SAT(I,M)+E2*CL(M,IR)                 DSN  01748
70    CONTINUE                                      DSN  01749
80    CONTINUE                                      DSN  01750
C     COMPUTE ANGULAR FLUX AND NEUTRON SUMS         DSN  01751
      ITRIG=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
      IT=IP                                         DSN  01757
      IS=IP+1                                       DSN  01758
      IF (IBR.EQ.1) GO TO 100                       DSN  01759
      XNI(M)=XNO(M)                                 DSN  01760
      IF (IBR.EQ.2) XNI(M)=RO(M)                    DSN  01761
      GO TO 110                                     DSN  01762
100   K=MR(M)                                       DSN  01763
      XNO(M)=XNO(K)                                 DSN  01764
      XNI(M)=XNO(K)                                 DSN  01765
110   IF (W(M).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=XNO(M)                                   DSN  01783
C     COMPUTE INWARD OR OUTWARD NEUTRON FLOW        DSN  01784
200   NFFU=0                                        DSN  01785
      DO 290 J=1,IM                                 DSN  01786
      I=IABS(IT-J)                                  DSN  01787
      K=IABS(IS-J)                                  DSN  01788
      TEMP=CT(I)                                    DSN  01789
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1749            XND(K,M)=XNMM                                                   DSN     01790
1800            E1=ST(I)                                                        DSN     01791
1801            IF (ISCT.GT.0) E1=E1+SAT(I,M)                                   DSN     01792
1802            IF (CT(I).GE.0.0) GO TO 210                                     DSN     01793
1803            E1=E1+TARA*QA(I,M)*A(JV-1+I)                                    DSN     01794
1804            CT(I)=CT(I)+TMBA*A(JV-1+I)                                      DSN     01795
1805            INEG=1                                                          DSN     01796
1806    210     CONTINUE                                                        DSN     01797
1807            E2=(XNMM*QA(I,M)+XNF(I)*DC(I,M)*E1)/(DB(I,M)+CT(I))             DSN     01798
1808            E3=XNF(I)                                                       DSN     01799
1809            E4=XNMM                                                         DSN     01800
1810            XNF(I)=E2+E3-XNF(I)                                             DSN     01801
1811            XNMM=E3+E2-XNMM                                                 DSN     01802
1812            IF (M(4).EQ.0.0) XNF(I)=E2                                      DSN     01803
1813            IF (XNF(I).GE.0.0.AND.XNMM.GE.0.0) GO TO 280                    DSN     01804
1814    C       STEP FUNCTION                                                   DSN     01805
1815            IF (ISF.GT.0) GO TO 220                                         DSN     01806
1816            E2=((QA(I,M)-QS(I,M))*E4+(DC(I,M)-0.5*DB(I,M)+DS(I,M))*E3*E1)/(CT( DSN     01807
1817           1(I)+0.5*DB(I,M))                                                DSN     01808
1818            XNF(I)=E2                                                       DSN     01809
1819            XNMM=E2                                                         DSN     01810
1820            GO TO 260                                                       DSN     01811
1821    220     CONTINUE                                                        DSN     01812
1822    C       NEGATIVE FLUX FIXUP                                             DSN     01813
1823            IF (XNF(I).GE.0.0) GO TO 230                                    DSN     01814
1824            IF (XNMM.GE.0.0.OR.XNMM.GE.XNF(I)) GO TO 240                    DSN     01815
1825    230     XNMM=0.0                                                        DSN     01816
1826            E2=((QA(I,M)-QS(I,M))*E4+DC(I,M)*E3*E1)/(CT(I)+DB(I,M)-2.*DS(I,M)) DSN  01817
1827            XNF(I)=E2+E2-E3                                                 DSN     01818
1828            IF (XNF(I).GE.0.0) GO TO 260                                    DSN     01819
1829            GO TO 250                                                       DSN     01820
1830    240     XNF(I)=0.0                                                      DSN     01821
1831            E2=(QA(I,M)*E4+(DC(I,M)-.5*DB(I,M)+DS(I,M))*E3*E1)/(CT(I)+2.*DS(I, DSN  01822
1832           1I))                                                             DSN     01823
1833            XNMM=E2+E2-E4                                                   DSN     01824
1834            IF (XNMM.GE.0.0) GO TO 260                                      DSN     01825
1835    250     IF (CT(I).EQ.0.0) GO TO 260                                     DSN     01826
1836            XNMM=0.0                                                        DSN     01827
1837            XNF(I)=0.0                                                      DSN     01828
1838            E2=((QA(I,M)-QS(I,M))*E4+(DC(I,M)-.5*DB(I,M)+DS(I,M))*E3*E1)/CT(I) DSN  01829
1839    260     IF (ILVF.LT.1) GO TO 280                                        DSN     01830
1840            NFFU=NFFU+1                                                     DSN     01831
1841            IF (NFFU.EQ.1) WRITE (9,270)IG,M,I,XNF(I),XNMM                  DSN     01832
1842    270     FORMAT (28H NEGATIVE FLUX FIXUP, GROUP=I4,12H, DIRECTION=I3,14H, S DSN  01833
1843           1PACE POINT=I5,10X,8H XNF(I)=E14.5,6H XNMM=E14.5)                DSN     01834
1844    280     XIN(I)=XNN(I)+W(M)*E2                                           DSN     01835
1845            QA(I,M)=E2                                                      DSN     01836
1846    290     CT(I)=TEMP                                                      DSN     01837
1847            I=IABS(IS-(P)                                                   DSN     01838
1848            XND(I,M)=XNMM                                                   DSN     01839
1849            IF (D(I).GE.0.0) GO TO 300                                      DSN     01840
1850            XNI(M)=XNMM                                                     DSN     01841
1851            GO TO 310                                                       DSN     01842
1852    300     XNO(M)=XNMM                                                     DSN     01843
1853    310     CONTINUE                                                        DSN     01844
1854    C       COMPUTE NEUTRON SUMS                                            DSN     01845
1855            IF (IBP.NE.2) GO TO 330                                         DSN     01846
1856            DO 320 M=1,MM                                                   DSN     01847
1857            IF (D(M).LE.0.0) XNO(M)=XNI(M)                                  DSN     01848
1858    320     CONTINUE                                                        DSN     01849
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330   E1=0.0                                                   DSN  01850
      E2=0.0                                                   DSN  01851
      DO 340 M=1,MM                                            DSN  01852
      E1=E1+W(M)*XNI(M)                                        DSN  01853
340   E2=E2+W(M)*XNO(M)                                        DSN  01854
      A(JRL)=E2*AV(IP)                                         DSN  01855
      A(JNL)=A(JRL)-E1*AV(1)                                   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
      XNR(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
      RLH=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)+RLH                                     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-1+I)           DSN  01892
      IF (IIC.GT.1) T=TM*(CS(I)+TARA*A(JV-1+I))                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   CA(I,M)=CA(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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      IF (ABS(XITA)+ABS(XITH).EQ.0.0.OR.IIC.GT.ITL) GO TO 490                DSN     01910
      IF (E2.GT.EPG.OR.E3.GT.EPG) GO TO 470                                  DSN     01911
      IF (EPSA.EQ.0.0) GO TO 460                                             DSN     01912
      IF (E4.GT.EPSA) GO TO 470                                              DSN     01913
460   IF (IHR.LT.1.OR.ABS(A(JNL)).LT.EPG) GO TO 490                          DSN     01914
470   IF (XITA.EQ.0.0) GO TO 20                                              DSN     01915
C     COMPUTE CURRENTS                                                       DSN     01916
      DO 480 M=1,MM                                                          DSN     01917
      E2=W(M)*E1                                                             DSN     01918
      DO 480 N=1,MM                                                          DSN     01919
      E3=E2*CL(M,N)                                                          DSN     01920
      DO 480 I=1,IM                                                          DSN     01921
      IF (M.EQ.1) XJJ(I,N)=0.0                                               DSN     01922
480   XJJ(I,N)=XJJ(I,N)+E3*(XND(I,M)+XND(I+1,M))                             DSN     01923
      GO TO 20                                                               DSN     01924
C     FLUX CONVERGED                                                         DSN     01925
490   DO 500 I=1,IP                                                          DSN     01926
      DO 500 M=1,MM                                                          DSN     01927
500   XND(I,M)=E1*XND(I,M)                                                   DSN     01928
      RETURN                                                                 DSN     01929
      END                                                                    DSN     01930
      SUBROUTINE FISSN (XN,C,XJ,B,IGM,IM,IHM,MT,MM,MMM,FG,IGP,F,AKE,MA,MZ    DSN     01931
     1,I/M,V,DG,DF)                                                          DSN     01932
C                                                                            DSN     01933
C     FISSION CALCULATION AND NORMALIZATIONS                                 DSN     01934
      COMMON /ALPHA/ LOAFM,TAMA,SCATT,SCATTP,BAL,XLAMAX,XLAMIN,EVMAX,EVM     ALPHA   00002
     1IN,IPRE,FSUM,INEG,KK                                                   ALPHA   00003
C                                                                            ALPHA   00004
      DIMENSION XN(IM,IGM), C(IHM,IGM,MT), XJ(IGM,IM,NM), B(IGM,MM), FG(     DSN     01936
     1IGP), F(IM), AKE(IGP), MA(IM), MZ(IZM), V(IM), DG(IGP), DF(IM)         DSN     01937
      COMMON IA(1000),A(10000)                                               DSN     01938
      EQUIVALENCE (INT,IA(13)), (ITP,A(15)), (IA(2),ITH), (IA(34),NFN),      DSN     01939
     1(XIA,A(16)), (IEVT,IA(14)), (XNF,A(8)), (IHR,IA(7)), (IGM,IA(21)),     DSN     01940
     2 (IA(10),IFN), (A(17),EPG), (EPS,A(3))                                 DSN     01941
      EQUIVALENCE (IA(191),IFR)                                              DSN     01942
      IFN=IABS(IFN)                                                          DSN     01943
      IM=INT-1                                                               DSN     01944
      ITP=FG(IGP)                                                            DSN     01945
      IF (IFN.GT.0) GO TO 20                                                 DSN     01946
      DO 10 J=1,IM                                                           DSN     01947
      DO 10 I=1,IGM                                                          DSN     01948
10    XN(J,I)=0.0                                                            DSN     01949
      IFN=1                                                                  DSN     01950
      GO TO 80                                                               DSN     01951
20    DO 30 I=1,IM                                                           DSN     01952
30    F(I)=0.0                                                               DSN     01953
      IF (ITH.LE.0) GO TO 60                                                 DSN     01954
      DO 40 I=1,IM                                                           DSN     01955
      DO 40 J=1,IGM                                                          DSN     01956
40    F(I)=F(I)+XKE(J)*XN(I,J)                                               DSN     01957
      DO 50 J=1,IGM                                                          DSN     01958
      FG(J)=0.0                                                              DSN     01959
      DO 50 I=1,IM                                                           DSN     01960
      L=MA(I)                                                                DSN     01961
      L=IABS(MZ(L))                                                          DSN     01962
50    FG(J)=FG(J)+V(I)*F(I)*C(IM,J,L)*DF(I)                                  DSN     01963
      GO TO 110                                                              DSN     01964
60    DO 70 I=1,IM                                                           DSN     01965
      L=MA(I)                                                                DSN     01966
      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(IH,J,L)*QF(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   HH=0.0                                                           DSN     01975
1987          DO 120 J=1,IGM                                                   DSN     01976
1988    120   HH=HH+FG(J)                                                      DSN     01977
1989          FG(IGP)=HH                                                       DSN     01978
1990          IF (NFN.EQ.1) GO TO 150                                          DSN     01979
1991          E1=FTP*QG(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 (IQM.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          HH=1./XLA                                                        DSN     01986
1998          DO 130 J=1,IGP                                                   DSN     01987
1999          FG(J)=HH*FG(J)                                                   DSN     01988
2000    130   XKE(J)=HH*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)=HH*F(I)                                                     DSN     01992
2004    150   NFN=0                                                            DSN     01993
2005          IF (IQM.EQ.0) GO TO 170                                          DSN     01994
2006    160   CPG=(QG(IGP)+FG(IGP))*4.*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 (IHR.NE.1) GO TO 160                                          DSN     02008
2020          DO 200 J=1,IGM                                                   DSN     02009
2021          DO 200 M=1,MM                                                    DSN     02010
2022    200   B(J,M)=B(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   IER=1                                                            DSN     02016
2028          RETURN                                                           DSN     02017
2029    240   FORMAT (46HNO DISTRIBUTED SOURCE OR FISSION SOURCE//)            DSN     02018
2030    250   FORMAT (18HNO FISSION SOURCE//)                                  DSN     02019
2031          END                                                              DSN     02020
2032          SUBROUTINE TOTGP (SNG,SCG,XNL,AG,SDG,RL,XNH,IGP,FNG,XNG,XNDG,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,TAHA,SCATT,SCATTP,BAL,XLAMAX,XLAMIN,EVMAX,EVM ALPHA 00002
2036         1IN,IPPE,FSUM,INEG,KK                                             ALPHA   00003
2037    C                                                                      ALPHA   00004
2038          DIMENSION SNG(IGP), SCG(IGP), XNL(IGP), AG(IGP), SDG(IGP), RL(IGP) DSN   02025
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2039          1, XNB(IGP), FNG(IGP), XNG(IGP), XNUG(IGP), QG(IGP), FG(IGP), XKE(I DSN     02026
2040          2GP), XKI(IGP)                                                      DSN     02027
2041           COMMON IA(1000),A(10000)                                           DSN     02028
2042           EQUIVALENCE (IG,IA(47)), (ICC,IA(33)), (XLA,A(16)), (XLAR,A(27)),  DSN     02029
2043          1(JN,IA(54)), (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(12)), (NM,IA(35)), (MM DSN     02031
2045          3,IA(41)), (IEVT,IA(11)), (ICVT,IA(39)), (XLAP,A(30)), (EQ,A(36)),  DSN     02032
2046          4(EQP,A(34)), (EVP,IA(33)), (EPS,A(3)), (E1,A(34)), (E2,A(35)), (JF DSN     02033
2047          5,IA(57)), (KMA,IA(108)), (KMZ,IA(109)), (JV,IA(68)), (IZM,IA(8)),  DSN     02034
2048          6(IIL,IA(30)), (IIM,IA(24)), (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     02040
2054           RL(IGP)=0.0                                                        DSN     02041
2055           XNB(IGP)=0.0                                                       DSN     02042
2056           DO 10 J=1,IGM                                                      DSN     02043
2057           SNG(IGP)=SNG(IGP)+SNG(J)                                           DSN     02044
2058           SCG(IGP)=SCG(IGP)+SCG(J)                                           DSN     02045
2059           XNL(IGP)=XNL(IGP)+XNL(J)                                           DSN     02046
2060           AG(IGP)=AG(IGP)+AG(J)                                              DSN     02047
2061           SDG(IGP)=SDG(IGP)+SDG(J)                                           DSN     02048
2062           RL(IGP)=RL(IGP)+RL(J)                                              DSN     02049
2063    10     XNB(IGP)=XNB(IGP)+XNB(J)                                           DSN     02050
2064           BAL=ABS(XNB(IGP))                                                  DSN     02051
2065           IF (ICVT.EQ.0) GO TO 50                                            DSN     02052
2066           IF (IPRE.EQ.1.OR.IPRE.EQ.2) GO TO 50                               DSN     02053
2067           FNG(IGP)=0.0                                                       DSN     02054
2068           XNG(IGP)=0.0                                                       DSN     02055
2069           XNUG(IGP)=0.0                                                      DSN     02056
2070           DO 20 J=1,IGM                                                      DSN     02057
2071           FNG(IGP)=FNG(IGP)+FNG(J)                                           DSN     02058
2072           XNG(IGP)=XNG(IGP)+XNG(J)                                           DSN     02059
2073    20     XNUG(IGP)=XNUG(IGP)+XNUG(J)                                        DSN     02060
2074           WRITE (9,30) (I,QG(I),FG(I),SNG(I),SCG(I),SDG(I),XNL(I),I=1,IG)    DSN     02061
2075           WRITE (9,40) (I,AG(I),XNB(I),RL(I),FNG(I),XNUG(I),XNG(I),I=1,IG)   DSN     02062
2076    30     FORMAT (///,13X,7H SOURCE,5X,15HFISSION SOURCE,1UX,10HIN SCATTER,8 DSN     02063
2077          1X,12HSELF SCATTER,9X,11HOUT SCATTER,9X,11HNET LEAKAGE,/(I4,1PE16.7 DSN     02064
2078          2,1P5E20.7))                                                        DSN     02065
2079    40     FORMAT (///,9X,11H ABSORPTION,5X,15HNEUTRON BALANCE,7X,13HRIGHT LE DSN     02066
2080          1AKAGE,4X,16HFISSION NEUTRONS,5X,15HNEUTRON DENSITY,8X,12HNEUTRON F DSN     02067
2081          2LUX,/(I4,1PE16.7,1P5E20.7))                                        DSN     02068
2082    50     ICC=ICC+1                                                          DSN     02069
2083           IPRT=IPRE-2                                                        DSN     02070
2084           IF (IPRT) 60,120,80                                                DSN     02071
2085    60     CONTINUE                                                           DSN     02072
2086           XLAH=XLA                                                           DSN     02073
2087    C      FISSION CALCULATION                                                DSN     02074
2088           CALL FISSN (A(JN),A(JC),A(JX),A(JB),IGM,IM,IHM,MT,NM,MM,FG,IGP,A(J DSN     02075
2089          1F),AKE,A(KMA),A(KMZ),IZM,A(JV),QG,A(JDF))                          DSN     02076
2090    C      CONVERGENCE NUMBERS                                                DSN     02077
2091           E1=1.-XLA                                                          DSN     02078
2092           E2=ABS(E1)                                                         DSN     02079
2093           IF (E2.LE.10.*EPS) IIL=IIM                                         DSN     02080
2094           E3=ABS(XLAH-XLA)                                                   DSN     02081
2095           IF (IABS(IA(21)).GT.0) GO TO 80                                    DSN     02082
2096           IF (IABS(IEVT).GT.1) GO TO 70                                      DSN     02083
2097           EV=AKI(IGP)/XNE(IGP)                                               DSN     02084
2098           GO TO 80                                                           DSN     02085
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2099    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 (EZ.LE.EPS) GO TO 110                                        DSN     02091
2105            CALL SSWTCH (4,K000FA)                                          DSN     02092
2106            GO TO (110,100), K000FX                                         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 100                                                       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,XND)                                DSN     02103
2117            DIMENSION XND(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      AND(I,M)=1.                                                     DSN     02108
2122    20      CONTINUE                                                        DSN     02109
2123            DO 30 I=1,IGM                                                   DSN     02110
2124    30      WRITE (3)AND                                                    DSN     02111
2125            RETURN                                                          DSN     02112
2126            END                                                             DSN     02113
2127            SUBROUTINE INDEX (IM,IP,IGM,IZM,MM,MZ,VE,V,AFR,AFA,W,GZ,IGP,IZP,MR DSN     02114
2128           1,TF,TS,TT,IMM,MT,MZZ,F,DF,C,XKI,AA,D)                           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), MR(MM), MZZ(IZM), F(IM), DF(IM), C(IMM,IGM,MT), XKI(IG DSN     02117
2131           2P), AA(IP), D(MM), TF(IM), TS(IM), TT(IM)                       DSN     02118
2132            COMMON IA(40001),A(10000)                                       DSN     02119
2133            EQUIVALENCE (ITH,IA(2)), (IGM,IA(3)), (IEVT,IA(11)), (IMT,IA(13)) DSN     02120
2134           1                                                                DSN     02121
2135            IF (ITH.EQ.0) RETURN                                            DSN     02122
2136            IMS=IABS(IA(14))                                                DSN     02123
2137    C       DO THE TME 1/V INTEGRAL                                         DSN     02124
2138            DO 20 IG=1,IGP                                                  DSN     02125
2139            DO 10 IZ=1,IZP                                                  DSN     02126
2140    10      GZ(IG,IZ)=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            FI=0.                                                           DSN     02142
2156            DO 50 M=1,MM                                                    DSN     02143
2157            MA=MR(M)                                                        DSN     02144
2158    50      FI=FI+(AFR(I+1,M)+AFR(I,M))*(AFA(I+1,MA)+AFA(I,MA))*W(M)        DSN     02145
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      60    GZ(IG,IZ)=GZ(IG,IZ)+T1*V(I)/(4.*VE(IDLE))                    DSN     02146
      70    CONTINUE                                                     DSN     02147
            WRITE (9,760)                                                DSN     02148
            ASSIGN 90 TO L                                               DSN     02149
            GO TO 500                                                    DSN     02150
C           DO THE SURFACE INTEGRAL                                      DSN     02151
      80    TMN=GZ(IGP,IZP)                                              DSN     02152
            DO 100 IG=1,IGP                                              DSN     02153
            DO 90 IZ=1,IZP                                               DSN     02154
      90    GZ(IG,IZ)=0.                                                 DSN     02155
     100    CONTINUE                                                     DSN     02156
            REWIND 2                                                     DSN     02157
            DO 130 IG=1,IGM                                              DSN     02158
            READ (2)AFA                                                  DSN     02159
            IDLE=IG                                                      DSN     02160
            IF (ITH.EQ.1) IDLE=IGP-IG                                    DSN     02161
            DO 120 I=1,IM                                                DSN     02162
            IZ=MZ(I)                                                     DSN     02163
            T1=0.                                                        DSN     02164
            DO 110 M=1,MM                                                DSN     02165
     110    T1=T1+W(M)*(AFR(I,M)+AFR(I+1,M))                             DSN     02166
     120    GZ(1,IZ)=GZ(1,IZ)+.5*V(I)*T1/(VE(IDLE)*TMN)                 DSN     02167
     130    CONTINUE                                                     DSN     02168
            IF (IZM.LE.1) GO TO 150                                      DSN     02169
            DO 140 IZ=2,IZM                                              DSN     02170
     140    GZ(1,IZ)=GZ(1,IZ)+GZ(1,IZ-1)                                 DSN     02171
     150    DO 170 IZ=1,IZM                                              DSN     02172
            DO 160 IG=2,IGP                                              DSN     02173
     160    GZ(IG,IZ)=GZ(1,IZ)                                           DSN     02174
     170    CONTINUE                                                     DSN     02175
            REWIND 3                                                     DSN     02176
            T2=0.                                                        DSN     02177
            DO 200 IG=1,IGM                                              DSN     02178
            READ (3)AFA                                                  DSN     02179
            T1=0.                                                        DSN     02180
            IDLE=IG                                                      DSN     02181
            IF (ITH.EQ.1) IDLE=IGP-IG                                    DSN     02182
            DO 180 M=1,MM                                                DSN     02183
     180    T1=T1+W(M)*O(M)*AFA(IP,M)*AA(IP)                             DSN     02184
            T2=T2+T1*AA(IDLE)                                            DSN     02185
            DO 190 IZ=1,IZM                                              DSN     02186
     190    GZ(IG,IZ)=GZ(IG,IZ)+T1                                       DSN     02187
     200    CONTINUE                                                     DSN     02188
            DO 210 IZ=1,IZM                                              DSN     02189
     210    GZ(IGP,IZ)=GZ(IGP,IZ)+T2                                     DSN     02190
            ASSIGN 240 TO L                                              DSN     02191
            WRITE (9,220)                                                DSN     02192
     220    FORMAT (1H0///18H  ACCEPTANCE AREAS)                         DSN     02193
            KA=1                                                         DSN     02194
            KM=6                                                         DSN     02195
            GO TO 550                                                    DSN     02196
     230    REWIND 3                                                     DSN     02197
            DO 240 I=1,IM                                                DSN     02198
     240    F(I)=0.                                                      DSN     02199
            DO 270 IG=1,IGM                                              DSN     02200
            READ (3)AFA                                                  DSN     02201
            IDLE=IGP-IG                                                  DSN     02202
            IF (ITH.EQ.0) IDLE=IG                                        DSN     02203
            DO 260 I=1,IM                                                DSN     02204
            T1=0.                                                        DSN     02205
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      DO 250 M=1,MM                                                    DSN    02206
  250 T1=T1+(AFA(I+1,M)+AFA(I,M))*W(M)                                 DSN    02207
  260 F(I)=F(I)+XKI(IDLE)*T1*.5                                        DSN    02208
  270 CONTINUE                                                         DSN    02209
      IF (IABS(IEVT).LT.1.OR.IABS(IEVT).GT.2) GO TO 280                DSN    02210
      IF (IA(21).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
      IHF=IA(13)-1                                                     DSN    02219
      DO 330 IG=1,IGM                                                  DSN    02220
      READ (2)AFR                                                      DSN    02221
      IDLE=IGP-IG                                                      DSN    02222
      IF (ITH.EQ.0) IDLE=IG                                            DSN    02223
      DO 320 I=1,IM                                                    DSN    02224
      IZ=MZ(I)                                                         DSN    02225
      IX=IABS(MZZ(IZ))                                                 DSN    02226
      T1=0.                                                            DSN    02227
      DO 310 M=1,MM                                                    DSN    02228
  310 T1=T1+(AFR(I+1,M)+AFR(I,M))*W(M)                                 DSN    02229
  320 GZ(IG,IZ)=GZ(IG,IZ)+F(I)*DF(I)*C(IHF+IDLE+IX)*V(I)*.5*T1         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 (ITH.EQ.0) IDLE=IG                                            DSN    02249
      DO 400 I=1,IM                                                    DSN    02250
      IZ=MZ(I)                                                         DSN    02251
      IX=IABS(MZZ(IZ))                                                 DSN    02252
      T1=0.                                                            DSN    02253
      DO 390 M=1,MM                                                    DSN    02254
      MA=MR(M)                                                         DSN    02255
  390 T1=T1+(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)+T1*C(IHT+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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2279    440   CONTINUE                                                        DSN     02266
2280          DO 490 IG=1,IGM                                                 DSN     02267
2281          READ (2)AFR                                                     DSN     02268
2282          REWIND 3                                                        DSN     02269
2283          IHF=MIN0(IHM,IHS+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,IDLE                                                 DSN     02273
2287    450   READ (3)AFA                                                     DSN     02274
2288    460   DO 480 IH=IHS+IHF                                               DSN     02275
2289          READ (3)AFA                                                     DSN     02276
2290          DO 480 I=1,IM                                                   DSN     02277
2291          IZ=MZ(I)                                                        DSN     02278
2292          IA=IABS(MZZ(IZ))                                                DSN     02279
2293          IDLE=IG+IH-IHS                                                  DSN     02280
2294          IF (ITM.EQ.1) IDLE=IGP-IG                                       DSN     02281
2295          IF (C(IH+IDLE+IX).EQ.0.) GO TO 480                              DSN     02282
2296          T1=0.                                                           DSN     02283
2297          T2=0.                                                           DSN     02284
2298          DO 470 M=1,MM                                                   DSN     02285
2299          T1=T1+(AFR(I+1,M)+AFR(I,M))*W(M)                                DSN     02286
2300    470   T2=T2+(AFA(I+1,M)+AFA(I,M))*W(M)                                DSN     02287
2301          GZ(IG,IZ)=GZ(IG,IZ)+.25*T1*T2*GF(I)*V(I)*C(IH+IDLE+IX)          DSN     02288
2302    480   CONTINUE                                                        DSN     02289
2303    490   CONTINUE                                                        DSN     02290
2304          WRITE (9,810)                                                   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     02294
2308    510   GZ(IG,IZP)=GZ(IG,IZP)+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(KB,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          KB=KB+M                                                         DSN     02308
2322          IF (KA.LE.IZP) GO TO 550                                        DSN     02309
2323          GO TO L, (80,230,340,420,570)                                   DSN     02310
2324    570   DO 580 I=1,IM                                                   DSN     02311
2325          F(I)=0.                                                         DSN     02312
2326          TF(I)=0.                                                        DSN     02313
2327          TS(I)=0.                                                        DSN     02314
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          IH=IHS+IGA-IGR                                                  DSN     02322
2336          IF (IH.GT.IHM) GO TO 620                                        DSN     02323
2337          IDLE=IGA                                                        DSN     02324
2338          IF (ITM.EQ.1) IDLE=IGP-IGR                                      DSN     02325
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2339            DO 610 I=1,IM                                                   DSN     02326
2340            T1=0.                                                           DSN     02327
2341            T2=0.                                                           DSN     02328
2342            DO 590 M=1,MM                                                   DSN     02329
2343            T1=T1+W(M)*(AFR(I,M)+AFR(I+1,M))                                DSN     02330
2344     590    T2=T2+W(M)*(AFA(I,M)+AFA(I+1,M))                                DSN     02331
2345            T1=.5*T1                                                        DSN     02332
2346            T2=.5*T2                                                        DSN     02333
2347            IZ=MZ(I)                                                        DSN     02334
2348            IX=IABS(MZZ(IZ))                                                DSN     02335
2349            TS(I)=TS(I)+T1*T2*C(ITH,IDLE,IX)                                DSN     02336
2350            IF (IGA.LT.IGA) GO TO 610                                       DSN     02337
2351            F(I)=F(I)+T1*C(IMT-1,IDLE,IX)                                   DSN     02338
2352            TF(I)=TF(I)+T2*XA(IDLE)                                         DSN     02339
2353            T1=0.                                                           DSN     02340
2354            DO 600 M=1,MM                                                   DSN     02341
2355            MA=MB(M)                                                        DSN     02342
2356     600    T1=T1+W(M)*(AFR(I,M)+AFR(I+1,M))*(AFA(I,MA)+AFA(I+1,MA))        DSN     02343
2357            TT(I)=TT(I)+.25*C(IM1,IDLE,IX)*T1                               DSN     02344
2358     610    CONTINUE                                                        DSN     02345
2359     620    CONTINUE                                                        DSN     02346
2360     630    CONTINUE                                                        DSN     02347
2361            OK=1.                                                           DSN     02348
2362            IF (IABS(IEVT).EQ.1) OK=1./A(1)                                 DSN     02349
2363            WRITE (4,640)                                                   DSN     02350
2364     640    FORMAT (1H0///40H  I, IZ, IX, K, MA, VOL, MAS, MV, MM, MT//)    DSN     02351
2365            VOL=0.                                                          DSN     02352
2366            XM=0.                                                           DSN     02353
2367            MT=0.                                                           DSN     02354
2368            TV=0.                                                           DSN     02355
2369            TM=0.                                                           DSN     02356
2370            K=IA(5)                                                         DSN     02357
2371            J=IA(5)                                                         DSN     02358
2372            DO 650 I=1,IM                                                   DSN     02359
2373            VOL=VOL+TV                                                      DSN     02360
2374            TV=.5*V(I)                                                      DSN     02361
2375            VOL=VOL+TV                                                      DSN     02362
2376            XM=XM+T4                                                        DSN     02363
2377            TM=TV*DR(I)                                                     DSN     02364
2378            XM=XM+T4                                                        DSN     02365
2379            T1=(OK*F(I)*TF(I)+TS(I)-TT(I))/TNN                              DSN     02366
2380            T2=T1*DR(I)                                                     DSN     02367
2381            MT=MT+T2*V(I)                                                   DSN     02368
2382            RA=(.5*(A(K)**J+A(K+1)**J))**(1./FLOAT(J))                      DSN     02369
2383            IZ=MZ(I)                                                        DSN     02370
2384            IX=MZZ(IZ)                                                      DSN     02371
2385            WRITE (4,660)I,IZ,IX,A(K),RA,VOL,XM,T2,T1,MT                    DSN     02372
2386     650    K=K+1                                                           DSN     02373
2387     660    FORMAT (3I4,1P7E13.5)                                           DSN     02374
2388            DO 740 M=1,MT                                                   DSN     02375
2389            ME=IND 1                                                        DSN     02376
2390            DO 670 I=1,IM                                                   DSN     02377
2391            F(I)=0.                                                         DSN     02378
2392            TF(I)=0.                                                        DSN     02379
2393            TS(I)=0.                                                        DSN     02380
2394     670    TT(I)=0.                                                        DSN     02381
2395            DO 720 IGA=1,IGM                                                DSN     02382
2396            READ (3)AFA                                                     DSN     02383
2397            ME=IND 2                                                        DSN     02384
2398            DO 710 IDR=1,IGA                                                DSN     02385
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      READ (2)AFR                                                       DSN   02386
      IH=IHS+IGA-IGH                                                    DSN   02387
      IF (IH.GT.IHM) GO TO 710                                          DSN   02388
      IDLE=IGA                                                          DSN   02389
      IF (IIH.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)+TS(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,4(2X,4HZONE,I3,4X))                                DSN   02418
  780 FORMAT (1H0///36H  FISSION INTEGRAL BY GROUP AND ZONE)            DSN   02419
  790 FORMAT (I4,1P6E13.5)                                              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,XND,MA,MZ,IHM,IGM,IM,IP,IGP,XKE,FG DSN   02424
     1,QG)                                                              DSN   02425
      COMMON /ALPHA/ LOAFR,TABA,SCATT,SCATTP,BAL,XLAMAX,XLAMIN,EVMAX,EVM ALPHA 00002
     1IN,IPRE,FSUM,INEG,KK                                              ALPHA 00003
C                                                                       ALPHA 00004
      COMMON IA(1000),A(10000)                                          DSN   02427
      DIMENSION C(IHM,IGM,1), Q(IM,1), XN(IM,1), XND(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),ICVT), (IA(41),MM), (A(1),EV), (A(3),EPS), ( DSN   02431
     2A(11),RLAL), (A(16),ALA), (A(17),EPO), (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 H                                                           DSN   02437
      NN=IA(106)+IGM                                                    DSN   02438
      H=0.0                                                             DSN   02439
      ICT=0                                                             DSN   02440
      IF (IPRE.GT.1) GO TO 50                                           DSN   02441
      IF (EV.LT.1.0) GO TO 230                                          DSN   02442
      FTMP=0.0                                                          DSN   02443
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      DO 10 I=1,IM                                                      DSN 02444
   10 FTMP=FTMP+F(I)*V(I)                                               DSN 02445
      FAC=EV/FTMP                                                       DSN 02446
      DO 30 I=1,IM                                                      DSN 02447
      DO 20 J=1,IGM                                                     DSN 02448
   20 XN(I,J)=XN(I,J)/FTMP                                              DSN 02449
   30 F(I)=FAC*F(I)                                                     DSN 02450
      XKT = 0                                                           DSN 02451
      DO 34 I = 1, IGM                                                  DSN 02452
   34 XKT = XKT + XKE (I)                                               DSN 02453
      XKT = 1.0 / XKT                                                   DSN 02454
      DO 36 I = 1, IGM                                                  DSN 02455
   36 XKE (I) = XKE (I) * XKT                                           DSN 02456
      IPRE=2                                                            DSN 02457
      IUM=1                                                             DSN 02458
      ICVT=0                                                            DSN 02459
C                                                                       DSN 02460
      EPSX=EPS                                                          DSN 02461
      XLA=1.0                                                           DSN 02462
      FSUM=FTMP/EV                                                      DSN 02463
      PRINT 40                                                          DSN 02464
   40 FORMAT (*1 IC        XLA            EV             F-OLD          DSN 02465
     1F-NEW           H              Q          CHI          REAL       DSN 02466
     2 IMAG*/)                                                          DSN 02467
      GO TO 80                                                          DSN 02468
C                                                                       DSN 02469
C     FIND SCALING PARAMETER                                            DSN 02470
C                                                                       DSN 02471
C     COMPUTE NEW F (I), EV, FSUM - TEST FOR CONVERGENCE - SET ICVT     DSN 02472
   50 CONTINUE                                                          DSN 02473
      FTMP=0                                                            DSN 02474
      DO 70 I=1,IM                                                      DSN 02475
      FI=0.0                                                            DSN 02476
      DO 60 IG=1,IGM                                                    DSN 02477
      FI=FI+XKE(IG)*XN(I,IG)                                            DSN 02478
   60 CONTINUE                                                          DSN 02479
      F(I)=FI                                                           DSN 02480
      FTMP=FTMP+FI*V(I)                                                 DSN 02481
   70 CONTINUE                                                          DSN 02482
C                                                                       DSN 02483
C     TEST FOR CONVERGENCE                                              DSN 02484
   80 CONTINUE                                                          DSN 02485
      EV=FTMP/FSUM                                                      DSN 02486
      EVT=ABS(EV-1.0)                                                   DSN 02487
      IF (EVT.LT.EPS) ICVT=1                                            DSN 02488
C     COMPUTE CHI (K) FOR K = 2, 5                                      DSN 02489
      KSN=-1                                                            DSN 02490
      DO 110 K=2,5                                                      DSN 02491
      KK=K-1                                                            DSN 02492
      KSN=KSN*(-1)                                                      DSN 02493
      CHIK=0.0                                                          DSN 02494
      DO 100 I=1,IM                                                     DSN 02495
      L=MA(I)                                                           DSN 02496
      L=IABS(MZ(L))                                                     DSN 02497
      FF=F(I)**K                                                        DSN 02498
      VI=V(I)                                                           DSN 02499
      DFI=DF(I)                                                         DSN 02500
      DO 90 IG=1,IGM                                                    DSN 02501
   90 CHIK=CHIK+(KSN*VI*DFI*FF*C(KK,IG,L))                              DSN 02502
  100 CONTINUE                                                          DSN 02503
```

```
          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
          H1=0                                                 DSN   02508
          H2=0                                                 DSN   02509
          IH=IHT-1                                             DSN   02510
          DO 130 I=1,IH                                        DSN   02511
          L=HA(I)                                              DSN   02512
          L=IABS(HZ(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
          H1=H1+VI*FF*DFI*C(IH,IG,L)                           DSN   02518
          KSN = 1                                              DSN   02519
          QIG = 0.0                                            DSN   02520
          FI = FF                                              DSN   02521
          DO 115 K = 1, 4                                      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
          H2 = H2 + VI * QIG                                   DSN   02527
  120     CONTINUE                                             DSN   02528
  130     CONTINUE                                             DSN   02529
          H=(1.0/EV-1.0)*H1+H2                                 DSN   02530
          LE=1                                                 DSN   02531
          M=5                                                  DSN   02532
          N=M-1                                                DSN   02533
          ALA(M)=H                                             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)+.00001)     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=IH*IGM                                            DSN   02563
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```
2579            CALL SCALE (XN,XLA,IT)                                          DSN     02564
2580            IT=IP*MM                                                        DSN     02565
2581            IF (ISCT.GT.0) CALL SCALF (XND,XLA,IT)                          DSN     02566
2582            PRINT 170, ICC,XLA,EV,FSUM,FTMP,M,B2,(CHI(I),RLA(I),I=1,4)      DSN     02567
2583  170       FORMAT (I5,1P6E15.6,1P3E12.4,/3(95X,1P3E12.4/)/)                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            IH=IHT-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=2,5                                                    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(IH,IG,L)                                    DSN     02599
2615            FGG=FGG+FGT*C(IH,IG,L)                                          DSN     02600
2616  200       CONTINUE                                                        DSN     02601
2617  210       CONTINUE                                                        DSN     02602
2618            IGP=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*EPS)/(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 (9,240)EV                                                 DSN     02619
2635  240       FORMAT (*0    * * 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 NERPOL, LE= *I6*   NO CONVERGENCE OR A0=0*)    DSN     02626
2642         RETURN                                                            DSN     02627
2643         END                                                               DSN     02628
2644         SUBROUTINE NERPOL (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),DN,DU,A,CZ                           DSN     02631
2647         EQUIVALENCE (AN,PN), (BN,DN), (CN,Z)                              DSN     02632
2648         N=IN                                                              DSN     02633
2649   10    N1=N+1                                                            DSN     02634
2650         IF (REAL(A(N1)).NE.0..OR.AIMAG(A(N1)).NE.0.) GO TO 30             DSN     02635
2651         R(N)=0.                                                           DSN     02636
2652         S(N)=0.                                                           DSN     02637
2653         N=N-1                                                             DSN     02638
2654         IF (N.GT.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=N1+1                                                           DSN     02645
2661         MI=25*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 SCPTACO (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(N1))                                                DSN     02659
2675         Z=X/CN                                                            DSN     02660
2676         CALL SCPTACO (N,U,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 SCPTACO (N,U,T,Z(I),PN(I),DN)                                DSN     02665
2681         I=1                                                               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=1.570M/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=0.                                                              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 SCPTACO (N,0.,A,T(NR),PN,DN)                       DSN     02687
2703            Y=ABS(AN(1))+ABS(AN(2))                                 DSN     02688
2704            V=ABS(BN(1))+ABS(BN(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            DD=A(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            DD=DD*(Z-T(I))                                          DSN     02699
2715    130     CONTINUE                                                DSN     02700
2716            PN=PN/DD                                                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.MI) GO TO 100                                 DSN     02707
2723    160     LE=1                                                    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 SCPTACO (N,N,A,R(NR),S(NI),T)                      DSN     02714
2730            Z=T                                                     DSN     02715
2731            BN(1)=ABS(S(NI))*CN(1)                                  DSN     02716
2732            BN(2)=ABS(S(NI+1))*CN(2)                                DSN     02717
2733            X=CABS(BN)*N                                            DSN     02718
2734            U=0.                                                    DSN     02719
2735            IF (X.EQ.0.) GO TO 200                                  DSN     02720
2736            DO 190 I=2,NI                                           DSN     02721
2737            NI=N+I+1                                                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*(N1-I)/I                                            DSN     02731
2747    200     CONTINUE                                                DSN     02732
2748            S(NR)=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=N1,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 SCPTACO (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+14000000000000000B,16+26000000000000002U,17 DSN   02747
     120+0000J0V0000G0010B/                                               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 (4)                                                      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,X,I,T3,T5,C,IGM,IM,NM,IO3,IZP,IHM,MT,XNR,IGP,M DSN   02799
     1E,RA,RAV,V,F,IP,KM3,KM4,JJ3,JJ4,MZ,IZM,XMD,MS,MF,MG,OF,VE,Q,SPI     DSN   02800
C                                                                         DSN   02801
C     FINAL PRINTS                                                        DSN   02802
      COMMON /ALPHA/ LOAFU,TAHA,SCATT,SCATTP,HAL,XLAMAX,XLAMIN,EVMAX,EVM ALPHA   00002
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2H19          1IN,IPHE,FSUM,INEG,KK                                          ALPHA   00603
2H20    C                                                                    ALPHA   00604
2H21          DIMENSION XN(IM,IGM), XJ(IGM,IM,NM), TJ(ID3,IZP), TS(ID3,IM), C(IM DSN     02H04
2H22         1M,IGM,MT), XNM(IGP), ME(IM), MA(IP), MAV(IP), V(IP), F(IM), KM3(JJ DSN     02H05
2H23         24), KM4(JJ4), MZ(IZH), XMD(MS), MP(MS), MG(MS), DF(IM), VE(1)      DSN     02H06
2H24          DIMENSION SP (IM,1), D (IM,1)                                     DSN     02H07
2H25          COMMON IA(1000),A(19000)                                          DSN     02H08
2H26          EQUIVALENCE (IA(1),ID), (IA(33),ICC), (IA(32),LC), (JN,IA(58)), (A DSN     02H09
2H27         1(3),EPS), (EV,A(1)), (XLA,A(16)), (IG,IA(93)), (IA(3),ISCT), (ID4, DSN     02H10
2H28         2IA(46)), (EQ,A(32)), (ITH,IA(2))                                 DSN     02H11
2H29          EQUIVALENCE (IA(13),IHT)                                          DSN     02H12
2H30    10    FORMAT (1H1,I5,2X,I4,4X,I8,4X,4E15.8///)                          DSN     02H13
2H31          WRITE (9,20)(I,ME(I),MA(I),MAV(I),F(I),V(I),I=1,IP)               DSN     02H14
2H32    20    FORMAT (1H0,5A,4HZONE,5X,11HFINAL RADII,3X,13HAVERAGE RADII,8X,8HF DSN     02H15
2H33         1ISSIONS,10X,6HVOLUME,/,(2I5,4E16.7))                             DSN     02H16
2H34          WRITE (9,30)                                                      DSN     02H17
2H35    30    FORMAT (20H1FLUX BY GROUP AND SPACE POINT///)                     DSN     02H18
2H36          MA=1                                                              DSN     02H19
2H37          MB=7                                                              DSN     02H20
2H38    40    MC=MIN0(MB,IGM)                                                   DSN     02H21
2H39          WRITE (9,60)(I,I=MA,MC)                                           DSN     02H22
2H40          WRITE (9,70)                                                      DSN     02H23
2H41          DO 50 I=1,IM                                                      DSN     02H24
2H42    50    WRITE (9,80)I,ME(I),MAV(I),(XN(I,J),J=MA,MC)                      DSN     02H25
2H43          MA=MA+7                                                           DSN     02H26
2H44          MB=MB+7                                                           DSN     02H27
2H45          IF (MA.LE.IGM) GO TO 40                                           DSN     02H28
2H46    60    FORMAT (1H0,4A,17H ZONE  AVG RADIUS,7(3X,5HGROUP,I3,3X))          DSN     02H29
2H47    70    FORMAT (1H0)                                                      DSN     02H30
2H48    80    FORMAT (2I5,1PE12.5,1P7E14.5)                                     DSN     02H31
2H49          IF (ISCT.LT.1) GO TO 130                                          DSN     02H32
2H50          DO 110 N=1,NM                                                     DSN     02H33
2H51          WRITE (9,120)N                                                    DSN     02H34
2H52          MA=1                                                              DSN     02H35
2H53          MB=7                                                              DSN     02H36
2H54    90    MC=MIN0(MB,IGM)                                                   DSN     02H37
2H55          WRITE (9,60)(I,I=MA,MC)                                           DSN     02H38
2H56          WRITE (9,70)                                                      DSN     02H39
2H57          DO 100 I=1,IM                                                     DSN     02H40
2H58    100   WRITE (9,80)I,ME(I),MAV(I),(XJ(J,I,N),J=MA,MC)                    DSN     02H41
2H59          MA=MA+7                                                           DSN     02H42
2H60          MB=MB+7                                                           DSN     02H43
2H61          IF (MA.LE.IGM) GO TO 90                                           DSN     02H44
2H62    110   CONTINUE                                                          DSN     02H45
2H63    120   FORMAT (15H1CURRENT NUMBER,I3,25H HY GROUP AND SPACE POINT///)    DSN     02H46
2H64    C     DUMP FLUXES                                                       DSN     02H47
2H65    130   CALL SSWTCH (5,ISW5)                                              DSN     02H48
2H66          IF (ISW5.EQ.1) PUNCH 140, ID,IG                                   DSN     02H49
2H67    140   FORMAT (1AH FLUX DUMP PROBLEM,I8,4X,I6,7H FLUXES,29X,8H ID CARD) DSN     02H50
2H68          IF (ITH.EQ.0) GO TO 180                                           DSN     02H51
2H69          ASSIGN 180 TO L                                                   DSN     02H52
2H70    150   KB=IGM/2                                                          DSN     02H53
2H71          DO 170 KA=1,KB                                                    DSN     02H54
2H72          KC=IGM+KA                                                         DSN     02H55
2H73          DO 160 I=1,IM                                                     DSN     02H56
2H74          TEMP=XN(I,KA)                                                     DSN     02H57
2H75          XN(I,KA)=XN(I,KC)                                                 DSN     02H58
2H76    160   XN(I,KC)=TEMP                                                     DSN     02H59
2H77    170   CONTINUE                                                          DSN     02H60
2H78          GO TO L, (180,200)                                                DSN     02H61
```

```
180   KA=(IG+5)/6                                              DSN  02862
      KC=JN                                                    DSN  02863
      KD=KC+5                                                  DSN  02864
      DO 190 K=1,KA                                            DSN  02865
      IF (ISW5.EQ.1) PUNCH 210, (A(I),I=KC,KD),K               DSN  02866
      KC=KC+6                                                  DSN  02867
190   KD=KD+6                                                  DSN  02868
      REWIND 6                                                 DSN  02869
      WRITE (6)XN                                              DSN  02870
      REWIND 6                                                 DSN  02871
      ASSIGN 200 TO L                                          DSN  02872
      IF (ITH.EQ.1) GO TO 150                                  DSN  02873
200   CONTINUE                                                 DSN  02874
210   FORMAT (1P6E12.2,4HFLUX,I4)                              DSN  02875
      IF (ID3.EQ.0) GO TO 450                                  DSN  02876
      CALL REAI (KM3,ID3,6HACT MA,6HT NO.S)                    DSN  02877
      CALL REAI (KM4,ID3,6HACT CX,6H POS. )                    DSN  02878
      DO 230 I=1,ID3                                           DSN  02879
      DO 220 J=1,IZP                                           DSN  02880
220   T3(I,J)=0.0                                              DSN  02881
      DO 230 J=1,IM                                            DSN  02882
230   T5(I,J)=0.0                                              DSN  02883
      DO 350 IG=1,IGM                                          DSN  02884
      DO 350 JJ=1,ID3                                          DSN  02885
      IF (JJ.EQ.1) GO TO 240                                   DSN  02886
      IF (KM3(JJ).EQ.KM3(JJ-1)) GO TO 330                      DSN  02887
240   IE=KM3(JJ)                                               DSN  02888
      DO 320 I=1,IM                                            DSN  02889
      IE1=ME(I)                                                DSN  02890
      IF1=IABS(MZ(IE1))                                        DSN  02891
      E2=0.0                                                   DSN  02892
      IF (IE.NE.IF1) GO TO 260                                 DSN  02893
      E2=1.0                                                   DSN  02894
250   RA(I)=E2*XN(I,IG)                                        DSN  02895
      RAV(I)=RA(I)*V(I)                                        DSN  02896
      GO TO 320                                                DSN  02897
260   DO 310 J=1,MS                                            DSN  02898
      IF (IE1.NE.MG(J)) GO TO 310                              DSN  02899
      IF (XMD(J).EQ.0.0) GO TO 270                             DSN  02900
      IF (MF(J).EQ.0) GO TO 290                                DSN  02901
      IF (MF(J)-IE) 310,300,310                                DSN  02902
270   IF (MF(J).NE.0) GO TO 280                                DSN  02903
      E2=1.0                                                   DSN  02904
      GO TO 310                                                DSN  02905
280   E2=E2*FV                                                 DSN  02906
      GO TO 310                                                DSN  02907
290   E2=E2*XMD(J)                                             DSN  02908
      GO TO 310                                                DSN  02909
300   E2=E2+XMD(J)                                             DSN  02910
310   CONTINUE                                                 DSN  02911
      GO TO 250                                                DSN  02912
320   CONTINUE                                                 DSN  02913
330   N=KM4(JJ)                                                DSN  02914
      DO 340 I=1,IM                                            DSN  02915
      J=ME(I)                                                  DSN  02916
      T3(JJ,J)=T3(JJ,J)+RAV(I)*C(N,IG,IE)*DF(I)                DSN  02917
      IF (ID4.NE.0) T5(JJ,I)=T5(JJ,I)+RA(I)*C(N,IG,IE)*DF(I)   DSN  02918
340   CONTINUE                                                 DSN  02919
350   CONTINUE                                                 DSN  02920
      DO 360 L=1,ID3                                           DSN  02921
```

```
      T3(L,I7P)=0.0                                         DSN 02922
      DO 360 I=1,I7M                                        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,ID3)                                       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 (IU4.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,JH                                         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.ID3) GO TO 370                              DSN 02939
  410 FORMAT (7H0  ZONE,5X,8(10H  MATERIAL,I3))             DSN 02940
  420 FORMAT (1H0)                                          DSN 02941
  430 FORMAT (3X,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 (22H1       MATERIAL TABLES/)                  DSN 02948
      DO 589 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 + DF (I) * V (I)            DSN 02954
  470 CONTINUE                                              DSN 02955
      IF (SUM.LE.0) GO TO 589                               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          XJ(IG,I)=XJ                                                       DSN     02985
3003    520   CONTINUE                                                          DSN     02986
3004    C                                                                       DSN     02987
3005    C     PRINT BLOCK FOR MATERIAL M                                        DSN     02988
3006          MM=0                                                              DSN     02989
3007          MA=1                                                              DSN     02990
3008          MB=7                                                              DSN     02991
3009    530   MC=MIN0(MB,IMT)                                                   DSN     02992
3010          IF (MC.GT.MM) WRITE (9,540)(MM,I,I=MA,MC)                         DSN     02993
3011    540   FORMAT (*0  G*,M(5X,*SIGMA*,I3,2X))                              DSN     02994
3012          IF (MC.LE.MM) WRITE (9,550)MM                                     DSN     02995
3013    550   FORMAT (*0  G*,54,*SIGMA*,I3)                                     DSN     02996
3014          MM=MC+1                                                           DSN     02997
3015          DO 570 IG=1,IGM                                                   DSN     02998
3016          WRITE (9,560)IG,(XJ(IG,K),K=MA,MB)                                DSN     02999
3017    560   FORMAT (I4,1P7E15.5)                                              DSN     03000
3018    570   CONTINUE                                                          DSN     03001
3019          WRITE (9,560)IGP,(RAV(K),K=MA,MM)                                 DSN     03002
3020          IF (MM.GT.IMT) GO TO 580                                          DSN     03003
3021          MA=MM+1                                                           DSN     03004
3022          MB=MC+7                                                           DSN     03005
3023          GO TO 530                                                         DSN     03006
3024    580   CONTINUE                                                          DSN     03007
3025    C                                                                       DSN     03008
3026    C     ADDITIONAL OUTPUT FOR PIP                                         DSN     03009
3027          IF (IPRE.LE.0) RETURN                                             DSN     03010
3028          PIP=0.0                                                           DSN     03011
3029          DO 610 I=1,IM                                                     DSN     03012
3030          L=ME(I)                                                           DSN     03013
3031          L=IABS(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
3040          PIP = 1.0 - EXP (PI)                                              DSN     03023
3041          WRITE ( 9, 620 ) PI, PIP                                          DSN     03024
3042    620 FORMAT ( /// *5H0 * * * FINAL VALUES FOR ALL GROUPS * * *       //  DSN     03025
3043         ( 20X, *PI =* 1PE20.6, 10X, *PIP =* 1PE20.6 )                      DSN     03026
3044          RETURN                                                            DSN     03027
3045          END                                                               DSN     03028
3046          SUBROUTINE PRNT (P,I1,I2,LL,A)                                    DSN     03029
3047          DIMENSION P(LL,1)                                                 DSN     03030
3048    C                                                                       DSN     03031
3049    C     P         BLOCK TO BE PRINTED                                     DSN     03032
3050    C     I1        INITIAL INDEX (GROUP)                                   DSN     03033
3051    C     I2        FINAL INDEX (GROUP)                                     DSN     03034
3052    C     LL        LENGTH OF FIRST DIMENSION OF BLOCK                      DSN     03035
3053    C     A         HOLLERITH TITLE TO PRINT )                              DSN     03036
3054    C                                                                       DSN     03037
3055          L1=I1                                                             DSN     03038
3056          L2=I1+7                                                           DSN     03039
3057    10    L2=MIN0(L2,I2)                                                    DSN     03040
3058          IH=I2-L2                                                          DSN     03041
```

```
      WRITE (9,20)(A,L,L=L1,L2)                                       DSN    03042
   20 FORMAT ('0   ',8(5X,A5,I3,2X)/)                                 DSN    03043
      DO 30 I=1,LL                                                    DSN    03044
      WRITE (9,50)I,(P(I,L),L=L1,L2)                                  DSN    03045
   30 CONTINUE                                                        DSN    03046
      L1=L2+1                                                         DSN    03047
      L2=L2+9                                                         DSN    03048
      IF (IW.LE.0) GO TO 40                                           DSN    03049
      GO TO 10                                                        DSN    03050
   40 CONTINUE                                                        DSN    03051
      RETURN                                                          DSN    03052
   50 FORMAT ( I5, 1P8E15.5 )                                         DSN    03053
      END                                                             DSN    03054
* * * NO FURTHER INFORMATION ON INPUT ( FSETIN) * * *

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.

```
   DSN - TEST PROBLEM - MATL 43

  ID  IDENTIFICATION NUMBER                                                    1
 ITH  THEORY (0/1=REGULAR/ADJOINT)                                             3
ISCT  SCATTERING (0/N=ISOTROPIC/NTH ORDER ANISOTROPIC)                         0
 ISN  QUADRATURE (SN, N=1, DN=2-1, ETC.)                                      -4
 IGE  GEOMETRY (1/2/3=PLANE/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
 IFN  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/MTB 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
 IOT  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
 IAS  FLOOR CROSS SECTIONS IF ZERO/TRUNCATE IF NON-ZERO                        1


  EV  EIGENVALUE TRY                                                    0.
 EVM  EIGENVALUE MODIFIER                                               0.
 EPS  CONVERGENCE CRITERION                                             1.0000000E-04
EPSA  SPECIAL CONVERGENCE CRITERION-USED ONLY IF NON-ZERO               0.
  BF  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 MULTIPLIER                                        1.0000000E+00


INTEGER STORAGE=  246
FLOATING POINT STORAGE= 3172
TOTAL DATA STORAGE=  3418 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  2264  2294  2324
```

```
 2324  2474  2500  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  3156  3172  3172
  230   261   272   283   288   293   299   329   629   629   629   929
 1149  1114  1125  1136  1107  1198  1229  1260  1415  1570  1725  1880
 1890  2190  2190  2201  2211  2241  2252  2263  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 2.3d880E+01 1.80400E+01 1.24000E+01 7.52200E+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 43

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

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

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

IN MATERIAL 1,GROUP 4, SIG(G,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, SIG(G,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
1.0482000E-01	1.0482000E-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	1.29106E-02	9.47335E-03	7.34291E-03	7.12319E-03	8.48002E-03	9.41119E-03
2	2.33434E-02	8.54195E-03	6.28764E-03	4.41092E-03	3.55492E-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	1.65464E-03
4	5.96160E-04	2.14245E-04	1.58355E-04	1.21095E-04	1.02665E-04	4.54145E-04	1.62995E-04	2.88315E-04
5	0.	4.20670E-06	1.24338E-05	5.33769E-05	2.02533E-04	5.74681E-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	1.33788E-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	2.38540E-02	1.84505E-02	1.25684E-02	1.11112E-02	1.07652E-02
9	2.93569E-02	2.22326E-02	2.26948E-02	1.83493E-02	1.41233E-02	7.80491E-03	3.63122E-03	2.70612E-03
10	0.	1.76907E-06	2.95528E-06	1.56777E-04	4.8879EE-04	1.16820E-03	2.93852E-03	1.92089E-03
11	0.	0.	0.	8.47350E-08	8.84141E-05	2.98646E-04	8.78864E-04	2.20788E-03
12	0.	0.	0.	0.	3.42801E-05	7.64346E-05	2.52105E-04	6.50192E-04
13	0.	0.	0.	0.	0.	2.31070E-05	1.22487E-04	2.52259E-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	3.89251E-02	
3	5.11703E-03	2.17164E-02	
4	1.14354E-03	7.27777E-03	
5	3.97292E-05	2.00520E-04	
6	2.98776E-03	3.94096E-03	
7	1.35106E-02	2.27419E-02	
8	9.57075E-03	8.36874E-03	
9	1.96845E-03	1.61303E-03	
10	6.9473eE-04	4.70783E-04	
11	1.08577E-03	3.45821E-04	
12	1.98345E-03	6.19196E-04	
13	6.95075E-04	1.42610E-03	
14	1.39446E-04	6.17369E-04	
15	1.55596E-05	1.40434E-04	
16	0.	1.79147E-05	
17	0.	0.	
18	0.	0.	

AVG RADIUS	RADIUS	VOLUME	AREA	
1.52360006E-01	0.	1.18519966E-01	0.	1
4.57080000E-01	3.04720006E-01	8.29639706E-01	1.16884136E+00	2
7.61800006E-01	6.09440006E-01	2.25187926E+00	4.66736516E+00	3
1.06652006E+00	9.14160006E-01	4.39523846E+00	1.05015716E+01	4
1.37124006E+00	1.21888006E+00	7.22971746E+00	1.86694606E+01	5
1.67596006E+00	1.52400006E+00	1.07853166E+01	2.91710326E+01	6
1.98068006E+00	1.82832006E+00	1.50520356E+01	4.20062866E+01	7
2.28540006E+00	2.13504006E+00	2.00298736E+01	5.71752226E+01	8
2.59012006E+00	2.43776006E+00	2.57188316E+01	7.46778426E+01	9
2.89484006E+00	2.74248006E+00	3.21169096E+01	9.45141436E+01	10

3.1995600E+00	3.0472300E+00	3.9230106E+01	1.1684413E+02	11
3.5042800E+00	3.3514200E+00	4.7052423E+01	1.4113779E+02	12
3.8090000E+00	3.6566400E+00	5.5985849E+01	1.6802514E+02	13
4.1137200E+00	3.9613600E+00	6.4830617E+01	1.9719618E+02	14
4.4184400E+00	4.2660800E+00	7.4786993E+01	2.2870084E+02	15
4.7231600E+00	4.5708000E+00	8.5528489E+01	2.6253924E+02	16
5.0278800E+00	4.8755200E+00	9.6830905E+01	2.9871137E+02	17
5.3326000E+00	5.1802400E+00	1.0891948E+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	1.4946538E+02	4.6673651E+02	21
6.5514800E+00	6.3991200E+00	1.6443871AE+02	5.1457700E+02	22
6.8562000E+00	6.7038400E+00	1.8003148E+02	5.6475118E+02	23
7.1609200E+00	7.0085600E+00	1.9634757E+02	6.1726903E+02	24
7.4656400E+00	7.3132800E+00	2.1345444E+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	2.6892178E+02	8.5062729E+02	28
8.6845200E+00	8.5321600E+00	2.8883314E+02	9.1480356E+02	29
8.9892400E+00	8.8368800E+00	3.0945561E+02	9.8131351E+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	8.9923065DE-14	9.21265866E-01	0.	9.21265866E-01
1	2	101	9.7697626A2E-14	9.8728579?E-01	0.	1.07146219E+00
1	3	147	9.1704421BE-14	1.0118605?E+00	0.	1.02498114E+00
1	4	193	9.9031A938E-14	1.0218604?E+00	0.	1.00948A2AE+00
1	5	237	1.0125234?E-13	1.0260772AE+00	0.	1.00412663E+00
1	6	273	1.0635936AE-13	1.0278737?E+00	0.	1.00175050E+00
1	7	302	1.0791367AE-13	1.0286903?E+00	0.	1.00079484E+00
1	8	323	9.6367358?E-14	1.0290169?E+00	0.	1.00031940E+00
1	9	338	1.0302A697E-13	1.0291913AE+00	0.	1.00016753E+00
1	10	349	1.0125234?E-13	1.0292900?E+00	0.	1.00009591E+00

ICT	KLA	EV	F-OLD	F-NEW	B	Q	CMI	REAL	IMAG
11	6.883485E+01	1.029351E+00	3.267507E-01	3.363411E-01	-8.857551F-02	-1.3104R3E-03	1.3104E-03 -3.5374E-07 6.2952E-11 -7.9651E-15	5.3050E+03 1.2648E+03 6.8835E+01 1.2648E+03	-1.2646E-14 5.3713E+03 -8.3477E-15 -5.3715E+03
12	9.933086E-01	9.998070E-01	7.085521E+01	7.084118E+01	-6.035604E+00	-6.077317E+00	6.1903E+00 -1.1437E-01 1.3916E-03 -1.2028E-05	7.7569E+01 1.8568E+01 9.9301E-01 1.8568E+01	-1.7820E-16 7.8549E+01 -1.0907E-16 -7.8547E+01
13	9.704524E-01	9.991818E-01	7.034590E+01	7.028834E+01	-5.805582E+00	-5.976711F+00	6.0867E+00 -1.1134E-01 1.3404E-03 -1.1459E-05	7.8403E+01 1.8800E+01 9.7085E-01 1.8800E+01	-1.7831E-16 7.9384E+01 -1.0869E-16 -7.9384E+01
14	9.899523E-01	9.997260E-01	6.823961E+01	6.822091E+01	-5.575600E+00	-5.631192E+00	5.7317E+00 -1.0169E-01 1.1872E-03 -9.8405E-06	8.0854E+01 1.9400E+01 8.8995E-01 1.9400E+01	-1.9526E-16 8.1868E+01 -1.1683E-16 -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 -9.8576E-02 1.1386E-03 -9.3375E-06	8.1720E+01 1.9613E+01 9.9553E-01 1.9613E+01	-2.0717E-16 8.2743E+01 -1.2202E-16 -8.2743E+01
16	9.975544E-01	9.999343E-01	6.722548E+01	6.722106E+01	-5.454213E+00	-5.467352E+00	5.5634E+00 -9.7216E-02 1.1176E-03 -9.1211E-06	8.2110E+01 1.9704E+01 9.9755E-01 1.9704E+01	-2.1404E-16 8.3134E+01 -1.2490E-16 -8.3134E+01
17	9.986191E-01	9.999630E-01	6.705667E+01	6.705418E+01	-5.432831E+00	-5.440214E+00	5.5356E+00 -9.6481E-02 1.1062E-03 -9.0049E-06	8.2325E+01 1.9762E+01 9.9862E-01 1.9762E+01	-2.1834E-16 8.3355E+01 -1.2663E-16 -8.3355E+01
18	9.992046E-01	9.999787E-01	6.696154E+01	6.696016E+01	-5.420712E+00	-5.424952E+00	5.5199E+00 -9.6064E-02 1.0999E-03 -8.9400E-06	8.2446E+01 1.9792E+01 9.9920E-01 1.9792E+01	-2.2090E-16 8.3473E+01 -1.2766E-16 -8.3473E+01
19	9.995350E-01	9.999876E-01	6.690690E+01	6.690607E+01	-5.413707E+00	-5.416182E+00	5.5104E+00 -9.5831E-02 1.0962E-03 -8.9024E-06	8.2516E+01 1.9810E+01 9.9954E-01 1.9810E+01	-2.2243E-16 8.3549E+01 -1.2827E-16 -8.3549E+01
20	9.997252E-01	9.999927E-01	6.687496E+01	6.687445E+01	-5.409599E+00	-5.411061E+00	5.5057E+00 -9.5692E-02 1.0941E-03	8.2557E+01 1.9820E+01 9.9973E-01	-2.2335E-16 8.3590E+01 -1.2863E-16

							-8.8811E-06	1.9820E+01	-8.3590E-01
21	9.998363E-01	9.999456E-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	8.223949E+01	-2.273736E-13	5.323015E+01	-2.273736E-13	4.383997E+00
2	-5.318028E-01	2.277173F+01	3.207467E-03	3.582644F+01	2.850730E-03	4.749333E+00
3	-3.916491E-01	1.676654E+01	4.762244E-03	3.520096E+01	4.583414E-03	4.704740E+00
4	-2.873116E-01	1.230595E+01	2.433061E-01	2.587194E+01	2.211497E-01	4.783604E+00
5	-2.227490E-01	9.489674E+00	8.815639E-01	1.764444E+01	7.639461E-01	4.743243E+00
6	-2.154912E-01	8.970750E+00	2.036321E+00	9.153400E+00	1.837097E+00	5.205194E+00
7	-2.569457E-01	1.022428E+01	5.084981E+00	4.513456E+00	5.210453E+00	5.760752E+00
8	-2.866114E-01	1.045825E+01	6.139271E+00	3.453602E+00	6.428939E+00	5.998034E+00
9	-5.534055E-01	1.693152E+01	5.653513E+00	3.477515E+00	8.149200E+00	8.607127E+00
10	-1.206540E+00	2.853304E+01	3.965939E+00	4.269703E+00	8.504650E+00	1.344251E+01
11	-5.405134E+00	1.987212E+02	2.401773E+01	1.926420E+02	3.112784E+01	6.237853E+01

	ABSORPTION	NEUTRON BALANCE	RIGHT LEAKAGE	FISSION NEUTRONS	NEUTRON DENSITY	NEUTRON FLUX
1	5.644722E+01	3.183231E-12	4.383994E+00	9.004489E+01	2.606613E+02	9.669794E+01
2	1.749314E+01	2.273738E-12	4.749333E+00	2.924081E+01	5.124813E+01	8.594312E+01
3	1.167194E+01	2.160044E-12	4.704740E+00	2.075132E+01	2.984236E+01	8.272304E+01
4	7.258285E+00	1.932676E-12	4.783604E+00	1.384521E+01	1.648365E+01	7.519847E+01
5	4.642189E+00	1.644459E-12	4.743243E+00	9.460165E+00	8.858054E+00	6.663028E+01
6	3.749943E+00	1.193711E-12	5.205194E+00	6.395313E+00	5.044132E+00	6.255072E+01
7	4.006370E+00	1.819894E-12	5.760752E+00	1.014060E+01	3.682838E+00	6.629109E+01
8	3.886758E+00	1.255955E-12	5.998034E+00	1.067390E+01	2.855674E+00	6.821635E+01
9	5.276132E+00	1.591615E-12	8.607127E+00	2.386185E+01	2.543089E+00	9.419604E+01
10	9.372910E+00	3.751656E-12	1.344251E+01	6.033021E+01	2.718543E+00	1.611739E+02
11	1.238462E+02	2.080449E-11	6.237853E+01	2.767043E+02	3.839181E+02	8.346209E+02

	ZONE	FINAL RADII	AVERAGE RADII	FISSIONS	VOLUME
1	1	0.	.152360E+00	.428648E-01	.113520E+00
2	1	.304729E+00	.457048E+00	.429594E-01	.823697E+00
3	1	.609440E+00	.761800E+00	.428282E-01	.225187E+01
4	1	.914160E+00	.106652E+01	.425752E-01	.434523E+01
5	1	.121884E+01	.137124E+01	.422009E-01	.722971E+01
6	1	.152360E+01	.167596E+01	.417226E-01	.107852E+02
7	1	.182832E+01	.198068E+01	.411411E-01	.150520E+02
8	1	.213304E+01	.228540E+01	.404621E-01	.200298E+02
9	1	.243776E+01	.259012E+01	.396893E-01	.257148E+02
10	1	.274248E+01	.289484E+01	.388266E-01	.321191E+02
11	1	.304720E+01	.319956E+01	.378826E-01	.392301E+02
12	1	.335192E+01	.350428E+01	.368482E-01	.470542E+02
13	1	.365664E+01	.380900E+01	.357099E-01	.555856E+02

14	1	.3961360E+01	.4113720E+01	.3456093E-01	.9443042E+02
15	1	.4266960E+01	.4414640E+01	.3331275E-01	.7478699E+02
16	1	.4570800E+01	.4723160E+01	.3200130E-01	.8545249E+02
17	1	.4875520E+01	.5027880E+01	.3063158E-01	.9631081E+02
18	1	.5180240E+01	.5332600E+01	.2920877E-01	.1049198E+03
19	1	.5484960E+01	.5637320E+01	.2773819E-01	.1217200E+03
20	1	.5789680E+01	.5942040E+01	.2622524E-01	.1323113E+03
21	1	.6094400E+01	.6246760E+01	.2467536E-01	.1434537E+03
22	1	.6399120E+01	.6551480E+01	.2309391E-01	.1643072E+03
23	1	.6703840E+01	.6856200E+01	.2148594E-01	.1810114E+03
24	1	.7008560E+01	.7160920E+01	.1985573E-01	.1933076E+03
25	1	.7313280E+01	.7465640E+01	.1820595E-01	.2114544E+03
26	1	.7618000E+01	.7770360E+01	.1653615E-01	.2312324E+03
27	1	.7922720E+01	.8075080E+01	.1483970E-01	.2497216E+03
28	1	.8227440E+01	.8379800E+01	.1309847E-01	.2649218E+03
29	1	.8532160E+01	.8684520E+01	.1127271E-01	.2848331E+03
30	1	.8836880E+01	.8989240E+01	.9282756E-02	.3094556E+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	6.786306E-02	5.811346E-02	5.640483E-02	5.090866E-02	4.434666E-02	4.019216-02	4.21240E-02
2	1	4.57080E-01	6.391346-02	5.810116-02	5.640466F-02	5.09326E-02	4.43956E-02	4.02797E-02	4.22302E-02
3	1	7.61800E-01	6.337646-02	5.787196F-02	5.617496-02	5.07352E-02	4.42350F-02	4.015546-02	4.21074E-02
4	1	1.09652E+00	6.249776-02	5.749046-02	5.580346F-02	5.03988E-02	4.39505E-02	3.987476-02	4.18643E-02
5	1	1.37124E+00	6.262436-02	5.699216F-02	5.528126-02	4.99253E-02	4.35436F-02	3.950406-02	4.15004E-02
6	1	1.67590E+00	6.173096-02	5.629776-02	5.462536-02	4.93291E-02	4.30290F-02	3.911376-02	4.10150E-02
7	1	1.98068E+00	6.089116-02	5.549926-02	5.383716-02	4.86116E-02	4.24078F-02	3.853646-02	4.04077E-02
8	1	2.28540E+00	5.991446-02	5.457116-02	5.292176-02	4.777806-02	4.16850F-02	3.787276-02	3.98065E-02
9	1	2.59012E+00	5.886336-02	5.351776-02	5.188206-02	4.68316E-02	4.08463F-02	3.720076-02	3.90493E-02
10	1	2.89484E+00	5.756216-02	5.234216-02	5.072386-02	4.57772E-02	3.992446F-02	3.638946-02	3.82306E-02
11	1	3.19956E+00	5.619816-02	5.104866-02	4.944966-02	4.46183E-02	3.89447F-02	3.549776-02	3.72788E-02
12	1	3.50428E+00	5.470756-02	4.964216-02	4.809636-02	4.33591E-02	3.78528F-02	3.452946-02	3.62714F-02
13	1	3.80900E+00	5.310776-02	4.812646-02	4.665726-02	4.20049E-02	3.668746F-02	3.344856-02	3.51194E-02
14	1	4.11372E+00	5.139546-02	4.650866-02	4.509786-02	4.05559AE-02	3.542846F-02	3.227456-02	3.40364E-02
15	1	4.41844E+00	4.957976-02	4.479776-02	4.343486-02	3.902896E-02	3.410446F-02	3.120056-02	3.28166E-02
16	1	4.72316E+00	4.766466-02	4.297416-02	4.170706-02	3.74176E-02	3.271236-02	2.997436-02	3.15353E-02
17	1	5.02788E+00	4.565636-02	4.107176-02	3.986196-02	3.573126-02	3.125716-02	2.868766-02	3.01977E-02
18	1	5.33260E+00	4.356036-02	3.908546-02	3.796106-02	3.397536-02	2.973436F-02	2.735126-02	2.88048E-02
19	1	5.63732E+00	4.138146-02	3.702006-02	3.596786-02	3.215556-02	2.811786-02	2.587016-02	2.73746E-02
20	1	5.94204E+00	3.912676-02	3.488226-02	3.387526-02	3.027776-02	2.648496F-02	2.436966-02	2.58986E-02
21	1	6.24676E+00	3.679316-02	3.267526-02	3.171886-02	2.834776-02	2.479006F-02	2.280466-02	2.43886E-02
22	1	6.55148E+00	3.438956-02	3.040426-02	2.950396-02	2.637136-02	2.307196F-02	2.121046-02	2.28475E-02
23	1	6.85620E+00	3.191006-02	2.807316-02	2.723546-02	2.435426-02	2.131966F-02	2.010186-02	2.12822E-02
24	1	7.16092E+00	2.935276-02	2.568516-02	2.491796-02	2.230146-02	1.951476F-02	1.857266-02	1.96963E-02
25	1	7.46564E+00	2.670626-02	2.324176-02	2.255446-02	2.021676-02	1.767646F-02	1.702576-02	1.80923E-02
26	1	7.77036E+00	2.395136-02	2.074116-02	1.994506-02	1.810086-02	1.581826F-02	1.546046-02	1.64697E-02
27	1	8.07508E+00	2.109636-02	1.817336-02	1.733256-02	1.594706-02	1.435926F-02	1.387056-02	1.48219E-02
28	1	8.37980E+00	1.796516-02	1.550936-02	1.464976-02	1.373156-02	1.248616F-02	1.223876-02	1.31317E-02
29	1	8.68452E+00	1.453756-02	1.265236-02	1.213506-02	1.138896-02	1.051296F-02	1.052756-02	1.13630E-02
30	1	8.98924E+00	9.981346-03	9.318646-03	9.034036-03	8.756066-03	8.326286F-03	8.643546-03	9.44738E-03

ZONE		AVG RADIUS	GROUP 8	GROUP 9	GROUP 10	GROUP
1	1	1.52360E-01	6.315976-02	5.885726-02	8.644646F-02	
2	1	4.57080E-01	6.327236-02	5.902936-02	8.671276F-02	
3	1	7.61800E-01	6.314716-02	5.887236-02	8.649156F-02	
4	1	1.09652E+00	6.290256-02	5.854756-02	8.606576F-02	
5	1	1.37124E+00	6.253276-02	5.805446-02	8.537526F-02	
6	1	1.67590E+00	6.205836-02	5.741966-02	8.443936-02	
7	1	1.98068E+00	6.138036-02	5.666356-02	8.337206F-02	
8	1	2.28540E+00	6.048376-02	5.573446-02	8.240086E-02	
9	1	2.59012E+00	6.000336-02	5.469426-02	8.090496F-02	
10	1	2.89484E+00	5.917306-02	5.359486-02	7.922876E-02	
11	1	3.19956E+00	5.822696-02	5.226526-02	7.738056F-02	
12	1	3.50428E+00	5.719936-02	5.088016-02	7.537006E-02	
13	1	3.80900E+00	5.609466-02	4.939006-02	7.320776E-02	
14	1	4.11372E+00	5.491746-02	4.780246-02	7.090036E-02	
15	1	4.41844E+00	5.367256-02	4.612146-02	6.845916F-02	
16	1	4.72316E+00	5.236446-02	4.435876-02	6.589926E-02	
17	1	5.02788E+00	5.099956-02	4.251546-02	6.321056-02	

18	1	5.33280E+00	2.95814E-02	4.06029E-02	6.04237E-02
19	1	5.63712E+00	2.81172E-02	3.86244E-02	5.75427E-02
20	1	5.94204E+00	2.66110E-02	3.65903E-02	5.45783E-02
21	1	6.24676E+00	2.50698E-02	3.45076E-02	5.15412E-02
22	1	6.55148E+00	2.34964E-02	3.23833E-02	4.84420E-02
23	1	6.85620E+00	2.18984E-02	3.02244E-02	4.52905E-02
24	1	7.16092E+00	2.02791E-02	2.80364E-02	4.20947E-02
25	1	7.46564E+00	1.86412E-02	2.58226E-02	3.88592E-02
26	1	7.77036E+00	1.69834E-02	2.35814E-02	3.55820E-02
27	1	8.07508E+00	1.53004E-02	2.13052E-02	3.22502E-02
28	1	8.37980E+00	1.35724E-02	1.89697E-02	2.88316E-02
29	1	8.68452E+00	1.17648E-02	1.65289E-02	2.52634E-02
30	1	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	8.68849E+01	4.23194E+01	1.03519E+01	1.08078E+00	0.	5.64321E+01	9.00361E+01
2	9.60334E+02	2.92470E+01	1.37633E+01	3.36202E+00	3.45208E-01	6.77815E-03	1.74714E+01	2.92779E+01
3	5.59439E+02	2.00231E+01	9.75151E+00	2.38370E+00	2.45594E-01	1.92836E-02	1.16708E+01	2.07493E+01
4	3.09038E+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	1.28249E-01	2.53004E-01	4.64173E+00	9.45924E+00
6	9.45733E+01	8.35344E+00	4.20014E+00	1.10230E+00	5.32581E-01	6.73700E-01	3.74728E+00	8.39449E+00
7	6.90453E+01	1.05393E+01	2.51704E+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	1.06671E+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	2.63564E+01	2.37780E+00	1.23434E+02	2.76757E+02

G	SIGMA 8
1	1.09027E+02
2	5.33172E+01
3	4.08723E+01
4	3.33481E+01
5	2.30483E+01
6	1.47391E+01
7	1.38094E+01
8	1.37643E+01
9	1.64020E+01
10	2.21501E+01
11	3.47582E+02

* * * FINAL VALUES FOR ALL GROUPS * * *

PI = -2.377804E+00 PIP = 9.072459E-01

CARD READ - 001117 30