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Argonne National Laboratory

THE ARGONNE-REVISED THERMOS CODE

by

B. J. Toppel and I. Baksys

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THE ARGONNE-REVISED THERMOS CODE

by

B. J. Toppel and I. Baksys

I. INTRODUCTION

The THERMOS code, developed by H. Honeck,^(1,2) computes the scalar thermal-neutron spectrum as a function of position in a lattice by solving the integral transport equation with isotropic scattering. One-dimensional slab or cylindrical geometry can be used.

The original version of the code was intended for use on the IBM-704, -709, and -7090 machines.

The speed and two-bank memory capacity of the CDC-3600 computer at Argonne has prompted a reprogramming effort to relax some of the original restrictions on dimensions of variables, and to provide a much more elaborate output edit. In connection with the revised output edit, the associated cross-section library preparation code, LIBP, was modified. The revised codes to be described here are written entirely in 3600 FORTRAN.

Since the original documentation by Honeck^(1,2) is quite lucid, this report will dwell only on the new aspects of the revised codes. We have, in general, followed the format of Ref. 2 in describing input and output so that the reader familiar with the original version can easily use the new specifications. The reader is referred to the original references^(1,2) for a general discussion of the theory and use of THERMOS and the associated LIBP and GAKER codes.

An important objective of the present effort was to develop a program that would produce directly all thermal group cross sections to be used with a multigroup cross-section set. The present code outputs flux-averaged values of Σ_a , Σ_f , $\nu\Sigma_f$, Σ_s , and D for the cell composition, and supplies values of Σ_a , Σ_f , $\nu\Sigma_f$, Σ_s , and Σ_{tr} for the isotopic constituents.

The usefulness of THERMOS has also been greatly increased by modifications that permit an automated sequence in which one problem generates a correct, energy-dependent, spatially-averaged set of cross sections for use in the next problem. This "pseudo material" generating feature facilitates the solution of geometrically complex systems.

In generating pseudo cross sections, the code computes the group-dependent cross sections averaged over regions NRI to NRF, using

$$\bar{\Sigma}_x(j) = \sum_{i=NRI}^{NRF} \Sigma_x(i, j) \frac{V_i \bar{\phi}_i(j)}{V \bar{\phi}(j)},$$

where x is absorption, fission, etc., j is the energy group, i is a region index ranging over region numbers NRI to NRF, $\Sigma_x(i, j)$ is the region- and group-dependent cross section, V_i is the region i volume, V is the sum of the V_i , $\bar{\phi}_i(j)$ is the region i average flux in group j , and $\bar{\phi}(j)$ is the average group j flux over the regions concerned. In the case of the diffusion constant, Σ_x is replaced by $1/3 \Sigma_{tr}(i, j)$, where $\Sigma_{tr} = \Sigma_a + (1 - \bar{\mu}) \Sigma_s$. The code allows the user to input V_i other than the values used in computing the $\bar{\phi}_i(j)$, if desired.

As described in the input specifications (Section III), the cross sections for the pseudo materials are edited in the problem output and written on tape. The pseudos may be used either in automated sequential problems, or later using the prepared tape.

The original THERMOS methods of solution⁽²⁾ have not been altered. However, the subroutines concerned with calculation of the slab and cylindrical transport kernels have been revised considerably so that the code now correctly allows for the presence of void regions in the system. The original Argonne IBM-704 THERMOS code could not cope with such void regions. The changes involved in the revised program are discussed in Section II.

Table I compares limitations of various problem parameters for the original and Argonne-revised THERMOS codes.

Table I

COMPARISON OF PROBLEM DIMENSIONS FOR ORIGINAL AND ARGONNE-REVISED THERMOS CODES

Variable	Original Code	Revised Code
Number of space points	20	20
Number of speed groups	30	50
Number of isotopes used in cell mixture	10	25
Number of isotopes used in edit	10	25
Number of mixtures	5	5

The enlarged output edit is described in Section IV. As seen in the formulas of Section IV and from the input specifications (Section III), the speed integration is performed over the range v_L to v_U (specified in the input), as opposed to the original code for which v_L was always the speed corresponding to the lowest group. The new version also edits the group-dependent, spatial point fluxes as well as neutron densities.

Because of the larger memory capacity of the present system, the cylinder and slab geometry options are now input options of the code. The original version consisted of two separate codes, one for each geometry. Having both geometries in a single code greatly increases the flexibility of the system, particularly when utilizing the pseudo material option.

The Argonne-revised THERMOS code requires 51751 memory locations, of which 20000 are in memory bank 0 and 31751 are in memory bank 1.

II. TRANSPORT KERNEL CONSIDERATIONS

A. General Comments

The original Argonne THERMOS code could not cope with void regions. The revised version has been altered, both for slab and cylindrical geometry, to correctly compute the transport kernels for these cases. The general approach of the original work^(1,2) has been retained, with additional coding included to allow for those cases that lead either to indeterminate or inaccurate results with the general algorithms.

The special cases for void regions are discussed in B and C below for slab and cylindrical geometry.

B. Slab Geometry

As shown by Honeck,⁽²⁾ the average flux in a slab of thickness Δx at x (see Fig. 1) due to a uniform unit source per unit volume in the slab of thickness $\Delta x'$ at x' is given by

$$K(x, x', v) = \frac{\Delta x'}{2\Delta\lambda\Delta\lambda'} [E_3(\lambda' - \lambda - \Delta\lambda) - E_3(\lambda' - \lambda) - E_3(\lambda' - \lambda - \Delta\lambda + \Delta\lambda') + E_3(\lambda' - \lambda + \Delta\lambda')]. \quad (1)$$

The λ and $\Delta\lambda$ are the optical thicknesses corresponding to x and Δx and are functions of the speed v . The E_i function is defined by

$$E_i(\lambda) = \int_1^\infty du u^{-i} \exp(-\lambda u). \quad (2)$$

Fig. 1

Slab Geometry Schematic Diagram

If $\Delta\lambda$ and/or $\Delta\lambda'$ are zero, Eq. (1) is indeterminate. These special cases have been explicitly allowed for now as indicated below.

If $\Delta\lambda = 0, \Delta\lambda' \neq 0$:

$$K(x, x', v) = \frac{\Delta x'}{2\Delta\lambda'} [E_2(\lambda' - \lambda) - E_2(\lambda' + \Delta\lambda' - \lambda)]. \quad (3)$$

If $\Delta\lambda \neq 0, \Delta\lambda' = 0$:

$$K(x, x', v) = \frac{\Delta x'}{2\Delta\lambda} [E_2(\lambda' - \lambda - \Delta\lambda) - E_2(\lambda' - \lambda)]. \quad (4)$$

If $\Delta\lambda = 0, \Delta\lambda' = 0, \lambda' - \lambda \neq 0$:

$$K(x, x', v) = \frac{\Delta x'}{2} E_1(\lambda' - \lambda). \quad (5)$$

If $\Delta\lambda = 0, \Delta\lambda' = 0, \lambda' - \lambda = 0$:

$K(x, x', v)$ displays a logarithmic singularity. In this case, the revised code returns the value 10^{30} for K . However, since K always multiplies the source at x' , for this case there is no contribution since only slowing-down sources are considered by THERMOS.

In the case of coinciding slabs ($x = x', \Delta x = \Delta x'$) in vacuum, $K(x, x, v)$ is again indeterminate and again is assigned the value 10^{30} by the revised program.

The original algorithms for the ordinary cases for which $\Delta\lambda$ and $\Delta\lambda'$ are nonzero have been retained. Thus, Eq. (1) is used in general, and if

$$E_3(\lambda' - \lambda - \Delta\lambda) - E_3(\lambda' - \lambda) - E_3(\lambda' - \lambda - \Delta\lambda + \Delta\lambda') + E_3(\lambda' - \lambda + \Delta\lambda') \leq 10^{-6},$$

the code evaluates K using

$$K(x, x', v) = \frac{\Delta x'}{2} E_1(\lambda' - \lambda + \frac{1}{2}\Delta\lambda' - \frac{1}{2}\Delta\lambda). \quad (6)$$

One may note that Eq. (5) is obtained from Eq. (6) directly for $\Delta\lambda' = \Delta\lambda = 0$. Also, in the limit of small $\Delta\lambda'$ and $\Delta\lambda$, Eqs. (3) and (4), respectively, go over to Eq. (6). However, the use of the correct formulas eliminates the inaccuracies that could result from the use of Eq. (6) for cases in which the $\Delta\lambda$ are not small.

Finally, for the case of coinciding slabs for nonvacuum regions, as before,

$$K(x, x, v) = \frac{\Delta x}{(\Delta\lambda)^2} [\Delta\lambda - \frac{1}{2} + E_3(\Delta\lambda)]. \quad (7)$$

C. Cylindrical Geometry

Consider a line source S located on the mean radius of the shell K (see Fig. 2). Given the angle β , the distance from S to the inner radius of

Fig. 2. Cylindrical Geometry Schematic Diagram

shell N (Sb) is ρ , and to the outer radius (Sc) is $\rho + \Delta\rho$. The corresponding optical lengths are λ and $\lambda + \Delta\lambda$. The length from S to the boundary of the source shell (Sa) is $\Delta\rho_K$ with corresponding optical length $\Delta\lambda_K$.

Honeck has shown^(1,2) that the average flux in the shell N due to neutrons emitted by S in the direction $\Delta\beta$ about β is given by

$$\phi(N, K, v) = \frac{\Delta\beta}{2\pi V_N \Sigma_N} [Ki_2(\lambda) - Ki_2(\lambda + \Delta\lambda)]. \quad (8)$$

The dependence on speed v is because λ is a function of v .

In Eq. (8), V_N is the volume (area) of the shell N and Σ_N is the total cross section at speed v for the composition of the shell N . The Ki_n function is defined by

$$Ki_n(\lambda) = \int_0^{\pi/2} d\theta \cos^{n-1}\theta \exp(-\lambda \sec \theta).$$

For the case of the flux in shell K due to the source in the same shell, Eq. (8) becomes

$$\phi(K, K, v) = \frac{\Delta\beta}{2\pi V_K \Sigma_K} [1 - Ki_2(\Delta\lambda_K)]. \quad (9)$$

If Σ_N in Eq. (8) or Σ_K in Eq. (9) vanish, these formulas become indeterminate.

The revised code tests whether

$$Ki_2(\lambda) - Ki_2(\lambda + \Delta\lambda) \leq 10^{-6} \quad (10)$$

for Eq. (8), and in the case of the source shell, whether

$$1 - Ki_2(\Delta\lambda_K) \leq 10^{-6}. \quad (11)$$

If conditions (10) and (11) are met, the thin-region forms of Eqs. (8) and (9) are employed. In particular, the code evaluates

$$\phi(N, K, v) = \frac{\Delta\beta\Delta\rho}{2\pi V_N} Ki_1(\lambda) \quad (12)$$

and

$$\phi(K, K, v) = \frac{\Delta\beta\Delta\rho_K}{4V_K}. \quad (13)$$

III. INPUT SPECIFICATIONS FOR THERMOS, LIBP, AND GAKER

A. General Comments

As described in Ref. 2, LIBP prepares a cross-section library tape for THERMOS, and GAKER computes the Nelkin scattering kernel for hydrogen in water. Since LIBP has been extensively altered, the new input is given in Section C below following the revised THERMOS input in Section B below.

The input to GAKER has not been changed, compared with the description of Ref. 2. However, GAKER has been recoded so that the temperature-dependent input constants $\bar{E}$, A, and $B^{(2)}$ are computed by the program. These three input numbers are ignored, therefore. Note that the constants given in Ref. 2 are for room temperature only. Also, in passing, note that the value given for $\bar{E}$ for $E > 0.32$ eV is in error in Ref. 2. The correct value is 0.0349 eV.

Since the format of the binary cards prepared by GAKER for LIBP are now somewhat different, the format of these cards is given in Section E below following the specifications of LIBP input.

The tape numbers used with these codes are listed below. As in the original codes, tape assignments are made at the beginning of each program and stored in common storage.

<u>Tape No.</u>	<u>Description</u>
60	Standard input, used by GAKER, LIBP, and THERMOS.
61	Standard output, used by GAKER, LIBP, and THERMOS.
62	Standard punch output, used by THERMOS.
51	Scratch tape used by LIBP and THERMOS.
20	Contains pseudo material cross sections, prepared and used by THERMOS.
10	Cross-section library tape, used by LIBP and THERMOS.
2	Contains the original Legendre components prepared by GAKER or similar programs, used by LIBP.
1	Punch tape, Legendre angular components are written on this tape and then are punched into binary cards, used by GAKER and LIBP.

In the following input descriptions, the information is given, in general, in four columns. These are, respectively, the card type number, the format used for the variables, the variable FORTRAN names, and a description of the meaning and ranges for the values to be supplied. The user is assumed to be familiar with the standard FORTRAN format designations.

B. THERMOS Input

1.	(72H 72)		72 Hollerith character identification with 1 in column 1 for program control.
2.	(2I5)	IDENT,

IBY | Identification number. If negative or zero, program exits.

Bypass, normally zero. If > 0 , cross sections used for last case will be used again. If < 0 , edit from last case will be repeated with new parameters. |

If IBY > 0 , go to item 18. If IBY < 0 , go to item 29.

Problem size

3.	(7I5)	NX,

IX,

MX,

ISOX,

ISOXE,

ICX,

ICXE | Number of space points ≤ 20 .

Number of speed groups ≤ 50 .

Number of mixtures ≤ 5 .

Number of isotopes used in cell from library ≤ 25 .

Number of isotopes used in edit from library ≤ 25 .

Number of isotopes used in cell not from library $\leq 25 - ISOX$.

Number of isotopes used in edit not from library $\leq 25 - ISOXE$. |
|----|-------|--|--|

Mixture table

4.	(20I1)	(MTBL(N),
N=1, NX) | Mixture number (1-5) assigned to each space point N. |
|----|--------|-----------------------|--|

Description of isotopes taken from library tape used in cell

5.	(2I5,	(ISTBA(J),

ISTBB(J),

5E10.5) | First identification of J^{th} isotope used in cell.

Second identification of J^{th} isotope used in cell.

Concentration of J^{th} isotope used in M^{th} mixture. |
| | | (C ϕ NCTA(J,M),
M=1, 5),
J=1, ISOX) | |

Speed mesh. If $ISOX + ISOXE \neq 0$ ignore this item.

6.	(7E10.5)	(V(I),
I=1,IX)	Speed mesh points v_i in increasing order.
7.	(7E10.5)	(DV(I),
I=1, IX)	Speed increments Δv_i .

Description of isotopes used in cell not from library. Ignore if ICX = 0.

8.	(2I5,	ISTBA(LP),	First identification of LP^{th} isotope in cell.
		ISTBB(LP),	Second identification of LP^{th} isotope used in cell.
	5E10.5)	(CØNCTA(LP,M),
M = 1, 5)	Concentration of LP^{th} isotope used in mixture M.
9.	(5I5,	NXAT,	If = 0, σ_a for LP^{th} isotope is tabular. If $\neq 0$, $\sigma_a = \sigma_a^0/v_i$.
		NKERT,	Number of terms in sum of LP^{th} scattering kernel (NKERT ≤ 10).
		IDNU,	If = 0, ν for LP^{th} isotope is tabular.
If > 0 , ν is constant.
If < 0 , ν is not pertinent.
		IDAF,	If = 0, σ_f for LP^{th} isotope is tabular.
If > 0 , $\sigma_f = \sigma_f^0/v_i$.
If < 0 , σ_f is not pertinent.
		IDMU,	If = 0, $\bar{\mu}$ is tabular.
If $\neq 0$, $\bar{\mu}$ is constant, only one value is given.
	E10.5)	TP	Temperature for LP^{th} isotope scattering kernel.
10.	(6E12.5)	(VALXA(I),

I = 1, IX) | If NXAT = 0, microscopic cross section $\sigma_a(v_i)$.
If NXAT $\neq 0$, only $\sigma_a(KT_0)$ is given. |
| 11. | (6E12.5) | (XNU(I),

I = 1, IX) | If IDNU = 0, ν is tabular.
If IDNU > 0 , ν is constant, give only one value.
If IDNU < 0 , skip this item. |

12.	(6E12.5)	(FX(I),

I = 1, IX) | <p>If IDAF = 0, microscopic cross section $\sigma_f(v_i)$.</p> <p>If IDAF > 0, only $\sigma_f(KT_0)$ is given.</p> <p>If IDAF < 0, skip this item.</p> |
| 13. | (6E12.5) | (XMU(I),

I = 1, IX) | <p>If IDMU = 0, the average cosine of the scattering angle at v_i, $\bar{\mu}(v_i)$.</p> <p>If IDMU $\neq$ 0, $\bar{\mu}$ is constant and only one value is given.</p> |
| 14. | (3E10.5) | (AT(N),

AMT(N),

AKT(N),
N = 1, NKERT) | <p>Cross section σ_n used in n^{th} term of LP^{th} isotope scattering kernel.</p> <p>Mass used in n^{th} term of LP^{th} isotope scattering kernel.</p> <p>Value κ_n used in n^{th} term of LP^{th} isotope scattering kernel.</p> |

Items 8-14 are repeated ICX times so that $LP = IS\phi X + 1, IS\phi X + ICX$.

Slowing down source data

15.	(2I5)	NSC,

NST | <p>Number of source cards used of type 17.</p> <p>If ≤ 0, spatially flat source is used.</p> <p>If > 0, distribution $S_d(r_i)$ is read.</p> |
| 16. | (7E10.5) | (SD(N),
N = 1, NX) | <p>Spatial source distribution $S_d(r_i)$.</p> <p>Omit if NST ≤ 0.</p> |
| 17. | (I5,

4E10.5) | M,

AM,

HXS,

HC ϕ N, | <p>Mixture number (1-5) in which this source is used.</p> <p>Mass used in calculation of this source.</p> <p>Microscopic, high-energy, cross section for source.</p> <p>Concentration of isotope for this source.</p> |

TP

Effective temperature of protons.
If this error-function correction is
not used, $TP = 0$.

Item 17 is repeated until NSC cards have been read.

Geometry data

18.	(3I5)	LTST,	If < 0 , full slab with vacuum boundaries or cylinder with vacuum boundaries.
			If $= 0$, half slab with symmetry and vacuum boundary or cylinder with vacuum boundary.
			If > 0 , slab or cylinder with reflecting boundaries.
		NRX,	Number of regions.
		NGEØM	If ≤ 0 , cylindrical geometry.
			If > 0 , slab geometry.
19.	(2I5	NRXA,	Region number in increasing order.
		NP,	Number of space points in this region.
	E10.5)	TH	Thickness of this region (half-thickness of innermost region for reflecting inner boundary).

Item 19 is repeated until NRX cards have been read.

Iteration parameters

20.	(5E10.5,	EPS,	Neutron density convergence criterion, $\epsilon_r (= 10^{-5})$.
		RELC,	Initial overrelaxation factor, $\omega_0 (= 1.2)$.
		EPSG,	Extrapolation criterion, $\epsilon_e (= 0.05)$.
		ØVERX,	Maximum extrapolation factor ($= 100$).
		FACTØR,	Under extrapolation factor ($= 1.00$).
	4I5,	ITBG,	Minimum iterations before extrapolation, $\ell_b (= 5)$.

	LCMX,	Number of overrelaxation factors tested, $\ell_e (= 5)$.
	ITDM,	Minimum delay between extrapolations, $\ell_d (= 5)$.
	ITMAX,	Maximum number of iterations allowed ($= 100$).
12)	IPT	If > 0 , record of each iteration is printed (-1). If ≤ 0 , print is omitted.

If item 20 is a blank card, the values in parentheses will be used.

Edit data

Description of isotopes used in the edit that are taken from the library tape.

21.	(2I5,	ISTBE(LP),	First identification of LP^{th} isotope used in edit.
		ISTBG(LP),	Second identification of LP^{th} isotope used in edit.
E10.5)		CØNCTE(LP)	Concentration of LP^{th} isotope.

Item 21 is repeated until ISØXE isotopes are read.

Description of the isotopes used in the edit not from the library tape.

Ignore if ICXE = 0.

22.	(2I5,	ISTBE(LP),	First identification of LP^{th} isotope used in edit.
		ISTBG(LP),	Second identification of LP^{th} isotope used in edit.
E10.5)		CØNCTE(LP)	Concentration of LP^{th} isotope.
23.	(5I5,	NXAT,	If $= 0$, σ_a for LP^{th} isotope is tabular. If $\neq 0$, $\sigma_a = \sigma_a^0/v_i$.
		NKERT,	Number of terms in sum of LP^{th} scattering kernel.

	IDNU,	If = 0, ν for LP^{th} isotope is tabular. If > 0, ν is constant. If < 0, ν is not pertinent.
	IDAF,	If = 0, σ_f for LP^{th} isotope is tabular. If > 0, $\sigma_f = \sigma_f^0/v_i$. If < 0, σ_f is not pertinent.
	IDMU,	If = 0, $\bar{\mu}$ for LP^{th} isotope is tabular. If $\neq 0$, $\bar{\mu}$ is constant, only one value is given.
E10.5)	TP	Temperature for LP^{th} isotope scattering kernel.
24. (6E12.5)	(VALXA(I), I = 1, IX)	If NXAT = 0, microscopic cross section $\sigma_a(v_i)$. If NXAT $\neq 0$, only $\sigma_a(KT_0)$ is given.
25. (6E12.5)	(XNU(I), I = 1, IX)	If IDNU = 0, ν is tabular. If IDNU > 0, ν is constant; give only one value. If IDNU < 0, ν skip this item.
26. (6E12.5)	(FX(I), I = 1, IX)	If IDAF = 0, microscopic cross section $\sigma_f(v_i)$. If IDAF > 0, only $\sigma_f(KT_0)$ is given. If IDAF < 0, skip this item.
27. (6E12.5)	(XMU(I), I = 1, IX)	If IDMU = 0, tabular $\bar{\mu}(v_i)$. If IDMU $\neq 0$, $\bar{\mu}$ is constant, only one value is given.
28. (3E10.5)	(AT(N), AMT(N),	Cross section σ_n used in n^{th} term of LP^{th} isotope scattering kernel. Mass used in n^{th} term of LP^{th} isotope scattering kernel.

AKT(N),
N = 1,NKERT)

Value κ_n used in n^{th} term of LP^{th}
isotope scattering kernel.

Items 22-28 are repeated ICXE times, so that $LP = IS\phi XE + 1$,
 $IS\phi XE + ICXE$.

29.	(14I5)	IXPCM,	Number of pairs of speed groups over which integration will be performed.
			If = 0, all speeds groups are evaluated.
		(IXPTL(J),	Lower speed group to be used in edit.
		IXPTU(J),	Upper speed group to be used in edit.
		J = 1,IXPCM)	
30.	(4I5)	NRI,	Smallest region number of cell used for spatial flux averaging. If blank, no spatial flux averaging is done.
		NRF,	Largest region number of cell used in spatial flux averaging in cell.
		NXS,*	Number of pseudo material to be generated. If NXS = 0, no pseudos are generated. If NXS < 0, card 32 is required and NXS is number of pseudo material generated.
		NXLAST*	Total number of pseudo materials to be generated.
31.	(50I1)	(NRTBL(N),	An integer is assigned to each space point. A sequence of the same integer defines an edit region. Spatial averages are done over an edit region.
		N = 1, NX)	
32.	(7E10.5)	(SUMV ϕ L(J),*	Regional volumes for regions NRI to NRF.
		J = NRI, NRF)	If NXS $\geq$ 0, ignore this card.

CARDS 29-32 are repeated until NXLAST pseudo materials have been processed.

*See comments regarding pseudo-material generation below.

TERMINATION

If more cases are to be done, return to item 1. To end the run, use the following cards.

33. (72H 72) ————— 72 Hollerith character card.

34. Blank card.

Comments Regarding Pseudo-material Generation

To generate a pseudo material, IXPCM = 0 (card 29) and NXS $\neq$ 0 (card 30).

When a pseudo material is generated, $\sigma_a(v_i)$, $\nu(v_i)$, $\sigma_f(v_i)$, $\bar{\mu}(v_i)$, $\sigma_s(v_i)$, and the scattering kernel $P(v_j \leftarrow v_i)$ for the pseudo are written in binary on tape 20.

If the pseudo-generating problem and the problem using the pseudo material are run sequentially, the necessary cross sections are read in automatically by the code from tape 20. The pseudo materials must be called for in the same order in which they were computed, since information is read from tape 20 sequentially with no tape searching. If the problem using the pseudo material is to be run at a later time, tape 20 must be saved and used as an input tape for the subsequent problem.

The input requirements for use of a pseudo material are summarized in Table II. The use of the tape input for the pseudo material is determined by ISTBB (and ISTBG) being negative as shown in Table II.

Table II

INPUT REQUIREMENTS FOR USE OF A PSEUDO MATERIAL

Card Number					
8	9	10-14	22 ^a	23 ^a	24-28 ^a
ISTBB<0	Blank	Ignore	ISTBG<0	Blank	Ignore

^aIgnore if ICXE = 0.

When running sequential problems, the cards for the second problem are merely added to the cards for the originating problem as indicated by the comment above card type 33 above. This process may be continued indefinitely so that any number of problems may be calculated during one run.

C. LIBP Input

To facilitate running the expanded version of THERMOS, the LIBP code has been altered from the original version.⁽²⁾ The new input required is described below.

1. (72H 72) 72 Hollerith character identification, with a 1 in column 1 for program control.

2. (4I5) ITAG, If ≥ 0 , make a new library tape.
If < 0 , update existing tape.

IX, Number of groups ≤ 50 .
NISA, Number of isotopes to be added.
NISD Number of isotopes to be deleted ≤ 100 .

3. (2I5) (NIDM(L), First identification of L^{th} isotope to be deleted.

NIDMA(L), Second identification of L^{th} isotope to be deleted.

L = 1, NISD) If NISD ≤ 0 , ignore.

4. (7E10.5) (V(I), Speed mesh v_i in increasing order.
I = 1, IX) If ITAG < 0 , ignore.

5. (7E10.5) (DV(I), Speed increments Δv_i .
I = 1, IX) If ITAG < 0 , ignore.

Input data for each of the NISA isotopes

6. (7I5) IDM, First identification of this isotope.
IDMA, Second identification of this isotope.
IDA, If ≥ 0 , IDA kernel decks are read and put on tape.

If = -1, gas kernel is computed and put on tape.

If = -2, gas kernel is computed, put on tape 10, and written on tape 1.

- If = -2, gas kernel is computed, put on tape 10, and written on tape 1.
- IDAP, If = 0, σ_a is tabular, $\sigma_a(v_i)$.
If $\neq 0$, $\sigma_a = \sigma_a^0/v_i$.
- IDNU, If = 0, ν is tabular.
If = > 0, ν is constant.
If = < 0, ν is not pertinent.
- IDMF, If = 0, σ_f is tabular, $\sigma_f(v_i)$.
If = > 0, $\sigma_f = \sigma_f^0/v_i$.
If = < 0, σ_f is not pertinent.
- IDMU, If = 0, $\bar{\mu}$ is tabular.
If = 0, $\bar{\mu}$ is constant.
7. (7E10.5) (XA(I), If IDAP = 0, microscopic cross section $\sigma_a(v_i)$.
I = 1, IX) If IDAP $\neq 0$, give only one value, σ_a^0 .
8. (7E10.5) (XNU(I), If IDNU = 0, ν is tabular, $\nu(v_i)$.
I = 1, IX) If IDNU > 0, give only one value of ν .
If IDNU < 0, ignore this card.
9. (7E10.5) (FX(I), If IDMF = 0, microscopic cross section $\sigma_f(v_i)$.
I = 1, IX) If IDMF > 0, only σ_f^0 is given.
If IDMF < 0, ignore this card.
10. (7E10.5) (XMU(I), If IDMU = 0, $\bar{\mu}$ is tabular, $\bar{\mu}(v_i)$.
I = 1, IX) If IDMU $\neq 0$, give only one value of $\bar{\mu}$.
- If IDA ≥ 0 , ignore cards 11 and 12.
11. (15,E10.5) NK, Number of terms in sum for gas kernel.
T Temperature for gas kernel.
12. (3E10.5) (ZAT(N), Cross section for n^{th} term of gas kernel.
ZAM(N), Mass used in n^{th} term of gas kernel.
ZAKT(N), Value of kappa used in n^{th} term of gas kernel.
N = 1, NK)

The output of LIBP has also been expanded to accommodate the new input and is described in D below.

D. Format of Binary Library Tape Prepared by LIBP

<u>Record</u>	<u>Symbol</u>	<u>Description</u>
1.	10-01	Library tape label.
2.	IX	Number of speed groups ≤ 50 .
3.	V(I)	The speed points in increasing order.
4.	DV(I)	The values of Δv_i .

The following group of records is repeated for each isotope:

5.	IDM	First identification number.
	IDMA	Second identification number.
	IDB	Normally zero. If negative, this is last isotope on tape.
	IDA	Number (0-4) of P decks for this isotope.
6.	XA(I)	Absorption cross section (barns) at v_i .
7.	P0(I,J)	Isotropic scattering (zeroth Legendre) component P deck. If IDA < 1, ignore.
8.	P1(I,J)	First Legendre component P deck. If IDA < 2, ignore.
9.	P2(I,J)	Second Legendre component P deck. If IDA < 3, ignore.
10.	P3(I,J)	Third Legendre component P deck. If IDA < 4, ignore.
11.	XNU (I)	Number of neutrons emitted per fission at v_i .
12.	FX (I)	Fission cross section (barns) at v_i .
13.	XMU (I)	Average cosine of scattering angle at v_i .

E. Format of Binary Deck Punched by GAKER

CARD 1

<u>Column</u>	<u>Description</u>
1	Punches in rows 12, 7, and 9.
5-8	$J\phi$.
9-12	WDK, number of energy groups.
13-16	T, temperature.
25-80	Punches arranged to produce visual image of name THERMOS.

CARD 2

<u>Column</u>	<u>Description</u>
1	Punches in rows 7 and 9.
5-8	Check sum for columns 9-80.
9-12	Value of J for the first $P_n(I,J)$ on this card (see columns 17-80).
13-16	Value of I-1 for the first $P_n(I,J)$ on this card (see columns 17-80).
17-80	16 values of $P_n(I,J)$ in order of $P_n(I,J)$, $P_n(I+1,J)$... $P_n(J,J)$, $P_n(1, J+1)$... For example, the first card would contain $P(1,1)$, $P(1,2)$, $P(2,2)$, $P(1,3)$, $P(2,3)$, $P(3,3)$... $P(1,6)$. The remaining cards are like card 2, until all the $P(I,J)$ have been punched.

Four kernel decks are punched corresponding to $n = 0, 1, 2$, and 3.

IV. THE THERMOS OUTPUT EDIT

Since the output edit has been substantially enlarged, the quantities in the output will be defined. As in the original THERMOS code, the printed output has been labeled and tabulated to the extent that it is largely self-explanatory.

The output edit involves integrals and averages which are defined below.

The symbol V_k is the volume associated with the point k . The symbol K denotes a spatial region constituted of a sequence of points k . A complete edit is produced for each pair of velocities v_L , v_U . These are given in the input as IXPTL and IXPTU (see input format, Section III). $N(\underline{r}, v)$ is the neutron density at spatial point $\underline{r}$ and speed v . The various Σ_a , Σ_f , etc. have their usual meanings.

The capitalized headings given in the following definitions are identical to those printed on the output, and the formulas are replaced by their appropriate values.

A. For Cell Composition

<u>PØINT</u>	<u>Volume</u>	<u>NDEN</u>	<u>NDEN*VØL</u>	<u>NFLUX</u>	<u>NFLX*VØL</u>
k	V _k	$\int_{V_L}^{V_U} dv N(\underline{r}, v)$	$V_k \int_{V_L}^{V_U} dv N(\underline{r}, v)$	$\int_{V_L}^{V_U} dv v N(\underline{r}, v)$	$V_k \int_{V_L}^{V_U} dv v N(\underline{r}, v)$
SUM	V _K	$\sum_K NDEN$	$\int_K d\underline{r} \int_{V_L}^{V_U} dv N(\underline{r}, v)$	$\sum_K NFLUX$	$\int_K d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v)$
V AVE			$\frac{1}{V_K} \int_K d\underline{r} \int_{V_L}^{V_U} dv N(\underline{r}, v)$		$\frac{1}{V_K} \int_K d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v)$
<hr/>					
$PHIBAR = \int_{\text{Spec. regions}} d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v) / \int_{\text{Spec. regions}} d\underline{r} \quad NBAR = \int_{\text{Spec. regions}} d\underline{r} \int_{V_L}^{V_U} dv N(\underline{r}, v) / \int_{\text{Spec. regions}} d\underline{r}$					
<hr/>					
<u>REGION AVE. DENSITY/NBAR</u>			<u>REGION AVE. FLUX/PHIBAR</u>		
$\frac{1}{NBAR} \cdot \int_K d\underline{r} \int_{V_L}^{V_U} dv N(\underline{r}, v) / \int_K d\underline{r}$			$\frac{1}{PHIBAR} \cdot \int_K d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v) / \int_K d\underline{r}$		
<hr/>					

PØINT	Volume	AVE V	AVE V**2	AVE V***3
k	V _k	$\frac{\int_{V_L}^{V_U} dv v N(\underline{r}, v)}{\int_{V_L}^{V_U} dv N(\underline{r}, v)}$	$\frac{\int_{V_L}^{V_U} dv v^2 N(\underline{r}, v)}{\int_{V_L}^{V_U} dv N(\underline{r}, v)}$	$\frac{\int_{V_L}^{V_U} dv v^3 N(\underline{r}, v)}{\int_{V_L}^{V_U} dv N(\underline{r}, v)}$
SUM	V _K	_____	_____	_____
N AVE	V _K	$\frac{\int_K d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v) dv}{\int_K d\underline{r} \int_{V_L}^{V_U} dv N(\underline{r}, v)}$	$\frac{\int_K d\underline{r} \int_{V_L}^{V_U} dv v^2 N(\underline{r}, v)}{\int_K d\underline{r} \int_{V_L}^{V_U} dv N(\underline{r}, v)}$	$\frac{\int_K d\underline{r} \int_{V_L}^{V_U} dv v^3 N(\underline{r}, v)}{\int_K d\underline{r} \int_{V_L}^{V_U} dv N(\underline{r}, v)}$
V AVE	V _K	_____	_____	_____
F AVE	V _K	_____	_____	_____

PØINT	Volume	ABSORPTION ^a	FISSION ^a
k	V _k	$V_k \int_{V_L}^{V_U} dv v \Sigma_a(\underline{r}, v) N(\underline{r}, v)$	$V_k \int_{V_L}^{V_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)$
SUM	V _K	$\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_a(\underline{r}, v) N(\underline{r}, v)$	$\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)$
N AVE	V _K	_____	_____
V AVE	V _K	$\frac{1}{V_K} \int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_a(\underline{r}, v) N(\underline{r}, v)$	$\frac{1}{V_K} \int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)$
F AVE	V _K	$\frac{\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_a(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v)}$	$\frac{\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v)}$

^aThe Σ_a and Σ_f are the macroscopic cross sections for the homogenized composition at the point involved.

PØINT	Volume	SCATTERING ^a	NU*FISSION ^a
k	V _k	$V_k \int_{V_L}^{V_U} dv v \Sigma_s(\underline{r}, v) N(\underline{r}, v)$	$V_k \int_{V_L}^{V_U} dv v \nu \Sigma_f(\underline{r}, v) N(\underline{r}, v)$
SUM	V _K	$\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_s(\underline{r}, v) N(\underline{r}, v)$	$\int_K d\underline{r} \int_{V_L}^{V_U} dv v \nu \Sigma_f(\underline{r}, v) N(\underline{r}, v)$
N AVE	V _K	_____	_____
V AVE	V _K	$\frac{1}{V_K} \int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_s(\underline{r}, v) N(\underline{r}, v)$	$\frac{1}{V_K} \int_K d\underline{r} \int_{V_L}^{V_U} dv v \nu \Sigma_f(\underline{r}, v) N(\underline{r}, v)$
F AVE	V _K	$\frac{\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_s(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v)}$	$\frac{\int_K d\underline{r} \int_{V_L}^{V_U} dv v \nu \Sigma_f(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v)}$

^aThe Σ_s and $\nu \Sigma_f$ are the macroscopic cross sections for the homogenized composition at the point involved.

PPOINT	Volume	D ^a
k	V _k	$V_k \int_{V_L}^{V_U} dv v \frac{1}{3\Sigma_{tr}(\underline{r}, v)} N(\underline{r}, v)$
SUM	V _K	$\int_K d\underline{r} \int_{V_L}^{V_U} dv v \frac{1}{3\Sigma_{tr}(\underline{r}, v)} N(\underline{r}, v)$
N AVE	V _K	_____
V AVE	V _K	$\frac{1}{V_K} \int_K d\underline{r} \int_{V_L}^{V_U} dv v \frac{1}{3\Sigma_{tr}(\underline{r}, v)} N(\underline{r}, v)$
F AVE	V _K	$\frac{\int_K d\underline{r} \int_{V_L}^{V_U} dv v \frac{1}{3\Sigma_{tr}(\underline{r}, v)} N(\underline{r}, v)}{\int_K d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v)}$

^a $\Sigma_{tr} = \Sigma_a + (1 - \bar{\mu})\Sigma_s$, where Σ_a , $\bar{\mu}$, and Σ_s are input values.
 Σ_{tr} corresponds to the homogenized mixture.

B. For Each Material Used in Cell

PPOINT	Volume	SIGMA A ^a	SIGMA F ^a
k	V _k	$\frac{\int_{V_L}^{V_U} dv v \Sigma_a(\underline{r}, v) N(\underline{r}, v)}{\int_{V_L}^{V_U} dv v N(\underline{r}, v)}$	$\frac{\int_{V_L}^{V_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)}{\int_{V_L}^{V_U} dv v N(\underline{r}, v)}$
EVENTS	V _K	$\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_a(\underline{r}, v) N(\underline{r}, v)$	$\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)$
AVE	V _K	$\frac{\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_a(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v)}$	$\frac{\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v)}$

^a Σ_a and Σ_f are the macroscopic isotopic cross sections at the point involved.

PPOINT	Volume	SIGMA F * NU ^a	SIGMA S ^a
k	V _k	$\frac{\int_{V_L}^{V_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)}{\int_{V_L}^{V_U} dv v N(\underline{r}, v)}$	$\frac{\int_{V_L}^{V_U} dv v \Sigma_s(\underline{r}, v) N(\underline{r}, v)}{\int_{V_L}^{V_U} dv v N(\underline{r}, v)}$
EVENTS	V _K	$\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)$	$\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_s(\underline{r}, v) N(\underline{r}, v)$
AVE	V _K	$\frac{\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v)}$	$\frac{\int_K d\underline{r} \int_{V_L}^{V_U} dv v \Sigma_s(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{V_L}^{V_U} dv v N(\underline{r}, v)}$

^a Σ_f and Σ_s are the macroscopic isotopic cross sections at the point involved.

PØINT	Volume	SIGMA TR ^a
k	V _k	$\frac{\int_{v_L}^{v_U} dv v \Sigma_{tr}(\underline{r}, v) N(\underline{r}, v)}{\int_{v_L}^{v_U} dv v N(\underline{r}, v)}$
EVENTS	V _K	$\int_K d\underline{r} \int_{v_L}^{v_U} dv v \Sigma_{tr}(\underline{r}, v) N(\underline{r}, v)$
AVE	V _K	$\frac{\int_K d\underline{r} \int_{v_L}^{v_U} dv v \Sigma_{tr}(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{v_L}^{v_U} dv v N(\underline{r}, v)}$

^a $\Sigma_{tr} = \Sigma_a + (1 - \bar{\mu})\Sigma_s$, and Σ_{tr} corresponds to the isotopic, macroscopic, cross section at the point concerned.

C. For Each Edit Material

PØINT	Volume	SIGMA A	REL ABS
k	V _k	$\frac{\int_{v_L}^{v_U} dv v \Sigma_a(\underline{r}, v) N(\underline{r}, v)}{\int_{v_L}^{v_U} dv v N(\underline{r}, v)}$	$\frac{\int_{v_L}^{v_U} dv v \Sigma_a(\underline{r}, v) N(\underline{r}, v)}{\left[\int_{v_L}^{v_U} dv v \Sigma_a(\underline{r}, v) N(\underline{r}, v) \right]_{k=1}}$
AVE	V _K	$\frac{\int_K d\underline{r} \int_{v_L}^{v_U} dv v \Sigma_a(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{v_L}^{v_U} dv v N(\underline{r}, v)}$	$\frac{\frac{1}{V_K} \int_K d\underline{r} \int_{v_L}^{v_U} dv v \Sigma_a(\underline{r}, v) N(\underline{r}, v)}{\left[\int_{v_L}^{v_U} dv v \Sigma_a(\underline{r}, v) N(\underline{r}, v) \right]_{k=1}}$
PØINT	Volume	SIGMA F	SIGMA F° NU
k	V _k	$\frac{\int_{v_L}^{v_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)}{\int_{v_L}^{v_U} dv v N(\underline{r}, v)}$	$\frac{\int_{v_L}^{v_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)}{\int_{v_L}^{v_U} dv v N(\underline{r}, v)}$
AVE	V _K	$\frac{\int_K d\underline{r} \int_{v_L}^{v_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{v_L}^{v_U} dv v N(\underline{r}, v)}$	$\frac{\int_K d\underline{r} \int_{v_L}^{v_U} dv v \Sigma_f(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{v_L}^{v_U} dv v N(\underline{r}, v)}$
PØINT	Volume	SIGMA S	SIGMA TR ^a
k	V _k	$\frac{\int_{v_L}^{v_U} dv v \Sigma_s(\underline{r}, v) N(\underline{r}, v)}{\int_{v_L}^{v_U} dv v N(\underline{r}, v)}$	$\frac{\int_{v_L}^{v_U} dv v \Sigma_{tr}(\underline{r}, v) N(\underline{r}, v)}{\int_{v_L}^{v_U} dv v N(\underline{r}, v)}$
AVE	V _K	$\frac{\int_K d\underline{r} \int_{v_L}^{v_U} dv v \Sigma_s(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{v_L}^{v_U} dv v N(\underline{r}, v)}$	$\frac{\int_K d\underline{r} \int_{v_L}^{v_U} dv v \Sigma_{tr}(\underline{r}, v) N(\underline{r}, v)}{\int_K d\underline{r} \int_{v_L}^{v_U} dv v N(\underline{r}, v)}$

^a $\Sigma_{tr} = \Sigma_a + (1 - \bar{\mu})\Sigma_s$, where Σ_a , $\bar{\mu}$, and Σ_s are input values.

V. SAMPLE PROBLEM

A problem similar to that given in Ref. 2 is included to display an explicit input and output example. As before,⁽²⁾ the problem is a two-region slab and is solved by using 10 space points and 30 speed groups. Two mixtures are used; four materials are used in the cell from the library, and one material is in the cell from input supplied from cards; one edit material is from the library. The mixtures (regions) consist of the compositions given in Table III.

Table III

COMPOSITIONS FOR SAMPLE PROBLEM

Isotope	Identification		Atom Density		Obtained from
	ISTBA ^a	ISTBB ^a	Mixture 1	Mixture 2	
U ²³⁵	23592	3..18	0.0005987	0	Library tape
U ²³⁸	23892	3..20	0.0467	0	Library tape
O16	..168	293.2	0	0.033445	Library tape
H	...18	3...1	0	0.066890	Library tape
B	..105	3..63	0	10 ⁻⁶	Cards

^aSee THERMOS Input Card Type 5 (Section III-B). The identifications given here are different from those of Ref. 2.

The slab regions containing mixtures 1 and 2 have half-thicknesses of 0.3175 and 1.27 cm, respectively, and as in the original example, the slowing-down source is taken to be spatially-flat in the water and zero in the uranium.

The built-in convergence criteria are used in the present example. Ref. 2 used somewhat different values.

Speed integrations are performed over groups 1 to 27 and 28 to 30 in the sample problem. In the previous example of Ref. 2, the integrations were for groups 1 to 27 and 1 to 30. A second edit is also included to illustrate the use of the variable IBY (card 2). This second edit is over energy groups 1 to 30 and is spatially integrated over both regions, as controlled by the variable NRTBL(L) (card 31).

The input data cards are listed next for comparison with the Section III specifications. The problem results are included to display the details of the output format. The formulas of Section IV define the various output quantities.

The problem shown required 1.03 min of 3600 time.

1 SAMPLE PROBLEM FOR THERMOS. SIMILAR TO PROBLEM IN 3NL-5826,

CARD 1

100 0

CARD 2

10 30 2 4 1 1 0

CARD 3

1111222222

CARD 4

235923 18 .0005987 0.

CARD 5

238923 20 .0467 0.

CARD 5

183 1 0. .06689

CARD 5

168293 2 0. .033445

CARD 5

1053 63 0. 1.00000006

CARD 8

1 0 -1 =1 1 1.

CARD 9

755.

CARD 10

.06167

CARD 13

1 0.

CARD 15

2 1. 20.4 .06689 0.

CARD 17

1 2 1

CARD 18

1 4 .3175

CARD 19

2 6 1.27

CARD 19

239943 21 1.

CARD 20

2 1 27 28 30

CARD 21

1 2 0 0

CARD 29

1111222222

CARD 30

1 SECOND EDIT. INTEGRATE OVER ENERGY GROUPS 1-30 AND OVER BOTH REGIONS,

CARD 31

200 -1

CARD 1

1 1 30

CARD 2

CARD 29

CARD 30

1111111111

CARD 31

1 THERMOS PROBLEMS COMPLETED.

CARD 33

CARD 34

SAMPLE PROBLEM FOR THERMOS. SIMILAR TO PROBLEM IN 6NL-5826.

IDENT 100

SPACE POINTS= 10

GROUPS= 30

MIXTURES= 2

LIBRARY ISOTOPES IN CELL= 4

LIBRARY ISOTOPES IN EDIT= 1

ADDED ISOTOPES IN CELL= 1

ADDED ISOTOPES IN EDIT= 0

GROUPS DO NOT AGREE WITH LIBRARY

ADDED ISOTOPE 105-30063 IN CELL

XA

7.55000+003 2.90385+003 1.79762+003 1.30172+003 1.02027+003 8.38889+002
7.12244+002 6.10852+002 5.47101+002 4.90260+002 4.44118+002 4.05914+002
3.75622+002 3.51143+002 3.29694+002 3.10700+002 2.93774+002 2.78598+002
2.64912+002 2.52508+002 2.41214+002 2.30887+002 2.20730+002 2.11429+002
2.02976+002 1.95040+002 1.87134+002 1.80106+002 1.73586+002 1.67522+002

NU

0.00000+000 0.00000+000 0.00000+000 0.00000+000 0.00000+000 0.00000+000
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XF

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MUBAR

6.16700-002 6.16700-002 6.16700-002 6.16700-002 6.16700-002 6.16700-002
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THERMOS CASE NO. 100 PAGE 2

ISOTOPE	CONC MIX 1	CONC MIX 2	CONC MIX 3	CONC MIX 4	CONC MIX 5
USED IN CELL					
23592-30018	5.98700-004	0.00000+000	0.00000+000	0.00000+000	0.00000+000
23892-30020	4.67000-002	0.00000+000	0.00000+000	0.00000+000	0.00000+000
18-30001	0.00000+000	6.68900-002	0.00000+000	0.00000+000	0.00000+000
168-29302	0.00000+000	3.34450-002	0.00000+000	0.00000+000	0.00000+000
105-30063	0.00000+000	1.00000-006	0.00000+000	0.00000+000	0.00000+000

REGION NO 1 2 3 4 5 6 7 8 9 10

MIXTURE NO 1 1 1 1 2 2 2 2 2 2

SOURCE DATA

NO. OF CARDS= 1

SPACE DIST

1.00000+000 1.00000+000 1.00000+000 1.00000+000 1.00000+000
1.00000+000 1.00000+000 1.00000+000 1.00000+000 1.00000+000

SOURCE CONSTANTS

MIX 2 MASS= 1.00000+000 XS= 2.04000+001 CON= 6.68900-002 TP= 0.00000+000

THERMOS CASE NO. 100 PAGE 3
SLAR CELL. REGIONS= 2

REGION	THICKNESS	POINT	VOLUME	POSITION
1	31.75000-002	1	79.37500-003	39.68750-003
		2	79.37500-003	11.90625-002
		3	79.37500-003	19.84375-002
		4	79.37500-003	27.78125-002
2	12.70000-001	5	21.16667-002	42.33333-002
		6	21.16667-002	63.50000-002
		7	21.16667-002	84.66667-002
		8	21.16667-002	10.58333-001
		9	21.16667-002	12.70000-001
		10	21.16667-002	14.81667-001

THERMOS CASE NO. 100 PAGE 4

K,I,Q(K,I)

1	1	0.99998	2	1	0.99997	3	1	0.99987	4	1	0.99988	5	1	0.99997	6	1	0.99994	7	1	0.99996
8	1	0.99996	9	1	0.99996	10	1	0.99996	1	2	0.99989	2	2	0.99988	3	2	0.99987	4	2	0.99974
5	2	0.99988	6	2	0.99988	7	2	0.99988	8	2	0.99986	9	2	0.99987	10	2	0.99987	1	3	0.99981
2	3	0.99981	3	3	0.99980	4	3	0.99990	5	3	0.99995	6	3	0.99995	7	3	0.99995	8	3	0.99995
9	3	0.99995	10	3	0.99989	1	4	0.99982	2	4	0.99982	3	4	0.99982	4	4	0.99981	5	4	0.99988
6	4	0.99988	7	4	0.99988	8	4	0.99988	9	4	0.99988	10	4	0.99988	1	5	0.99985	2	5	0.99985
3	5	0.99985	4	5	0.99975	5	5	0.99984	6	5	0.99984	7	5	0.99984	8	5	0.99984	9	5	0.99984
10	5	0.99982	1	6	0.99987	2	6	0.99978	3	6	0.99978	4	6	0.99978	5	6	0.99986	6	6	0.99986
7	6	0.99986	8	6	0.99986	9	6	0.99982	10	6	0.99984	1	7	0.99986	2	7	0.99978	3	7	0.99978
4	7	0.99978	5	7	0.99985	6	7	0.99985	7	7	0.99985	8	7	0.99982	9	7	0.99984	10	7	0.99984
1	8	0.99982	2	8	0.99974	3	8	0.99974	4	8	0.99975	5	8	0.99983	6	8	0.99983	7	8	0.99980
8	8	0.99982	9	8	0.99982	10	8	0.99982	1	9	0.99981	2	9	0.99981	3	9	0.99974	4	9	0.99974
5	9	0.99981	6	9	0.99979	7	9	0.99980	8	9	0.99981	9	9	0.99980	10	9	0.99980	1	10	0.99973
2	10	0.99980	3	10	0.99980	4	10	0.99981	5	10	0.99980	6	10	0.99983	7	10	0.99983	8	10	0.99983
9	10	0.99983	10	10	0.99983	1	11	0.99984	2	11	0.99977	3	11	0.99977	4	11	0.99978	5	11	0.99979
6	11	0.99981	7	11	0.99981	8	11	0.99981	9	11	0.99981	10	11	0.99981	1	12	0.99980	2	12	0.99980
3	12	0.99980	4	12	0.99973	5	12	0.99977	6	12	0.99978	7	12	0.99978	8	12	0.99978	9	12	0.99978
10	12	0.99978	1	13	0.99972	2	13	0.99972	3	13	0.99973	4	13	0.99973	5	13	0.99977	6	13	0.99977
7	13	0.99977	8	13	0.99977	9	13	0.99977	10	13	0.99977	1	14	0.99970	2	14	0.99970	3	14	0.99970
4	14	0.99970	5	14	0.99970	6	14	0.99970	7	14	0.99970	8	14	0.99970	9	14	0.99970	10	14	0.99970
1	15	0.99967	2	15	0.99967	3	15	0.99967	4	15	0.99973	5	15	0.99974	6	15	0.99974	7	15	0.99974
8	15	0.99974	9	15	0.99974	10	15	0.99974	1	16	0.99966	2	16	0.99972	3	16	0.99971	4	16	0.99971
5	16	0.99972	6	16	0.99970	7	16	0.99970	8	16	0.99970	9	16	0.99970	10	16	0.99970	1	17	0.99975
2	17	0.99975	3	17	0.99975	4	17	0.99968	5	17	0.99969	6	17	0.99964	7	17	0.99964	8	17	0.99964
9	17	0.99964	10	17	0.99964	1	18	0.99970	2	18	0.99970	3	18	0.99970	4	18	0.99970	5	18	0.99973
6	18	0.99974	7	18	0.99974	8	18	0.99974	9	18	0.99974	10	18	0.99974	1	19	0.99966	2	19	0.99973
3	19	0.99973	4	19	0.99973	5	19	0.99969	6	19	0.99972	7	19	0.99970	8	19	0.99970	9	19	0.99970
10	19	0.99970	1	20	0.99976	2	20	0.99970	3	20	0.99970	4	20	0.99970	5	20	0.99965	6	20	0.99970
7	20	0.99966	8	20	0.99966	9	20	0.99966	10	20	0.99966	1	21	0.99973	2	21	0.99973	3	21	0.99973
4	21	0.99967	5	21	0.99961	6	21	0.99968	7	21	0.99962	8	21	0.99962	9	21	0.99962	10	21	0.99962
1	22	0.99970	2	22	0.99970	3	22	0.99970	4	22	0.99976	5	22	0.99972	6	22	0.99972	7	22	0.99974
8	22	0.99973	9	22	0.99973	10	22	0.99973	1	23	0.99969	2	23	0.99969	3	23	0.99969	4	23	0.99975
5	23	0.99972	6	23	0.99972	7	23	0.99973	8	23	0.99972	9	23	0.99972	10	23	0.99972	1	24	0.99972
2	24	0.99972	3	24	0.99971	4	24	0.99971	5	24	0.99968	6	24	0.99968	7	24	0.99968	8	24	0.99961
9	24	0.99961	10	24	0.99961	1	25	0.99969	2	25	0.99969	3	25	0.99969	4	25	0.99975	5	25	0.99972
6	25	0.99972	7	25	0.99972	8	25	0.99973	9	25	0.99972	10	25	0.99972	1	26	0.99967	2	26	0.99973
3	26	0.99973	4	26	0.99973	5	26	0.99968	6	26	0.99968	7	26	0.99968	8	26	0.99971	9	26	0.99969
10	26	0.99969	1	27	0.99977	2	27	0.99977	3	27	0.99971	4	27	0.99971	5	27	0.99964	6	27	0.99964
7	27	0.99964	8	27	0.99969	9	27	0.99965	10	27	0.99965	1	28	0.99976	2	28	0.99976	3	28	0.99976
4	28	0.99976	5	28	0.99967	6	28	0.99967	7	28	0.99967	8	28	0.99967	9	28	0.99967	10	28	0.99961
1	29	0.99973	2	29	0.99973	3	29	0.99979	4	29	0.99979	5	29	0.99970	6	29	0.99970	7	29	0.99970
8	29	0.99970	9	29	0.99972	10	29	0.99970	1	30	0.99978	2	30	0.99978	3	30	0.99978	4	30	0.99978
5	30	0.99967	6	30	0.99967	7	30	0.99967	8	30	0.99967	9	30	0.99967	10	30	0.99962			

THERMOS CASE NO. 100 PAGE 5

EARLIEST EXTRAP= 5

NO. TESTED= 5

INCREMENT= 5

MAX ITS=100

CONV CRIT= 1.00000-005

OVERRELAXATION= 1.20000+000

EXTRAP CRIT= 5.00000-002

MAX EXTRAP= 1.00000+002

FACTOR= 1.00000+000

EXTRAPOLATION AT 9 BY 3.1141

MU= 0.67888 LAM= 0.73240 OMEGA= 1.57779

EXTRAPOLATION AT 19 BY 3.3599

MU= 0.70237 LAM= 0.81136 OMEGA= 1.68260

THERMOS CASE NO. 100 PAGE 6

ITCNT= 27 RENDRM= 1.00000+000 EPS= 4.20121-005

LARGEST RES= 2.88343-005 MEAN RES= 1.26032-006 N(V*)= 5.48899-002

K,I,N(K,I)

1	1	6.2332-003	1	2	1.8100-001	1	3	6.7634-001	1	4	1.4159+000	1	5	2.2228+000
1	6	2.9058+000	1	7	3.3236+000	1	8	3.4097+000	1	9	3.1756+000	1	10	2.6865+000
1	11	2.0989+000	1	12	1.5395+000	1	13	1.1181+000	1	14	8.0801-001	1	15	5.7271-001
1	16	4.0622-001	1	17	2.9538-001	1	18	2.2154-001	1	19	1.7325-001	1	20	1.4104-001
1	21	1.1737-001	1	22	1.0249-001	1	23	9.2522-002	1	24	8.2646-002	1	25	7.6579-002
1	26	7.0264-002	1	27	6.5243-002	1	28	5.9772-002	1	29	5.4639-002	1	30	4.8944-002
2	1	8.8262-003	2	2	1.9969-001	2	3	7.1259-001	2	4	1.4654+000	2	5	2.2793+000
2	6	2.9624+000	2	7	3.3757+000	2	8	3.4540+000	2	9	3.2108+000	2	10	2.7124+000
2	11	2.1041+000	2	12	1.5509+000	2	13	1.1256+000	2	14	8.1300-001	2	15	5.7600-001
2	16	4.0845-001	2	17	2.9691-001	2	18	2.2266-001	2	19	1.7411-001	2	20	1.4175-001
2	21	1.1798-001	2	22	1.0304-001	2	23	9.3013-002	2	24	8.3033-002	2	25	7.6886-002
2	26	7.0468-002	2	27	6.5443-002	2	28	5.9941-002	2	29	5.4782-002	2	30	4.9103-002
3	1	1.5866-002	3	2	2.4272-001	3	3	7.9347-001	3	4	1.5746+000	3	5	2.4030+000
3	6	3.0871+000	3	7	3.4900+000	3	8	3.5510+000	3	9	3.2867+000	3	10	2.7679+000
3	11	2.1458+000	3	12	1.5754+000	3	13	1.1417+000	3	14	8.2376-001	3	15	5.8310-001
3	16	4.1320-001	3	17	3.0923-001	3	18	2.2507-001	3	19	1.7593-001	3	20	1.4328-001
3	21	1.1930-001	3	22	1.0423-001	3	23	9.4070-002	3	24	8.3868-002	3	25	7.7546-002
3	26	7.1028-002	3	27	6.5871-002	3	28	6.0306-002	3	29	5.5094-002	3	30	4.9446-002
4	1	3.5718-002	4	2	3.3252-001	4	3	9.5264-001	4	4	1.7832+000	4	5	2.6357+000
4	6	3.3109+000	4	7	3.7021+000	4	8	3.7298+000	4	9	3.4268+000	4	10	2.8696+000
4	11	2.2145+000	4	12	1.6200+000	4	13	1.1711+000	4	14	8.4334-001	4	15	5.9605-001
4	16	4.2184-001	4	17	3.0623-001	4	18	2.2945-001	4	19	1.7926-001	4	20	1.4609-001
4	21	1.2171-001	4	22	1.0641-001	4	23	9.6011-002	4	24	8.5393-002	4	25	7.8758-002
4	26	7.2050-002	4	27	6.6657-002	4	28	6.0972-002	4	29	5.5657-002	4	30	5.0075-002
5	1	1.1329-001	5	2	6.8151-001	5	3	1.6108+000	5	4	2.6963+000	5	5	3.6931+000
5	6	4.3946+000	5	7	4.6855+000	5	8	4.5539+000	5	9	4.0672+000	5	10	3.3367+000
5	11	2.5370+000	5	12	1.8325+000	5	13	1.3103+000	5	14	9.3554-001	5	15	6.5659-001
5	16	4.6206-001	5	17	3.3389-001	5	18	2.4925-001	5	19	1.9407-001	5	20	1.5835-001
5	21	1.3206-001	5	22	1.1557-001	5	23	1.0414-001	5	24	9.1741-002	5	25	8.3832-002
5	26	7.6374-002	5	27	6.9985-002	5	28	6.3792-002	5	29	5.8029-002	5	30	5.2730-002
6	1	1.5360-001	6	2	9.4260-001	6	3	2.1804+000	6	4	3.5487+000	6	5	4.7247+000
6	6	5.4709+000	6	7	5.6852+000	6	8	5.3982+000	6	9	4.7290+000	6	10	3.8300+000
6	11	2.8865+000	6	12	2.0644+000	6	13	1.4600+000	6	14	1.0326+000	6	15	7.1875-001
6	16	5.0176-001	6	17	3.5966-001	6	18	2.6655-001	6	19	2.0624-001	6	20	1.6775-001
6	21	1.3956-001	6	22	1.2192-001	6	23	1.0960-001	6	24	9.5910-002	6	25	8.7120-002
6	26	7.9111-002	6	27	7.2073-002	6	28	6.5523-002	6	29	5.9453-002	6	30	5.4259-002
7	1	1.7558-001	7	2	1.0899+000	7	3	2.5241+000	7	4	4.0903+000	7	5	5.4069+000
7	6	6.2048+000	7	7	6.3831+000	7	8	5.9979+000	7	9	5.2057+000	7	10	4.1903+000
7	11	3.1454+000	7	12	2.2374+000	7	13	1.5712+000	7	14	1.1038+000	7	15	7.6351-001
7	16	5.2947-001	7	17	3.7680-001	7	18	2.7736-001	7	19	2.1334-001	7	20	1.7281-001
7	21	1.4333-001	7	22	1.2494-001	7	23	1.1209-001	7	24	9.7762-002	7	25	8.8553-002
7	26	8.0272-002	7	27	7.2948-002	7	28	6.6230-002	7	29	6.0020-002	7	30	5.4838-002

THERMOS CASE NO. 100 PAGE 7

ITCNT= 27 RENORM= 1.00090+000 EPS= 4.20121-005
 LARGEST RES= 2.88343-005 MEAN RES= 1.26032-006 N(V*)= 5.48899-002

K,I,N(K,I)

8	1	1.8994+001	8	2	1.1844+000	8	3	2.7484+000	8	4	4.4522+000	8	5	5.8734+000
8	6	6.7176+000	8	7	6.8798+000	8	8	6.4317+000	8	9	5.5547+000	8	10	4.4559+000
8	11	3.3373+000	8	12	2.3661+000	8	13	1.6540+000	8	14	1.1567+000	8	15	7.9645+001
8	16	5.4957+001	8	17	3.8893+001	8	18	2.8475+001	8	19	2.1799+001	8	20	1.7595+001
8	21	1.4556+001	8	22	1.2665+001	8	23	1.1346+001	8	24	9.8759+002	8	25	8.9320+002
8	26	8.0884+002	8	27	7.3407+002	8	28	6.6594+002	8	29	6.0306+002	8	30	5.5125+002
9	1	1.9890+001	9	2	1.2430+000	9	3	2.8874+000	9	4	4.6787+000	9	5	6.1687+000
9	6	7.0461+000	9	7	7.2021+000	9	8	6.7162+000	9	9	5.7855+000	9	10	4.6322+000
9	11	3.4649+000	9	12	2.4520+000	9	13	1.7094+000	9	14	1.1920+000	9	15	8.1833+001
9	16	5.6242+001	9	17	3.9681+001	9	18	2.8946+001	9	19	2.2088+001	9	20	1.7783+001
9	21	1.4685+001	9	22	1.2761+001	9	23	1.1420+001	9	24	9.9300+002	9	25	8.9729+002
9	26	8.1206+002	9	27	7.3646+002	9	28	6.6782+002	9	29	6.0457+002	9	30	5.5271+002
10	1	2.0325+001	10	2	1.2712+000	10	3	2.9546+000	10	4	4.7883+000	10	5	6.3123+000
10	6	7.2069+000	10	7	7.3609+000	10	8	6.8574+000	10	9	5.9004+000	10	10	4.7203+000
10	11	3.5287+000	10	12	2.4949+000	10	13	1.7371+000	10	14	1.2096+000	10	15	8.2927+001
10	16	5.4941+001	10	17	4.0071+001	10	18	2.9176+001	10	19	2.2227+001	10	20	1.7872+001
10	21	1.4745+001	10	22	1.2805+001	10	23	1.1454+001	10	24	9.9539+002	10	25	8.9910+002
10	26	8.1347+002	10	27	7.3751+002	10	28	6.6865+002	10	29	6.0520+002	10	30	5.5332+002

THERMOS CASE NO. 100 PAGE 8

ITCNT= 27 RENORM= 1.00000+000 EPS= 4.20121-005
 LARGEST RES= 2.88343-005 MEAN RES= 1.26032-006 N(V*)= 5.48899-002

K,I,F(K,I) POINT FLUXES

1	1	6.2332+004	1	2	4.7059+002	1	3	2.8406+001	1	4	8.2124+001	1	5	1.6449+000
1	6	2.6152+000	1	7	3.5230+000	1	8	4.1599+000	1	9	4.3823+000	1	10	4.1372+000
1	11	3.5545+000	1	12	2.8635+000	1	13	2.2473+000	1	14	1.7372+000	1	15	1.3115+000
1	16	9.8711+001	1	17	7.5912+001	1	18	6.0038+001	1	19	4.9375+001	1	20	4.2171+001
1	21	3.6736+001	1	22	3.3515+001	1	23	3.1647+001	1	24	2.9512+001	1	25	2.8485+001
1	26	2.7176+001	1	27	2.6323+001	1	28	2.5056+001	1	29	2.3765+001	1	30	2.2059+001
2	1	8.8262+004	2	2	5.1919+002	2	3	2.9929+001	2	4	8.4996+001	2	5	1.6867+000
2	6	2.6662+000	2	7	3.5782+000	2	8	4.2139+000	2	9	4.4309+000	2	10	4.1772+000
2	11	3.5839+000	2	12	2.8847+000	2	13	2.2624+000	2	14	1.7480+000	2	15	1.3190+000
2	16	9.9253+001	2	17	7.6307+001	2	18	6.0341+001	2	19	4.9621+001	2	20	4.2382+001
2	21	3.6928+001	2	22	3.3695+001	2	23	3.1815+001	2	24	2.9651+001	2	25	2.8599+001
2	26	2.7278+001	2	27	2.6403+001	2	28	2.5127+001	2	29	2.3827+001	2	30	2.2130+001
3	1	1.5866+003	3	2	6.3108+002	3	3	3.3326+001	3	4	9.1324+001	3	5	1.7783+000
3	6	2.7784+000	3	7	3.6995+000	3	8	4.3322+000	3	9	4.5357+000	3	10	4.2626+000
3	11	3.6478+000	3	12	2.9303+000	3	13	2.2948+000	3	14	1.7711+000	3	15	1.3353+000
3	16	1.0041+000	3	17	7.7158+001	3	18	6.0994+001	3	19	5.0141+001	3	20	4.2842+001
3	21	3.7342+001	3	22	3.4084+001	3	23	3.2176+001	3	24	2.9949+001	3	25	2.8845+001
3	26	2.7495+001	3	27	2.6576+001	3	28	2.5280+001	3	29	2.3963+001	3	30	2.2285+001
4	1	3.5718+003	4	2	8.6456+002	4	3	4.0011+001	4	4	1.0343+000	4	5	1.9504+000
4	6	2.9879+000	4	7	3.9243+000	4	8	4.5504+000	4	9	4.7290+000	4	10	4.4192+000
4	11	3.7647+000	4	12	3.0132+000	4	13	2.3539+000	4	14	1.8132+000	4	15	1.3649+000
4	16	1.0251+000	4	17	7.8701+001	4	18	6.2181+001	4	19	5.1089+001	4	20	4.3682+001
4	21	3.8097+001	4	22	3.4797+001	4	23	3.2840+001	4	24	3.0493+001	4	25	2.9295+001
4	26	2.7891+001	4	27	2.6893+001	4	28	2.5559+001	4	29	2.4208+001	4	30	2.2568+001
5	1	1.1329+002	5	2	1.7719+001	5	3	6.7653+001	5	4	1.5639+000	5	5	2.7329+000
5	6	3.9552+000	5	7	4.9667+000	5	8	5.5558+000	5	9	5.6127+000	5	10	5.1386+000
5	11	4.3129+000	5	12	3.4085+000	5	13	2.6336+000	5	14	2.0114+000	5	15	1.5036+000
5	16	1.1228+000	5	17	8.5810+001	5	18	6.7547+001	5	19	5.5310+001	5	20	4.7346+001
5	21	4.1335+001	5	22	3.7792+001	5	23	3.5622+001	5	24	3.2760+001	5	25	3.1183+001
5	26	2.9564+001	5	27	2.8236+001	5	28	2.6741+001	5	29	2.5239+001	5	30	2.3765+001
6	1	1.5360+002	6	2	2.4508+001	6	3	9.1577+001	6	4	2.0582+000	6	5	3.4963+000
6	6	4.9238+000	6	7	6.0263+000	6	8	6.5859+000	6	9	6.5260+000	6	10	5.8982+000
6	11	4.9070+000	6	12	3.8398+000	6	13	2.9345+000	6	14	2.2201+000	6	15	1.6459+000
6	16	1.2193+000	6	17	9.2433+001	6	18	7.2236+001	6	19	5.8779+001	6	20	5.0156+001
6	21	4.3683+001	6	22	3.9868+001	6	23	3.7489+001	6	24	3.4249+001	6	25	3.2406+001
6	26	3.0624+001	6	27	2.9078+001	6	28	2.7467+001	6	29	2.5859+001	6	30	2.4454+001
7	1	1.7558+002	7	2	2.8337+001	7	3	1.0601+000	7	4	2.3724+000	7	5	4.0011+000
7	6	5.5843+000	7	7	6.7660+000	7	8	7.3174+000	7	9	7.1839+000	7	10	6.4530+000
7	11	5.3472+000	7	12	4.1616+000	7	13	3.1580+000	7	14	2.3732+000	7	15	1.7484+000
7	16	1.2866+000	7	17	9.6838+001	7	18	7.5165+001	7	19	6.0803+001	7	20	5.1669+001
7	21	4.4862+001	7	22	4.0855+001	7	23	3.8341+001	7	24	3.4910+001	7	25	3.2939+001
7	26	3.1073+001	7	27	2.9431+001	7	28	2.7764+001	7	29	2.6105+001	7	30	2.4715+001

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ITCNT= 27 RENORM= 1.00000+000 EPS= 4.20121-005

LARGEST RES= 2.88343-005 MEAN RES= 1.26032-006 M(V*)= 5.48899-002

K,I,F(K,I) POINT FLUXES

8 1	1.8994-002	8 2	3.0796-001	8 3	1.1543+000	8 4	2.5823+000	8 5	4.3463+000
8 6	6.0459+000	8 7	7.2926+000	8 8	7.8467+000	8 9	7.6655+000	8 10	6.8621+000
8 11	5.6734+000	8 12	4.4010+000	8 13	3.3246+000	8 14	2.4869+000	8 15	1.8239+000
8 16	1.3355+000	8 17	9.9955-001	8 18	7.7168-001	8 19	6.2128-001	8 20	5.2610-001
8 21	4.5560-001	8 22	4.1415-001	8 23	3.8807-001	8 24	3.5266-001	8 25	3.3224-001
8 26	3.1310-001	8 27	2.9617-001	8 28	2.7916-001	8 29	2.6230-001	8 30	2.4844-001
9 1	1.9890-002	9 2	3.2317-001	9 3	1.2127+000	9 4	2.7136+000	9 5	4.5649+000
9 6	6.3415+000	9 7	7.6342+000	9 8	8.1938+000	9 9	7.9839+000	9 10	7.1336+000
9 11	5.8903+000	9 12	4.5607+000	9 13	3.4358+000	9 14	2.5627+000	9 15	1.8740+000
9 16	1.3676+000	9 17	1.0198+000	9 18	7.8443-001	9 19	6.2951-001	9 20	5.3173-001
9 21	4.5944-001	9 22	4.1729-001	9 23	3.9063-001	9 24	3.5459-001	9 25	3.3376-001
9 26	3.1435-001	9 27	2.9713-001	9 28	2.7995-001	9 29	2.6295-001	9 30	2.4910-001
10 1	2.0325-002	10 2	3.3050-001	10 3	1.2409+000	10 4	2.7772+000	10 5	4.6711+000
10 6	6.4842+000	10 7	7.8026+000	10 8	8.3660+000	10 9	8.1426+000	10 10	7.2692+000
10 11	5.9987+000	10 12	4.6406+000	10 13	3.4916+000	10 14	2.6007+000	10 15	1.8990+000
10 16	1.3637+000	10 17	1.0298+000	10 18	7.9067-001	10 19	6.3347-001	10 20	5.3439-001
10 21	4.6151-001	10 22	4.1871-001	10 23	3.9177-001	10 24	3.5545-001	10 25	3.3443-001
10 26	3.1490-001	10 27	2.9755-001	10 28	2.8030-001	10 29	2.6323-001	10 30	2.4938-001

THERMOS CASE NO. 100 PAGE 10

ISOTOPE CONC MIX 1

USED IN EDIT

23994-30021 1.00000+000

THERMOS CASE NO. 100 PAGE 11

AVERAGES FOR I= 1 TO I=27 V= 2.06000-002 TO V= 4.11326+000 E= 1.01200-005 TO E= 4.28049-001

POINT	REG	MIX	VOLUME	NREN	NREN*VOL	NFLX	NFLX*VOL
1	1	1	7.9375-002	4.3951+000	3.4886-001	6.0032+000	4.7650-001
2	1	1	7.9375-002	4.4637+000	3.5430-001	6.0741+000	4.8213-001
3	1	1	7.9375-002	4.6142+000	3.6625-001	6.2287+000	4.9440-001
4	1	1	7.9375-002	4.6983+000	3.8880-001	6.5160+000	5.1721-001
SUM	1		3.1750-001	1.8371+001	1.4582+000	2.4822+001	1.9702+000
V AVE	1				4.5928+000		6.2055+000
5	2	2	2.1167-001	6.1749+000	1.3070+000	7.6284+000	1.6570+000
6	2	2	2.1167-001	7.4233+000	1.5713+000	9.1461+000	1.9359+000
7	2	2	2.1167-001	8.2727+000	1.7511+000	1.0063+001	2.1300+000
8	2	2	2.1167-001	8.8706+000	1.8776+000	1.0718+001	2.2686+000
9	2	2	2.1167-001	9.2568+000	1.9593+000	1.1144+001	2.3589+000
10	2	2	2.1167-001	9.4468+000	1.9996+000	1.1355+001	2.4035+000
SUM	2		1.2700+000	4.9445+001	1.0466+001	6.0255+001	1.2754+001
V AVE	2				8.2409+000		1.0043+001

V AVE AVERAGE OVER REGIONS NR= 1 TO NR= 2

PHIBAR= 9.2751+000 NBAR= 7.5112+000

REGION REGION AVE. DENSITY/NBAR REGION AVE. FLUX/PHIBAR

1	6.1146-001	6.6905-001
2	1.0971+000	1.0827+000

THERMOS CASE NO. 100 PAGE 12

AVERAGES FOR I= 1 TO I=27 V= 2.00000-002 TO V= 4.11326+000 E= 1.01200-005 TO E= 4.28049-001

POINT	REG	MIX	AVE V	AVE V**2	AVE V**3	ABSORPTION	FISSION	SCATTERING	NU*FISSION	D
1	1	1	1.36587	2.23111	4.30955	1.8056-001	1.1611-001	1.8781-001	2.8216-001	2.1640-001
2	1	1	1.36079	2.21750	4.27607	1.8345-001	1.1799-001	1.9003-001	2.8672-001	2.1865-001
3	1	1	1.34990	2.18853	4.20499	1.8981-001	1.2212-001	1.9487-001	2.9676-001	2.2355-001
4	1	1	1.33027	2.13695	4.07946	2.0182-001	1.2992-001	2.0388-001	3.1572-001	2.3259-001
SUM	1					7.5563-001	4.8615-001	7.7659-001	1.1814+000	8.9119-001
N AVE	1		1.35113	2.19201	4.21381					
V AVE	1					2.3799+000	1.5312+000	2.4460+000	3.7208+000	2.8069+000
F AVE	1					3.8352-001	2.4675-001	3.9416-001	5.9960-001	4.5232-001
5	2	2	1.26778	1.96952	3.66578	3.0013-002	0.0000+000	4.7957+000	0.0000+000	3.0315-001
6	2	2	1.23208	1.86784	3.40144	3.6080-002	0.0000+000	5.6934+000	0.0000+000	3.4612-001
7	2	2	1.21640	1.82027	3.27103	4.0209-002	0.0000+000	6.3106+000	0.0000+000	3.7624-001
8	2	2	1.20824	1.79431	3.19708	4.3115-002	0.0000+000	6.7478+000	0.0000+000	3.9792-001
9	2	2	1.20393	1.78011	3.15554	4.4991-002	0.0000+000	7.0312+000	0.0000+000	4.1210-001
10	2	2	1.20203	1.77375	3.13665	4.5915-002	0.0000+000	7.1709+000	0.0000+000	4.1913-001
SUM	2					2.4032-001	0.0000+000	3.7749+001	0.0000+000	2.2547+000
N AVE	2		1.21863	1.82499	3.27935					
V AVE	2					1.8923-001	0.0000+000	2.9724+001	0.0000+000	1.7753+000
F AVE	2					1.8843-002	0.0000+000	2.9598+000	0.0000+000	1.7678-001

THERMOS CASE NO. 100 PAGE 13

AVERAGES FOR I= 1 TO I=27 V= 2.00000-002 TO V= 4.11326+000 E= 1.01200-005 TO E= 4.28049-001

MATERIALS USED IN CELL

ISOTOPE			23592--30018				
POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1			5.9870-004		
1	1	1	2.8626-001	2.4368-001	5.9214-001	5.9954-003	2.9224-001
2	1	1	2.8749-001	2.4473-001	5.9470-001	5.9955-003	2.9347-001
3	1	1	2.9016-001	2.4701-001	6.0023-001	5.9957-003	2.9614-001
4	1	1	2.9508-001	2.5120-001	6.1043-001	5.9961-003	3.0106-001
EVENTS	1		5.7109-001	4.8615-001	1.1814+000	1.1813-002	5.8286-001
AVE	1		2.8985-001	2.4675-001	5.9960-001	5.9957-003	2.9583-001
CONC	2	2			0.0000+000		
5	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
6	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
7	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
8	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
9	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
10	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
EVENTS	2		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
AVE	2		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

THERMOS CASE NO. 100 PAGE 14

AVERAGES FOR I= 1 TO I=27 V= 2.00000-002 TO V= 4.11326+000 E= 1.01200-005 TO E= 4.28049+001

MATERIALS USED IN CELL

ISOTOPE 23892--30020

POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1			4.6700-002		
1	1	1	9.2657-002	0.0000+000	0.0000+000	3.8815-001	4.7972-001
2	1	1	9.3003-002	0.0000+000	0.0000+000	3.8815-001	4.8007-001
3	1	1	9.3753-002	0.0000+000	0.0000+000	3.8816-001	4.8083-001
4	1	1	9.5136-002	0.0000+000	0.0000+000	3.8819-001	4.8224-001
EVENTS	1		1.8455-001	0.0000+000	0.0000+000	7.6478-001	9.4718-001
AVE	1		9.3667-002	0.0000+000	0.0000+000	3.8816-001	4.8074-001
CONC	2	2			0.0000+000		
5	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
6	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
7	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
8	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
9	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
10	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
EVENTS	2		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
AVE	2		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

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AVERAGES FOR I= 1 TO I=27 V= 2.00000-002 TO V= 4.11326+000 E= 1.01200-005 TO E= 4.28049+001

MATERIALS USED IN CELL

ISOTOPE 18--30001

POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1			0.0000+000		
1	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
EVENTS	1		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
AVE	1		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
CONC	2	2			6.6890-002		
5	2	2	1.7517-002	0.0000+000	0.0000+000	2.7653+000	2.0568+000
6	2	2	1.8024-002	0.0000+000	0.0000+000	2.8118+000	2.1153+000
7	2	2	1.8257-002	0.0000+000	0.0000+000	2.8335+000	2.1425+000
8	2	2	1.8380-002	0.0000+000	0.0000+000	2.8452+000	2.1571+000
9	2	2	1.8446-002	0.0000+000	0.0000+000	2.8514+000	2.1649+000
10	2	2	1.8475-002	0.0000+000	0.0000+000	2.8542+000	2.1683+000
EVENTS	2		2.3242-001	0.0000+000	0.0000+000	3.6102+001	2.7279+001
AVE	2		1.8223-002	0.0000+000	0.0000+000	2.8306+000	2.1388+000

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AVERAGES FOR I= 1 TO I=27 V= 2.00000-002 TO V= 4.11326+000 E= 1.01200-005 TO E= 4.28049-001

MATERIALS USED IN CELL

ISOTOPE			168--29302				
POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1			0.0000+000		
1	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
EVENTS	1		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
AVE	1		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
CONC	2	2			3.3445-002		
5	2	2	0.0000+000	0.0000+000	0.0000+000	1.2890-001	1.2353-001
6	2	2	0.0000+000	0.0000+000	0.0000+000	1.2910-001	1.2372-001
7	2	2	0.0000+000	0.0000+000	0.0000+000	1.2919-001	1.2380-001
8	2	2	0.0000+000	0.0000+000	0.0000+000	1.2923-001	1.2384-001
9	2	2	0.0000+000	0.0000+000	0.0000+000	1.2925-001	1.2387-001
10	2	2	0.0000+000	0.0000+000	0.0000+000	1.2926-001	1.2388-001
EVENTS	2		0.0000+000	0.0000+000	0.0000+000	1.6474+000	1.5788+000
AVE	2		0.0000+000	0.0000+000	0.0000+000	1.2917-001	1.2379-001

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AVERAGES FOR I= 1 TO I=27 V= 2.00000-002 TO V= 4.11326+000 E= 1.01200-005 TO E= 4.28049-001

MATERIALS USED IN CELL

ISOTOPE			105--30063				
POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1			0.0000+000		
1	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
EVENTS	1		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
AVE	1		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
CONC	2	2			1.0000-006		
5	2	2	5.9553-004	0.0000+000	0.0000+000	0.0000+000	5.9553-004
6	2	2	6.1278-004	0.0000+000	0.0000+000	0.0000+000	6.1278-004
7	2	2	6.2068-004	0.0000+000	0.0000+000	0.0000+000	6.2068-004
8	2	2	6.2487-004	0.0000+000	0.0000+000	0.0000+000	6.2487-004
9	2	2	6.2711-004	0.0000+000	0.0000+000	0.0000+000	6.2711-004
10	2	2	6.2810-004	0.0000+000	0.0000+000	0.0000+000	6.2810-004
EVENTS	2		7.9017-003	0.0000+000	0.0000+000	0.0000+000	7.9017-003
AVE	2		6.1955-004	0.0000+000	0.0000+000	0.0000+000	6.1955-004

THERMOS CASE NO. 100 PAGE 18

AVERAGES FOR I= 1 TO I=27 V= 2.00000-002 TO V= 4.11326+000 E= 1.01200-005 TO E= 4.28049-001

MATERIALS USED IN EDIT

ISOTOPE

23994--30021

POINT	REG	MIX	SIGMA A	REL ABS	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
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CONC	1	1			1.0000+000			
1	1	1	1.0463+003	1.0000+000	6.9877+002	2.0194+003	9.6132+000	1.0559+003
2	1	1	1.0473+003	1.0127+000	6.9978+002	2.0224+003	9.6134+000	1.0569+003
3	1	1	1.0493+003	1.0405+000	7.0202+002	2.0288+003	9.6137+000	1.0589+003
4	1	1	1.0534+003	1.0928+000	7.0632+002	2.0413+003	9.6143+000	1.0630+003
AVE	1		1.0492+003	6.6579-001	7.0181+002	2.0282+003	9.6136+000	1.0588+003

CONC	2	2			1.0000+000			
5	2	2	1.0651+003	1.3274+000	7.1961+002	2.0797+003	9.6163+000	1.0747+003
6	2	2	1.0671+003	1.5537+000	7.2483+002	2.0948+003	9.6174+000	1.0766+003
7	2	2	1.0651+003	1.7063+000	7.2560+002	2.0970+003	9.6178+000	1.0747+003
8	2	2	1.0624+003	1.8135+000	7.2529+002	2.0961+003	9.6181+000	1.0724+003
9	2	2	1.0611+003	1.8826+000	7.2484+002	2.0948+003	9.6182+000	1.0707+003
10	2	2	1.0602+003	1.9166+000	7.2457+002	2.0940+003	9.6182+000	1.0698+003
AVE	2		1.0633+003	1.2237+000	7.2432+002	2.0933+003	9.6177+000	1.0729+003

THERMOS CASE NO. 100 PAGE 19

AVERAGES FOR I=28 TO I=30 V= 4.11326+000 TO V= 4.58559+000 E= 4.28048-001 TO E= 5.31999-001

POINT	REG	MIX	VOLUME	NDEN	NDEN*VOL	NFLX	NFLX*VOL
1	1	1	7.9375-002	2.5719-002	2.0414-003	1.1159-001	8.8578-003
2	1	1	7.9375-002	2.5793-002	2.0473-003	1.1192-001	8.8834-003
3	1	1	7.9375-002	2.5954-002	2.0601-003	1.1261-001	8.9388-003
4	1	1	7.9375-002	2.6246-002	2.0833-003	1.1389-001	9.0397-003

SUM	1		3.1750-001	1.0371-001	8.2321-003	4.5001-001	3.5720-002
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V AVE	1				2.5928-002		1.1250-001
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5	2	2	2.1167-001	2.7481-002	5.8169-003	1.1925-001	2.5242-002
6	2	2	2.1167-001	2.8219-002	5.9730-003	1.2246-001	2.5920-002
7	2	2	2.1167-001	2.8511-002	6.0348-003	1.2372-001	2.6188-002
8	2	2	2.1167-001	2.8658-002	6.0660-003	1.2436-001	2.6324-002
9	2	2	2.1167-001	2.8735-002	6.0822-003	1.2469-001	2.6394-002
10	2	2	2.1167-001	2.8767-002	6.0891-003	1.2484-001	2.6424-002

SUM	2		1.2700+000	1.7037-001	3.6062-002	7.3933-001	1.5649-001
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V AVE	2				2.8395-002		1.2322-001
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V AVE AVERAGE OVER REGIONS NR= 1 TO NR= 2

PHIBAR= 1.2108-001 NRAR= 2.7902-002

REGION REGION AVE. DENSITY/NBAR REGION AVE. FLUX/PHIBAR

1	9.2926-001	9.2918-001
2	1.0177+000	1.0177+000

THERMOS CASE NO. 100 PAGE 20

AVERAGES FOR I=28 TO I=30 V= 4.11326+000 TO V= 4.58559+000 E= 4.28048-001 TO E= 5.31999-001

POINT	REG	MIX	AVE V	AVE V+2	AVE V+3	ABSORPTION	FISSION	SCATTERING	NU*FISSION	D
1	1	1	4.33899	18.84323	81.90307	7.9757-004	4.7748-004	3.4523-003	1.1603-003	6.1714-003
2	1	1	4.33901	18.84341	81.90424	7.9987-004	4.7886-004	3.4623-003	1.1636-003	6.1893-003
3	1	1	4.33905	18.84379	81.90678	8.0484-004	4.8184-004	3.4838-003	1.1709-003	6.2280-003
4	1	1	4.33913	18.84450	81.91146	8.1390-004	4.8725-004	3.5231-003	1.1840-003	6.2984-003
SUM	1					3.2162-003	1.9254-003	1.3921-002	4.6788-003	2.4887-002
N AVE	1		4.33905	18.84374	81.90641					
V AVE	1					1.0130-002	6.0644-003	4.3847-002	1.4736-002	7.8385-002
F AVE	1					9.0040-002	5.3904-002	3.8974-001	1.3099-001	6.9674-001
5	2	2	4.33945	18.84726	81.92973	1.3357-004	0.0000+000	4.1311-002	0.0000+000	1.1730-002
6	2	2	4.33953	18.84801	81.93470	1.3716-004	0.0000+000	4.2420-002	0.0000+000	1.2046-002
7	2	2	4.33952	18.84793	81.93424	1.3857-004	0.0000+000	4.2858-002	0.0000+000	1.2171-002
8	2	2	4.33951	18.84779	81.93337	1.3929-004	0.0000+000	4.3080-002	0.0000+000	1.2233-002
9	2	2	4.33950	18.84771	81.93284	1.3966-004	0.0000+000	4.3195-002	0.0000+000	1.2266-002
10	2	2	4.33949	18.84765	81.93243	1.3982-004	0.0000+000	4.3244-002	0.0000+000	1.2280-002
SUM	2					8.2807-004	0.0000+000	2.5611-001	0.0000+000	7.2726-002
N AVE	2		4.33950	18.84773	81.93290					
V AVE	2					6.5203-004	0.0000+000	2.0166-001	0.0000+000	5.7265-002
F AVE	2					5.2915-003	0.0000+000	1.6366+000	0.0000+000	4.6473-001

THERMOS CASE NO. 100 PAGE 21

AVERAGES FOR I=28 TO I=30 V= 4.11326+000 TO V= 4.58559+000 E= 4.28048-001 TO E= 5.31999-001

MATERIALS USED IN CELL

ISOTOPE			23592--30018				
POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F+NU	SIGMA S	SIGMA TR
CONC	1	1			5.9870-004		
1	1	1	6.0875-002	5.3906-002	1.3099-001	5.9273-003	6.6785-002
2	1	1	6.0874-002	5.3905-002	1.3099-001	5.9273-003	6.6785-002
3	1	1	6.0872-002	5.3904-002	1.3099-001	5.9273-003	6.6783-002
4	1	1	6.0869-002	5.3901-002	1.3098-001	5.9272-003	6.6780-002
EVENTS	1		2.1744-003	1.9254-003	4.6788-003	2.1172-004	2.3855-003
AVE	1		6.0873-002	5.3904-002	1.3099-001	5.9273-003	6.6783-002
CONC	2	2			0.0000+000		
5	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
6	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
7	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
8	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
9	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
10	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
EVENTS	2		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
AVE	2		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

THERMOS CASE NO. 100 PAGE 22

AVERAGES FOR I=28 TO I=30 V= 4.11326+000 TO V= 4.58559+000 E= 4.28048-001 TO E= 5.31999-001

MATERIALS USED IN CELL

ISOTOPE			23892--30020				
POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1			4.6700-002		
1	1	1	2.9167-002	0.0000+000	0.0000+000	3.8382-001	4.1191-001
2	1	1	2.9167-002	0.0000+000	0.0000+000	3.8382-001	4.1191-001
3	1	1	2.9167-002	0.0000+000	0.0000+000	3.8381-001	4.1191-001
4	1	1	2.9166-002	0.0000+000	0.0000+000	3.8381-001	4.1190-001
EVENTS	1		1.0418-003	0.0000+000	0.0000+000	1.3710-002	1.4713-002
AVE	1		2.9167-002	0.0000+000	0.0000+000	3.8382-001	4.1191-001
CONC	2	2			0.0000+000		
5	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
6	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
7	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
8	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
9	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
10	2	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
EVENTS	2		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
AVE	2		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000

THERMOS CASE NO. 100 PAGE 23

AVERAGES FOR I=28 TO I=30 V= 4.11326+000 TO V= 4.58559+000 E= 4.28048-001 TO E= 5.31999-001

MATERIALS USED IN CELL

ISOTOPE			18--30001				
POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1			0.0000+000		
1	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
EVENTS	1		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
AVE	1		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
CONC	2	2			6.6890-002		
5	2	2	5.1176-003	0.0000+000	0.0000+000	1.5145+000	6.0146-001
6	2	2	5.1175-003	0.0000+000	0.0000+000	1.5144+000	6.0143-001
7	2	2	5.1175-003	0.0000+000	0.0000+000	1.5144+000	6.0143-001
8	2	2	5.1175-003	0.0000+000	0.0000+000	1.5144+000	6.0143-001
9	2	2	5.1175-003	0.0000+000	0.0000+000	1.5145+000	6.0143-001
10	2	2	5.1175-003	0.0000+000	0.0000+000	1.5145+000	6.0143-001
EVENTS	2		8.0085-004	0.0000+000	0.0000+000	2.3700-001	9.4119-002
AVE	2		5.1175-003	0.0000+000	0.0000+000	1.5145+000	6.0144-001

THERMOS CASE NO. 100 PAGE 24

AVERAGES FOR I=28 TO I=30 V= 4.11326+000 TO V= 4.58559+000 E= 4.28048-001 TO E= 5.31999+001

MATERIALS USED IN CELL

ISOTOPE			168--29302				
POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1			0.0000+000		
1	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
EVENTS	1		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
AVE	1		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
CONC	2	2			3.3445-002		
5	2	2	0.0000+000	0.0000+000	0.0000+000	1.2211-001	1.1702-001
6	2	2	0.0000+000	0.0000+000	0.0000+000	1.2210-001	1.1702-001
7	2	2	0.0000+000	0.0000+000	0.0000+000	1.2210-001	1.1702-001
8	2	2	0.0000+000	0.0000+000	0.0000+000	1.2210-001	1.1702-001
9	2	2	0.0000+000	0.0000+000	0.0000+000	1.2210-001	1.1702-001
10	2	2	0.0000+000	0.0000+000	0.0000+000	1.2210-001	1.1702-001
EVENTS	2		0.0000+000	0.0000+000	0.0000+000	1.9108-002	1.8312-002
AVE	2		0.0000+000	0.0000+000	0.0000+000	1.2210-001	1.1702-001

THERMOS CASE NO. 100 PAGE 25

AVERAGES FOR I=28 TO I=30 V= 4.11326+000 TO V= 4.58559+000 E= 4.28048-001 TO E= 5.31999+001

MATERIALS USED IN CELL

ISOTOPE			105--30063				
POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1			0.0000+000		
1	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
EVENTS	1		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
AVE	1		0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
CONC	2	2			1.0000-006		
5	2	2	1.7399-004	0.0000+000	0.0000+000	0.0000+000	1.7399-004
6	2	2	1.7398-004	0.0000+000	0.0000+000	0.0000+000	1.7398-004
7	2	2	1.7398-004	0.0000+000	0.0000+000	0.0000+000	1.7398-004
8	2	2	1.7398-004	0.0000+000	0.0000+000	0.0000+000	1.7398-004
9	2	2	1.7398-004	0.0000+000	0.0000+000	0.0000+000	1.7398-004
10	2	2	1.7398-004	0.0000+000	0.0000+000	0.0000+000	1.7398-004
EVENTS	2		2.7227-005	0.0000+000	0.0000+000	0.0000+000	2.7227-005
AVE	2		1.7398-004	0.0000+000	0.0000+000	0.0000+000	1.7398-004

THERMOS CASE NO. 100 PAGE 26

AVERAGES FOR I=28 TO I=30 V= 4.11326+000 TO V= 4.58559+000 E= 4.28048-001 TO E= 5.31999-001

MATERIALS USED IN EDIT

ISOTOPE			23994--30021					
POINT	REG	MIX	SIGMA A	REL ABS	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1	1.0000+000					
1	1	1	4.0689+002	1.0000+000	2.4975+002	7.2178+002	9.5067+000	4.1637+002
2	1	1	4.0687+002	1.0029+000	2.4974+002	7.2175+002	9.5067+000	4.1635+002
3	1	1	4.0684+002	1.0090+000	2.4972+002	7.2170+002	9.5066+000	4.1632+002
4	1	1	4.0678+002	1.0203+000	2.4969+002	7.2159+002	9.5065+000	4.1626+002
AVE	1		4.0684+002	4.0915-001	2.4972+002	7.2170+002	9.5066+000	4.1632+002
CONC	2	2	1.0000+000					
5	2	2	4.0654+002	1.0677+000	2.4955+002	7.2119+002	9.5059+000	4.1602+002
6	2	2	4.0649+002	1.0963+000	2.4951+002	7.2109+002	9.5057+000	4.1597+002
7	2	2	4.0650+002	1.1076+000	2.4952+002	7.2111+002	9.5057+000	4.1598+002
8	2	2	4.0652+002	1.1134+000	2.4953+002	7.2114+002	9.5057+000	4.1599+002
9	2	2	4.0652+002	1.1164+000	2.4953+002	7.2116+002	9.5057+000	4.1600+002
10	2	2	4.0653+002	1.1177+000	2.4954+002	7.2117+002	9.5057+000	4.1601+002
AVE	2		4.0652+002	6.8269-001	2.4953+002	7.2114+002	9.5057+000	4.1600+002

SECOND EDIT. INTEGRATE OVER ENERGY GROUPS 1-30 AND OVER BOTH REGIONS.

IDENT 200 SAME XSECT AS 100

THERMOS CASE NO. 200 PAGE 27

AVERAGES FOR I= 1 TO I=30 V= 2.00000-002 TO V= 4.58559+000 E= 1.01200-005 TO E= 5.31999-001

POINT	REG MIX	VOLUME	NDEN	NDEN*VOL	NFLX	NFLX*VOL
1	1 1	7.9375-002	4.4208+000	3.5090-001	6.1148+000	4.8536-001
2	1 1	7.9375-002	4.4895+000	3.5635-001	6.1860+000	4.9102-001
3	1 1	7.9375-002	4.6402+000	3.6831-001	6.3413+000	5.0334-001
4	1 1	7.9375-002	4.9245+000	3.9088-001	6.6299+000	5.2625-001
5	1 2	2.1167-001	6.2024+000	1.3128+000	7.9477+000	1.6823+000
6	1 2	2.1167-001	7.4515+000	1.5772+000	9.2686+000	1.9618+000
7	1 2	2.1167-001	8.3012+000	1.7571+000	1.0187+001	2.1562+000
8	1 2	2.1167-001	8.8993+000	1.8837+000	1.0842+001	2.2949+000
9	1 2	2.1167-001	9.2855+000	1.9654+000	1.1269+001	2.3853+000
10	1 2	2.1167-001	9.4756+000	2.0057+000	1.1480+001	2.4300+000
SUM	1	1.5875+000	6.8090+001	1.1968+001	8.0266+001	1.4916+001
V AVE	1			7.5391+000		9.3962+000

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AVERAGES FOR I= 1 TO I=30 V= 2.00000-002 TO V= 4.58559+000 E= 1.01200-005 TO E= 5.31999-001

POINT	REG	MIX	AVE V	AVE V**2	AVE V**3	ABSORPTION	FISSION	SCATTERING	NU*FISSION	D
1	1	1	1.38317	2.32775	4.76096	1.8135-001	1.1659-001	1.9126-001	2.8332-001	2.2257-001
2	1	1	1.37790	2.31302	4.72206	1.8425-001	1.1847-001	1.9349-001	2.8789-001	2.2484-001
3	1	1	1.36562	2.28169	4.63960	1.9061-001	1.2260-001	1.9836-001	2.9793-001	2.2977-001
4	1	1	1.34631	2.22600	4.49428	2.0263-001	1.3041-001	2.0740-001	3.1690-001	2.3889-001
5	1	2	1.28139	2.64430	4.01255	3.0146-002	0.0000+000	4.8370+000	0.0000+000	3.1488-001
6	1	2	1.24385	1.93214	3.69885	3.6217-002	0.0000+000	5.7358+000	0.0000+000	3.5817-001
7	1	2	1.22713	1.87975	3.54121	4.0347-002	0.0000+000	6.3534+000	0.0000+000	3.8841-001
8	1	2	1.21833	1.84923	3.45063	4.3254-002	0.0000+000	6.7909+000	0.0000+000	4.1015-001
9	1	2	1.21363	1.83293	3.39933	4.5131-002	0.0000+000	7.0743+000	0.0000+000	4.2437-001
10	1	2	1.21155	1.82558	3.37587	4.6055-002	0.0000+000	7.2141+000	0.0000+000	4.3141-001
SUM	1					1.0000+000	4.8808-001	3.8796+001	1.1860+000	3.2435+000
N AVE	1		1.24632	1.93270	3.68427					
V AVE	1					6.2492-001	3.0745-001	2.4438+001	7.4711+001	2.0431+000
F AVE	1					6.7040-002	3.2721-002	2.6009+000	7.9512-002	2.1744-001

THERMOS CASE NO. 200 PAGE 29

AVERAGES FOR I= 1 TO I=30 V= 2.00000-002 TO V= 4.58559+000 E= 1.01200-005 TO E= 5.31999-001

MATERIALS USED IN CELL

ISOTOPE			23592--30018				
POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1			5.9870-004		
1	1	1	2.8215-001	2.4022-001	5.8373-001	5.9941-003	2.8813-001
2	1	1	2.8339-001	2.4128-001	5.8631-001	5.9942-003	2.8937-001
3	1	1	2.8409-001	2.4358-001	5.9189-001	5.9945-003	2.9206-001
4	1	1	2.9105-001	2.4781-001	6.0219-001	5.9949-003	2.9703-001
CONC	1	2			0.0000+000		
5	1	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
6	1	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
7	1	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
8	1	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
9	1	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
10	1	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
EVENTS	1		5.7326-001	4.8808-001	1.1860+000	1.2025-002	5.8525-001
AVE	1		3.8431-002	3.2721-002	7.9512-002	8.0613-004	3.9235-002

THERMOS CASE NO. 200 PAGE 30

AVERAGES FOR I= 1 TO I=30 V= 2.00000-002 TO V= 4.58559+000 E= 1.01200-005 TO E= 5.31999-001

MATERIALS USED IN CELL

ISOTOPE 23892--30020

POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F+NU	SIGMA S	SIGMA TR
CONC	1	1			4.6700-002		
1	1	1	9.1498-002	0.0000+000	0.0000+000	3.8807-001	4.7848-001
2	1	1	9.1848-002	0.0000+000	0.0000+000	3.8807-001	4.7883-001
3	1	1	9.2606-002	0.0000+000	0.0000+000	3.8809-001	4.7961-001
4	1	1	9.4003-002	0.0000+000	0.0000+000	3.8811-001	4.8103-001
CONC	1	2			0.0000+000		
5	1	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
6	1	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
7	1	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
8	1	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
9	1	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
10	1	2	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
EVENTS	1		1.8559-001	0.0000+000	0.0000+000	7.7849-001	9.6190-001
AVE	1		1.2442-002	0.0000+000	0.0000+000	5.2190-002	6.4486-002

THERMOS CASE NO. 200 PAGE 31

AVERAGES FOR I= 1 TO I=30 V= 2.00000-002 TO V= 4.58559+000 E= 1.01200-005 TO E= 5.31999-001

MATERIALS USED IN CELL

ISOTOPE 18--30001

POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F+NU	SIGMA S	SIGMA TR
CONC	1	1			0.0000+000		
1	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
CONC	1	2			6.6890-002		
5	1	2	1.7331-002	0.0000+000	0.0000+000	2.7465+000	2.0350+000
6	1	2	1.7854-002	0.0000+000	0.0000+000	2.7947+000	2.0953+000
7	1	2	1.8097-002	0.0000+000	0.0000+000	2.8175+000	2.1238+000
8	1	2	1.8228-002	0.0000+000	0.0000+000	2.8299+000	2.1392+000
9	1	2	1.8298-002	0.0000+000	0.0000+000	2.8366+000	2.1476+000
10	1	2	1.8330-002	0.0000+000	0.0000+000	2.8396+000	2.1513+000
EVENTS	1		2.3322-001	0.0000+000	0.0000+000	3.6339+001	2.7373+001
AVE	1		1.5635-002	0.0000+000	0.0000+000	2.4362+000	1.8351+000

THERMOS CASE NO. 200 PAGE 32

AVERAGES FOR I= 1 TO I=30 V= 2.00000-002 TO V= 4.58559+000 E= 1.01200-005 TO E= 5.31999-001

MATERIALS USED IN CELL

ISOTOPE			168--29302				
POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1			0.0000+000		
1	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
CONC	1	2			3.3445-002		
5	1	2	0.0000+000	0.0000+000	0.0000+000	1.2879-001	1.2343-001
6	1	2	0.0000+000	0.0000+000	0.0000+000	1.2901-001	1.2363-001
7	1	2	0.0000+000	0.0000+000	0.0000+000	1.2910-001	1.2372-001
8	1	2	0.0000+000	0.0000+000	0.0000+000	1.2915-001	1.2377-001
9	1	2	0.0000+000	0.0000+000	0.0000+000	1.2917-001	1.2379-001
10	1	2	0.0000+000	0.0000+000	0.0000+000	1.2918-001	1.2380-001
EVENTS	1		0.0000+000	0.0000+000	0.0000+000	1.6665+000	1.5971+000
AVE	1		0.0000+000	0.0000+000	0.0000+000	1.1172-001	1.0707-001

THERMOS CASE NO. 200 PAGE 33

AVERAGES FOR I= 1 TO I=30 V= 2.00000-002 TO V= 4.58559+000 E= 1.01200-005 TO E= 5.31999-001

MATERIALS USED IN CELL

ISOTOPE			105--30063				
POINT	REG	MIX	SIGMA A	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1			0.0000+000		
1	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
2	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
3	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
4	1	1	0.0000+000	0.0000+000	0.0000+000	0.0000+000	0.0000+000
CONC	1	2			1.0000-006		
5	1	2	5.8920-004	0.0000+000	0.0000+000	0.0000+000	5.8920-004
6	1	2	6.0699-004	0.0000+000	0.0000+000	0.0000+000	6.0699-004
7	1	2	6.1526-004	0.0000+000	0.0000+000	0.0000+000	6.1526-004
8	1	2	6.1970-004	0.0000+000	0.0000+000	0.0000+000	6.1970-004
9	1	2	6.2210-004	0.0000+000	0.0000+000	0.0000+000	6.2210-004
10	1	2	6.2317-004	0.0000+000	0.0000+000	0.0000+000	6.2317-004
EVENTS	1		7.9290-003	0.0000+000	0.0000+000	0.0000+000	7.9290-003
AVE	1		5.3156-004	0.0000+000	0.0000+000	0.0000+000	5.3156-004

THERMOS CASE NO. 200 PAGE 34

AVERAGES FOR I= 1 TO I=30 V= 2.00000-002 TO V= 4.58559+000 E= 1.01200-005 TO E= 5.31999-001

MATERIALS USED IN EDIT

ISOTOPE

23994--30021

POINT	REG	MIX	SIGMA A	REL ABS	SIGMA F	SIGMA F*NU	SIGMA S	SIGMA TR
CONC	1	1			1.0000+000			
1	1	1	1.0347+003	1.0000+000	6.9057+002	1.9958+003	9.6113+000	1.0443+003
2	1	1	1.0357+003	1.0126+000	6.9164+002	1.9988+003	9.6114+000	1.0453+003
3	1	1	1.0379+003	1.0403+000	6.9399+002	2.0056+003	9.6118+000	1.0475+003
4	1	1	1.0423+003	1.0923+000	6.9848+002	2.0186+003	9.6124+000	1.0519+003
5	1	2	1.0552+003	1.3255+000	7.1255+002	2.0593+003	9.6146+000	1.0648+003
6	1	2	1.0583+003	1.5504+000	7.1855+002	2.0766+003	9.6159+000	1.0679+003
7	1	2	1.0571+003	1.7020+000	7.1982+002	2.0803+003	9.6165+000	1.0667+003
8	1	2	1.0553+003	1.8085+000	7.1984+002	2.0803+003	9.6168+000	1.0649+003
9	1	2	1.0539+003	1.8771+000	7.1958+002	2.0796+003	9.6169+000	1.0634+003
10	1	2	1.0531+003	1.9109+000	7.1940+002	2.0791+003	9.6170+000	1.0627+003
AVE	1		1.0530+003	1.3754+000	7.1523+002	2.0670+003	9.6158+000	1.0626+003

THERMOS PROBLEMS COMPLETED.

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APPENDIX A
CODE LISTING FOR THERMOS

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C*****ARGONNE-REVISED THERMOS CODE*****

C*****BEGIN MAIN*****

PROGRAM MAIN	MAIN 000
BANK,(0),/1000/	MAIN 001
COMMON/1000/T(20,20,50)	MAIN 002
COMMON/2000/DELTAJ,ICX	MAIN 003
COMMON/3000/AT(10),AMT(10),AKT(10)	MAIN 004
COMMON/RIG1/F(20,50),H(20,50),R(20,50),VOL(20),RAD(20),DV(50),V(50)	MAIN 005
1),MTBL(20),Q(20,50),XTM(20,50),XAM(20,50),NRTBL(20),ISTBA(25),ISTB	MAIN 006
28(25),ISTBE(25),ISTBG(25),CONCTA(25,5),CONCTE(25),XAT(25,50),XST(2	MAIN 007
35,50),S(20,50),IX,NX,IXPCM,ISOX,ISOXE,LEAKT,NPAGE,IDENT,MX,IBY,ITC	MAIN 008
4NT,RENORM,EPSA,ROLD,RNEW,NTIN,NTOUT,NTLIB,NTPUN,NTEMP,FVSTR,NRX,XN	MAIN 009
5U(50),XNUFT(25,50),FX(50),XFT(25,50),XMU(50),XMUFT(25,50),XA(50),	MAIN 010
6ICXE,P(50,50,5)	MAIN 011
NOVERLAY=1	MAIN 012
10 NTIN=60	MAIN 013
NTOUT=61	MAIN 014
NTLIB=10	MAIN 015
NTEMP=20	MAIN 016
100 READINPUTTAPENTIN,110	MAIN 017
REWIND NTEMP	MAIN 018
REWIND NTLIB	MAIN 019
110 FORMAT(72H	MAIN 020
1	MAIN 021
WRITEOUTPUTTAPENTOUT,110	MAIN 022
120 FORMAT(9I5)	MAIN 023
READ INPUTTAPENTIN,120,IDENTA,IBY	MAIN 024
98 IF(IDENTA) 121,121,123	MAIN 025
121 STOP	MAIN 026
123 IF(IBY)122,101,122	MAIN 027
122 WRITEOUTPUTTAPENTOUT,125,IDENTA,IDENT	MAIN 028
125 FORMAT(6H0IDENT16,15H SAME XSECT ASI6)	MAIN 029
IDENT=IDENTA	MAIN 030
IF(IBY)156,156,128	MAIN 031
128 DO 129 I=1,20000	MAIN 032
129 T(I,1,1)=0.0	MAIN 033
GO TO 880	MAIN 034
101 DO 111 I=1,26403	MAIN 035
111 F(I,1)=0.0	MAIN 036
DO 112 I=1,20000	MAIN 037
112 T(I,1,1)=0.0	MAIN 038
127 IDENT=IDENTA	MAIN 039
113 CALL OVERLAY(1,,NOVERLAY,,)	MAIN 040
1000 IF(ICX)1160,1160,1010	MAIN 041
1010 CALL OVERLAY(2,,NOVERLAY,,)	MAIN 042
1160 CALL OVERLAY(3,,NOVERLAY,,)	MAIN 043
880 READ INPUT TAPE NTIN,120,LEAKT,NRX,NGEOM	MAIN 044
IF(NGEOM)882,882,883	MAIN 045
882 CALL OVERLAY(4,,NOVERLAY,,)	MAIN 046
GO TO 884	MAIN 047
883 CALL OVERLAY(5,,NOVERLAY,,)	MAIN 048
884 CALL OVERLAY(6,,NOVERLAY,,)	MAIN 049
150 CALL OVERLAY(7,,NOVERLAY,,)	MAIN 050
IF(ICXE)256,256,300	MAIN 051
300 CALL OVERLAY(8,,NOVERLAY,,)	MAIN 052
256 CALL OVERLAY(9,,NOVERLAY,,)	MAIN 053
156 CALL OVERLAY(10,,NOVERLAY,,)	MAIN 054
GO TO 100	MAIN 055
END	MAIN 056

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C*****BEGIN OVERLAY 1*****
PROGRAM XPREP
BANK,(0),/1000/
DIMENSION PP(50,50),WK(20),SD(20),SP(50)
COMMON/1000/T(20,20,50)
COMMON/2000/DELTAJ,ICX
COMMON/3000/AT(10),AMT(10),AKT(10)
COMMON/RIG1/F(20,50),H(20,50),R(20,50),VOL(20),RAD(20),DV(50),V(50)
1) ,MTPL(20),Q(20,50),XTM(20,50),XAM(20,50),NRTBL(20),ISTBA(25),ISTBXPREP006
2B(25),ISTBE(25),ISTBG(25),CONCTA(25,5),CONCTE(25),XAT(25,50),XST(2XPREP007
35,50),S(20,50),IX,NX,IXPCM,ISOX,ISOXE,LEAKI,NPAGE,IDENT,MX,IBY,ITCXPREP009
4NT,RENORM,EPISA,ROLD,RNEW,NTIN,NTOUT,NTLIB,NTPUN,NTEMP,FVSTR,NRX,XNXPREP010
5U(50),XNUFT(25,50),FX(50),XF1(25,50),XMU(50),XMJFT(25,50),XA(50), XPREP011
6ICXE,P(50,50,5)
EQUIVALENCE(PP,T)
120 FORMAT(9I5)
NTIN=60
NTOUT=61
NTLIB=10
NTEMP=20
REWIND NTEMP
140 FORMAT(6E12.5)
141 FORMAT(7E10.5)
READINPUTTAPENTIN,120,NX,IX,MX,ISOX,ISOXE,ICX,ICXE
WRITEOUTPUTTAPENTOUT,130,IDENT,NX,IX,MX,ISOX,ISOXE,ICX,ICXE
130 FORMAT(6H0IDENTI6/14H0SPACE POINTS=13/8H GROUPS=13/10H MIXTURES=13XPREP024
1/26H LIBRARY ISOTOPES IN CELL=13/26H LIBRARY ISOTOPES IN EDIT=13/2XPREP025
24H ADDED ISOTOPES IN CELL=13/24H ADDED ISOTOPES IN EDIT=13) XPREP026
IF(ISOX+ISOXE+ICX+ICXE)135,135,137
135 CALL XSTOP(100)
STOP
137 IF(ISOX+ICX-25)139,139,138
138 CALL XSTOP(102)
STOP
139 IF(ISOXE+ICXE-25)160,160,150
150 CALL XSTOP(103)
STOP
160 READINPUTTAPENTIN,170,(MTBL(N),N=1,NX)
170 FORMAT(50I1)
NPAGE=1
IF(ISOX)195,195,171
171 READ INPUT TAPE NTIN,180,(ISTBA(J),ISTBB(J),(CONCTA(J,M),
XM=1,5),J=1,ISOX)
180 FORMAT(2I5,5E10.5)
GO TO 200
195 IF(ISOX+ISOXE)200,197,200
197 READINPUTTAPENTIN,141,(V(I),I=1,IX)
READINPUTTAPENTIN,141,(DV(I),I=1,IX)
GOTO1000
200 REWINDNTLIB
READTAPENTLIB, IXA
IF(IX-IXA)210,220,210
210 WRITEOUTPUTTAPENTOUT,215
215 FORMAT(33H GROUPS DO NOT AGREE WITH LIBRARY)
220 READTAPENTLIB, V
READTAPENTLIB, DV
IF(ISOX)100,490,100
100 ISOC=0
300 READTAPENTLIB, IDM,IDMA,IDB,IDA
DG320J=1,ISOX
L=J
IF(ISTBA(J)-IDM)320,310,320

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310	IF(ISTBB(J)=IDMA)320,380,320	XPREP061
320	CONTINUE	XPREP062
	IF(IDB)350,360,360	XPREP063
C	=====ISOTOPE NOT ON TAPE 10=====	XPREP064
350	CALL XSTOP(101)	XPREP065
	STOP	XPREP066
360	L=IDA+4	XPREP067
	DO370J=1,L	XPREP068
370	READTAPENTLIB,	XPREP069
	GOTO300	XPREP070
380	ISOC=ISOC+1	XPREP071
	READTAPENTLIB, XA	XPREP072
	DO390I=1,IX	XPREP073
390	XAT(L,I)=XA(I)	XPREP074
	IF(IDA)480,480,400	XPREP075
400	READTAPENTLIB, PP	XPREP076
	DO420J=1,IX	XPREP077
	DO410I=1,IX	XPREP078
410	XST(L,J)=XST(L,J)+PP(I,J)*DV(I)	XPREP079
420	XST(L,J)=XST(L,J)/(V(J)*DV(J))	XPREP080
	DO450M=1,MX	XPREP081
	IF(CONCTA(L,M))430,450,430	XPREP082
430	DO440J=1,IX	XPREP083
	DO440I=1,IX	XPREP084
440	P(I,J,M)=P(I,J,M)+CONCTA(L,M)*PP(I,J)/V(I)	XPREP085
450	CONTINUE	XPREP086
	IF(IDA-1)480,480,460	XPREP087
460	N=IDA-1	XPREP088
465	DO 470 J=1,N	XPREP089
470	READ TAPE NTLIB	XPREP090
480	READ TAPE NTLIB,XNU	XPREP091
	READ TAPE NTLIB,FX	XPREP092
	READ TAPE NTLIB,XMU	XPREP093
	DO 485 J=1,IX	XPREP094
	XNUFT(L,J)=XNU(J)	XPREP095
	XFT(L,J)=FX(J)	XPREP096
485	XMUFT(L,J)=XMU(J)	XPREP097
486	IF(ISOC-ISOX)300,490,490	XPREP098
490	REWIND NTLIB	XPREP099
1000	CONTINUE	XPREP100
	END	XPREP101

	SUBROUTINE XSTOP(K)	XSTOP000
C	SUBROUTINE TO PRINT ERROR STOP NUMBERS	XSTOP001
	NTOUT=61	XSTOP002
	WRITEOUTPUTTAPENTOUT,1,K	XSTOP003
1	FORMAT(19H0PROGRAM ERROR STOP16)	XSTOP004
	END	XSTOP005


```

C*****BEGIN OVERLAY 2*****
PROGRAM CARDINP                                CRDNP000
BANK,(0),/1000/                                CRDNP001
DIMENSION PP(50,50),WK(20),SD(20),SP(50)       CRDNP002
COMMON/1000/T(20,20,50)                        CRDNP003
COMMON/2000/DELTAJ,ICX                         CRDNP004
COMMON/3000/AT(10),AMT(10),AKT(10)             CRDNP005
COMMON/RIG1/F(20,50),H(20,50),R(20,50),VOL(20),RAD(20),DV(50),V(50) CRDNP006
1),MTBL(20),Q(20,50),XTM(20,50),XAM(20,50),NRTBL(20),ISTBA(25),ISTBCRDNP007
2B(25),ISTBE(25),ISTBG(25),CONCTA(25,5),CONCTE(25),XAT(25,50),XST(2CRDNP008
35,50),S(20,50),IX,NX,IXPCM,ISOX,ISOXE,LEAKT,NPAGE,IDENT,MX,IBY,ITCCRDNP009
4NT,RENORM,EPSA,ROLD,RNEW,NTIN,NTOUT,NTLIB,NTPUN,NTMP,FVSTR,NRX,XNCRDNP010
5U(50),XNUFT(25,50),FX(50),XFT(25,50),XMU(50),XMUFT(25,50),XA(50), CRDNP011
6ICXE,P(50,50,5)                                CRDNP012
EQUIVALENCE(PP,T)                                CRDNP013
1010 DO 1080 L=1,ICX                             CRDNP014
      LP=L+ISOX                                    CRDNP015
      READ INPUT TAPE NTIN,180,ISTBA(LP),ISTBB(LP),(CONCTA(LP,M),M=1,5) CRDNP016
      READ INPUT TAPE NTIN,1011,NXAT,NKERT,IDNU,IDAF,IDMU,TP CRDNP017
1011 FORMAT(5I5,E10,5)                            CRDNP018
      IF(ISTBB(LP))1012,1015,1015                 CRDNP019
1012 READ TAPE NTEMP,(XAT(LP,I),I=1,IX)           CRDNP020
      READ TAPE NTEMP,(XNUFT(LP,I),I=1,IX)        CRDNP021
      READ TAPE NTEMP,(XFT(LP,I),I=1,IX)          CRDNP022
      READ TAPE NTEMP,(XMUFT(LP,I),I=1,IX)        CRDNP023
      READ TAPE NTEMP,(XA(I),I=1,IX)              CRDNP024
      READ TAPE NTEMP,((PP(I,J),I=1,IX),J=1,IX)   CRDNP025
      GO TO 960                                    CRDNP026
1015 IF(NXAT)1020,1030,1020                       CRDNP027
1020 READ INPUT TAPE NTIN,140,VALXA              CRDNP028
      DO 1025 I=1,IX                             CRDNP029
1025 XAT(LP,I)=VALXA/V(I)                         CRDNP030
      GO TO 1035                                   CRDNP031
1030 READ INPUT TAPE NTIN,140,(XAT(LP,I),I=1,IX)  CRDNP032
1035 IF(IDAF)900,910,910                         CRDNP033
      900 DO 905 I=1,50                           CRDNP034
          XNUFT(LP,I)=0.0                         CRDNP035
      905 XFT(LP,I)=0.0                           CRDNP036
          GO TO 930                               CRDNP037
      910 IF(IDNU)900,915,925                     CRDNP038
      915 READ INPUT TAPE NTIN,140,(XNUFT(LP,I),I=1,IX) CRDNP039
          IF(IDAF)900,920,927                     CRDNP040
      920 READ INPUT TAPE NTIN,140,(XFT(LP,I),I=1,IX) CRDNP041
          GO TO 930                               CRDNP042
      925 READ INPUT TAPE NTIN,140,XNU(1)         CRDNP043
          DO 926 I=1,IX                           CRDNP044
      926 XNUFT(LP,I)=XNU(1)                     CRDNP045
          IF(IDAF)900,920,927                     CRDNP046
      927 READ INPUT TAPE NTIN,140,XF            CRDNP047
          DO 928 I=1,IX                           CRDNP048
      928 XFT(LP,I)=XF/V(I)                     CRDNP049
      930 IF(IDMU)940,950,940                     CRDNP050
      940 READ INPUT TAPE NTIN,140,XMUX          CRDNP051
          DO 945 I=1,IX                           CRDNP052
      945 XMUFT(LP,I)=XMUX                      CRDNP053
          GO TO 960                               CRDNP054
      950 READ INPUT TAPE NTIN,140,(XMUFT(LP,I),I=1,IX) CRDNP055
      960 WRITE OUTPUT TAPE NTOUT,1040,ISTBA(LP),ISTBB(LP) CRDNP056
1040 FORMAT(14H0ADDED ISOTOPE17,1H-15,9H IN CELL) CRDNP057
      WRITE OUTPUT TAPE NTOUT,1045,(XAT(LP,I),I=1,IX) CRDNP058
1044 FORMAT(3H0NU/(6E12,5))                     CRDNP059
1045 FORMAT(3H0XA/(6E12,5))                     CRDNP060

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WRITE OUTPUT TAPE NTOUT,1044,(XNUFT(LP,I),I=1,IX)	CRDNP061
WRITE OUTPUT TAPE NTOUT,1046,(XFT(LP,I),I=1,IX)	CRDNP062
WRITE OUTPUT TAPE NTOUT,1047,(XMUFT(LP,I),I=1,IX)	CRDNP063
IF(IST88(LP))107,1050,1050	CRDNP064
1046 FORMAT(3H0XF/(6E12.5))	CRDNP065
1047 FORMAT(6H0MUBAR/(6E12.5))	CRDNP066
1050 READINPUTIAPENTIN,1055,(AT(I),AMT(I),AKT(I),I=1,NKERT)	CRDNP067
1055 FORMAT(3E10.5)	CRDNP068
WRITEOUTPUTTAPENTOUT,1056,(AT(I),AMT(I),AKT(I),I=1,NKERT)	CRDNP069
1056 FORMAT(6H0 XS= E12.5,6H M=E12.5,10H KAPPA=E12.5)	CRDNP070
CALLRASK(PP,V,DV,XA,AT,AKT,AMT,TP,IX,NKERT)	CRDNP071
107 DO1070M=1,MX	CRDNP072
IF(CONCTA(LP,M))1060,1070,1060	CRDNP073
1060 DO1065J=1,IX	CRDNP074
DO1065I=1,IX	CRDNP075
1065 P(I,J,M)=P(I,J,M)+CONCTA(LP,M)*PP(I,J)/V(I)	CRDNP076
1070 CONTINUE	CRDNP077
1076 DO 1077 I=1,IX	CRDNP078
1077 XST(LP,I)=XA(I)	CRDNP079
WRITEOUTPUTTAPENTOUT,1075,(XA(I),I=1,IX)	CRDNP080
1075 FORMAT(3H0XS/(6E12.5))	CRDNP081
1080 CONTINUE	CRDNP082
1160 CONTINUE	CRDNP083
140 FORMAT(6E12.5)	CRDNP084
180 FORMAT(2I5,5E10.5)	CRDNP085
END	CRDNP086

	SUBROUTINE BASK(P,V,DV,XS,AT,AKT,AMT,T,IX,NISO)	BASK 000
	DIMENSION P(50,50),V(50),DV(50),XS(50),X(50),E(50),AT(10),AKT(10),ABASK	001
	1MT(10)	BASK 002
10	D015I=1,IX	BASK 003
	XS(I)=0.	BASK 004
	D015J=1,IX	BASK 005
15	P(I,J)=0.	BASK 006
100	D0500N=1,NISO	BASK 007
	IF(AT(N))110,500,110	BASK 008
110	AM=AMT(N)	BASK 009
	BETS=AM/T	BASK 010
	BET=SQRTF(BETS)	BASK 011
	D0120I=1,IX	BASK 012
	X(I)=BET*V(I)	BASK 013
120	E(I)=X(I)*X(I)	BASK 014
	TAUS=BETS/(BETS+AKT(N))	BASK 015
	TAU=SQRTF(TAUS)	BASK 016
	ALPHA=AKT(N)*TAUS/BETS	BASK 017
	THETA=(AM+1.)/(2.*AM*TAU)	BASK 018
	ZETA=TAU-THETA	BASK 019
	OMEG=TAUS*(BETS+(AM+1.)*AKT(N))/BETS	BASK 020
	CONST=(AT(N)*TAU*TAUS*(AM+1.)*(AM+1.))/(4.*AM*OMEG)	BASK 021
200	D0400I=1,IX	BASK 022
	D0300J=1,IX	BASK 023
	IF EXPONENT FAULT 250,250	BASK 024
250	EA=ERF((THETA*X(I))+(ZETA*X(J)))*ERF((THETA*X(I))-(ZETA*X(J)))	BASK 025
	EB=ERF((THETA*X(J))-(ZETA*X(I)))*ERF((ZETA*X(I))+(THETA*X(J)))	BASK 026
	WA=ALPHA*E(J)	BASK 027
	IF(WA-50.)252,251,251	BASK 028
251	WA=0.	BASK 029
	GOTO253	BASK 030
252	WA=EXPF(-WA)	BASK 031
253	WB=(E(J)-OMEG*E(I))/AM	BASK 032
	TEM=CONST*(X(I)/X(J))*(EA*WA+EB*EXPF(WB))	BASK 033
	IF EXPONENT FAULT 300,260	BASK 034
260	IF(TEM-1.E-15)350,350,270	BASK 035
270	P(I,J)=P(I,J)+TEM	BASK 036
300	CONTINUE	BASK 037
350	EA=TAU*X(I)	BASK 038
	WA=ALPHA*E(I)	BASK 039
	IF(WA-50.)352,351,351	BASK 040
351	WA=0.	BASK 041
	GOTO353	BASK 042
352	WA=EXPF(-WA)	BASK 043
353	EB=WA*ERF(EA)*(EA+(0.5/EA))	BASK 044
	IF(E(I)-50.)355,354,354	BASK 045
354	WB=0.	BASK 046
	GOTO703	BASK 047
355	WB=EXPF(-E(I))	BASK 048
703	XS(I)=XS(I)+(AT(N)*TAUS*TAUS/BET)*(EB+0.5641896*WB)	BASK 049
400	CONTINUE	BASK 050
500	CONTINUE	BASK 051
600	D0610I=1,IX	BASK 052
610	E(I)=(V(I)*V(I))*EXPF(-(V(I)*V(I))/T)	BASK 053
	D0620I=1,IX	BASK 054
	D0620J=1,IX	BASK 055
620	P(J,I)=P(I,J)*E(J)/E(I)	BASK 056
	D0650J=1,IX	BASK 057
	TEM=0.	BASK 058
	D0640I=1,IX	BASK 059
640	TEM=TEM+P(I,J)*DV(I)	BASK 060
650	P(J,J)=((XS(J)-TEM)/DV(J))+P(J,J)	BASK 061
	D0680I=1,IX	BASK 062
	XS(I)=XS(I)/V(I)	BASK 063
	D0680J=1,IX	BASK 064
680	P(I,J)=P(I,J)*DV(J)	BASK 065
	RETURN	BASK 066
	END	BASK 067

FUNCTION ERF(X)		ERF	000
CERF		ERF	001
10	IF(ABS(X)-3.7)30,20,20	ERF	002
20	ERF=1.	ERF	003
	GOTO55	ERF	004
30	XX=ABS(X)	ERF	005
	IF(XX-1.E-5)40,40,50	ERF	006
40	ERF=1.12838*XX	ERF	007
	GOTO55	ERF	008
50	ERF=1.-1./(1.+XX*(.14112821+XX*(.08864027+XX*(.02743349*XX*	ERF	009
	1*(-.00039446+XX*.00328975)))))*.8	ERF	010
55	IF(X)60,70,70	ERF	011
60	ERF=-ERF	ERF	012
70	RETURN	ERF	013
	END	ERF	014

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C*****BEGIN OVERLAY 3*****
PROGRAM MERGE
BANK,(0),/1000/
DIMENSION PP(50,50),WK(20),SD(20),SP(50)
COMMON/1000/T(20,20,50)
COMMON/2000/DELTAJ,ICX
COMMON/3000/AT(10),AMT(10),AKT(10)
COMMON/RIG1/F(20,50),H(20,50),R(20,50),VOL(20),RAD(20),DV(50),V(50)
1),MTBL(20),Q(20,50),XTM(20,50),XAM(20,50),NRTBL(20),ISTBA(25),ISTB
28(25),ISTBE(25),ISTBG(25),CONCTA(25,5),CONCTE(25),XAT(25,50),XST(2
35,50),S(20,50),IX,NX,IXPCM,ISOX,ISOXE,LEAKT,NPAGE,IDENT,MX,IBY,ITC
4NT,RENORM,EPSA,ROLD,RNEW,NTIN,NTOUT,NTLIB,NTUN,NTMP,FVSTR,NRX,XN
5U(50),XNUFT(25,50),FX(50),XFT(25,50),XMU(50),XMUFT(25,50),XA(50),
6ICXE,P(50,50,5)
EQUIVALENCE(PP,T)
1160 ISOX=ISOX+ICX
550 DO600J=1,ISOX
DO600M=1,MX
IF(CONCTA(J,M))560,600,560
560 DO590N=1,NX
MP=MTBL(N)
IF(MP-M)590,570,590
570 DO580I=1,IX
XAM(N,I)=XAM(N,I)+CONCTA(J,M)*XAT(J,I)
580 XTM(N,I)=XTM(N,I)+CONCTA(J,M)*XST(J,I)
590 CONTINUE
600 CONTINUE
DO605I=1,IX
DO605N=1,NX
605 XTM(N,I)=XTM(N,I)+XAM(N,I)
2000 NPAGE=NPAGE+1
WRITEOUTPUTTAPENTOUT,2010,IDENT,NPAGE
2010 FORMAT(17H1THERMOS CASE NO.15,6H PAGE13)
WRITEOUTPUTTAPENTOUT,2020
2020 FORMAT(72H0 ISOTOPE CONC MIX 1 CONC MIX 2 CONC MIX 3 CONC M
1IX 4 CONC MIX 5)
WRITEOUTPUTTAPENTOUT,2030
2030 FORMAT(72H -----)
1-----)
WRITEOUTPUTTAPENTOUT,2040
2040 FORMAT(13H USED IN CELL)
WRITEOUTPUTTAPENTOUT,2050,(ISTBA(I),ISTBB(I),(CONCTA(I,M),M=1,5),I
1=1,ISOX)
2050 FORMAT(16,1H-15, 5E12,5)
WRITEOUTPUTTAPENTOUT,2080,(N,N=1,NX)
2080 FORMAT(11H0REGION NO 2013)
WRITEOUTPUTTAPENTOUT,2090,(MTBL(N),N=1,NX)
2090 FORMAT(11H MIXTURE NO2013)
WRITEOUTPUTTAPENTOUT,610
610 FORMAT(12H2SOURCE DATA)
700 READINPUTTAPENTIN,120,NSC,NST
WRITEOUTPUTTAPENTOUT,705,NSC
705 FORMAT(14H0NO. OF CARDS=15)
IF(NST)710,710,730
710 DO720N=1,NX
720 SD(N)=1.
GOTO740
730 READINPUTTAPENTIN,141,(SD(N),N=1,NX)
740 EM=(V(IX)+0.5*DV(IX))**2
EMA=(V(IX)-0.5*DV(IX))**2
WRITEOUTPUTTAPENTOUT,742,(SD(N),N=1,NX)
742 FORMAT(11H0SPACE DIST/( 5E12,5))

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	WRITEOUTPUTTAPENTOUT,743	MERGE061
743	FORMAT(17H0SOURCE CONSTANTS)	MERGE062
	D0860NS=1,NSC	MERGE063
	READINPUTTAPENTIN,870,M,AM,HXS,HCON,TP	MERGE064
	WRITEOUTPUTTAPENTOUT,745,M,AM,HXS,HCON,TP	MERGE065
745	FORMAT(4H MIXI2,8H MASS= E12,5,6H XS= E12,5,7H CON= E12,5	MERGE066
	1,6H TP= E12,5)	MERGE067
	ALPH=((AM-1.)/(AM+1.))*2	MERGE068
	D0750I=1,IX	MERGE069
750	SP(I)=0.	MERGE070
	IF(EMA-ALPH*EM)760,760,770	MERGE071
760	SP(IX)=HCON*HXS/(DV(IX)*(AM+0.667))	MERGE072
	GOTO820	MERGE073
770	D0790I=1,IX	MERGE074
	A=V(I)*(1./EM-ALPH/(V(I)*V(I)))	MERGE075
	IF(A)790,790,780	MERGE076
780	SP(I)=HCON*HXS*A/(1.-ALPH)	MERGE077
790	CONTINUE	MERGE078
	IF(TP)820,820,800	MERGE079
800	D0810I=1,IX	MERGE080
	A=V(I)*V(I)/TP	MERGE081
	A=1.+A*(.278393+A*(.230389+A*(.000972+A*.078108)))	MERGE082
	IF(A-1.E+5)805,803,803	MERGE083
803	A=1.	MERGE084
	GOTO810	MERGE085
805	A=1.-1./((A**4)	MERGE086
810	SP(I)=A*SP(I)	MERGE087
820	D0850N=1,NX	MERGE088
	MP=MTBL(N)	MERGE089
	IF(M-MP)850,830,850	MERGE090
830	D0840I=1,IX	MERGE091
840	S(N,I)=S(N,I)+SP(I)*SD(N)/V(I)	MERGE092
850	CONTINUE	MERGE093
860	CONTINUE	MERGE094
870	FORMAT(15,5E10.5)	MERGE095
120	FORMAT(9I5)	MERGE096
141	FORMAT(7E10.5)	MERGE097
	END	MERGE098

```

C*****BEGIN OVERLAY 4*****
PROGRAM GEOMR
BANK,(0),/1000/
DIMENSION RN(20),RI(20),RO(20),BETA(21),DX(20),DL(20),FNA(100),
1FNB(100),FNB1(100),FNA1(100)
COMMON/1000/T(20,20,50)
COMMON/2000/DELTAJ,ICX
COMMON/BIG1/F(20,50),H(20,50),R(20,50),VOL(20),RAD(20),DV(50),V(50)
1),MTRL(20),Q(20,50),XTM(20,50),XAM(20,50),NRTBL(20),ISTBA(25),ISTBGEOMR006
28(25),ISTBE(25),ISTBG(25),CONCTA(25,5),CONCTE(25),XAT(25,50),XST(2GEOMR007
35,50),S(20,50),IX,NX,IXPCM,ISUX,ISOXE,LEAKT,NPAGE,IDENT,MX,IBY,ITCGEOMR009
4NT,RENORM,EPSA,ROLD,RNEW,NTIN,NTOUT,NTLIB,NTPUN,NTEMP,FVSTR,NRX,XNGEOMR010
5U(50),XNUFT(25,50),FX(50),XFT(25,50),XMU(50),XMUFT(25,50),XA(50), GEOMR011
6ICXE,P(50,50,5)
EQUIVALENCE(FNB1,F),(FNA1,F(101))
100 FORMAT(9I5)
NPAGE=NPAGE+1
WRITEOUTPUTTAPENTOUT,2000,IDENT,NPAGE
IF(LEAKT)120,120,110
110 WRITEOUTPUTTAPENTOUT,2010
LEAKT=-1
GOTO150
120 WRITEOUTPUTTAPENTOUT,2020
LEAKT=1
150 WRITEOUTPUTTAPENTOUT,2030
WRITEOUTPUTTAPENTOUT,2040
NRC=1
N=1
RIP=0
RAP=0
160 READINPUTTAPENTIN,170,NR,NP,TH
170 FORMAT(2I5,E10.5)
WRITEOUTPUTTAPENTOUT,2050,NR,TH
DT=TH/(FLOATF(NP)-0.5)
RCP=DT/2.
NC=0
IF(NR-1)175,220,175
175 CALL XSTOP(250)
200 READINPUTTAPENTIN,170,NR,NP,TH
WRITEOUTPUTTAPENTOUT,2050,NR,TH
DT=TH/FLOATF(NP)
NC=0
NRC=NRC+1
IF(NRC-NR)175,210,175
210 RNP=RIP+0.5*DT
ROP=RIP+DT
220 VX=3.14159*(ROP*ROP-RIP*RIP)
RN(N)=RNP
RI(N)=RIP
RO(N)=ROP
RAD(N)=RNP
VOL(N)=VX
WRITEOUTPUTTAPENTOUT,2060,N,VX,RNP,RIP
RIP=ROP
NC=NC+1
N=N+1
IF(N-NX)230,230,240
230 IF(NC-NP)210,200,200
240 DO250I=1,NX
DO250J=1,NX
DO250K=1,IX
250 T(I,J,K)=0.

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	DH=.05	GEOMR061
	CA=1.0	GEOMR062
	X=0.	GEOMR063
	DO260L=1,100	GEOMR064
	X=X+DH	GEOMR065
	A=.001352852153+X*(.2031025486+X*(4.557657076+X*(24.02730460	GEOMR066
	1+X*(35.64815114+X*(15.80553881+X*(1.866032641))))))	GEOMR067
	B=.001352852262+X*(.2045502171+X*(4.771899521+X*(28.64849162	GEOMR068
	1+X*(58.50777370+X*(47.46853418+X*(15.03011023+X*(1.488882521))))	GEOMR069
	2))))	GEOMR070
	CB=SQRTF(1.+X)*EXP(-X)*A/B	GEOMR071
	FNB(L)=(CB-CA)/DH	GEOMR072
	FNA(L)=CA-FNB(L)*(X-DH)	GEOMR073
260	CA=CB	GEOMR074
	CA=1.5707963	GEOMR075
	X=0.	GEOMR076
	DO 262 L=1,100	GEOMR077
	X=X+DH	GEOMR078
	A=.2437997090E-07+X*(.1467588796E=03+X*(.05736867829+X*(	GEOMR079
	12.838501203+X*(24.28269118+X*(41.44135900+X*(12.14837747))))))	GEOMR080
	B=.1552083950E-07+X*(.9353689972E=04+X*(.03696900541+X*(	GEOMR081
	11.930093672+X*(19.71226041+X*(52.67424655+X*(43.95298186+X*(	GEOMR082
	29.693354952))))))	GEOMR083
	CB=SQRTF(1.+X)*EXP(-X)*A/B	GEOMR084
	FNB1(L)=(CB-CA)/DH	GEOMR085
	FNA1(L)=CA-FNB1(L)*(X-DH)	GEOMR086
262	CA=CB	GEOMR087
	BETA(1)=0.	GEOMR088
	BETA(2)=3.1415926	GEOMR089
	BETA(3)=.15707963	GEOMR090
	DO270L=4,21	GEOMR091
270	BETA(L)=BETA(L-1)+BETA(3)	GEOMR092
	DO800L=1,21	GEOMR093
	DO800K=1,NX	GEOMR094
500	RCA=RN(K)*SINF(BETA(L))	GEOMR095
	RCAS=RCA*RCA	GEOMR096
	NMIN=1	GEOMR097
	A=0.	GEOMR098
	DO600N=1,NX	GEOMR099
	IF(RO(N)-RCA)520,520,530	GEOMR100
520	NMIN=NMIN+1	GEOMR101
	DX(N)=0.	GEOMR102
	GOTO600	GEOMR103
530	B=SQRTF(RO(N)*RO(N)-RCAS)	GEOMR104
	DX(N)=B-A	GEOMR105
	A=B	GEOMR106
600	CONTINUE	GEOMR107
	DO760I=1,IX	GEOMR108
	DO620N=NMIN,NX	GEOMR109
620	DL(N)=XTM(N,I)*DX(N)	GEOMR110
	IF(RN(K))635,630,635	GEOMR111
630	X=DL(K)	GEOMR112
	RHO2=DX(K)	GEOMR113
	GOTO636	GEOMR114
635	IF(L-2)625,624,621	GEOMR115
625	RHO2=RO(K)-RN(K)	GEOMR116
	GO TO 639	GEOMR117
624	RHO2=RN(K)-RI(K)	GEOMR118
	GO TO 639	GEOMR119
621	IF(L-12)623,622,632	GEOMR120
623	IF(RI(K)-RCA)627,627,626	GEOMR121
626	RHO2=DX(K)-SQRTF(RN(K)**2-RCAS)*SQRTF(RI(K)**2-RCAS)	GEOMR122

	GO TO 639	GEOMR123
627	RH02=DX(K)-SQRTF(RN(K)**2-RCAS)	GEOMR124
	GO TO 639	GEOMR125
622	RH02=DX(K)	GEOMR126
	GO TO 639	GEOMR127
632	IF(RCA-RI(K))634,633,633	GEOMR128
633	RH02=SQRTF(RN(K)**2-RCAS)	GEOMR129
	GO TO 639	GEOMR130
634	RH02=SQRTF(RN(K)**2-RCAS)-SQRTF(RI(K)**2-RCAS)	GEOMR131
639	X=RH02*XTM(K,I)	GEOMR132
636	LP=1.+X/DH	GEOMR133
	IF(LP-100)638,638,637	GEOMR134
637	CA=0.	GEOMR135
	GO TO 604	GEOMR136
638	CA=FNA(LP)+X*FNB(LP)	GEOMR137
	IF(1.-CA-1.E-6)602,602,604	GEOMR138
604	T(K,K,I)=T(K,K,I)+(1.-CA)/XTM(K,I)	GEOMR139
	GO TO 603	GEOMR140
602	T(K,K,I)=T(K,K,I)+1.5707963*RH02	GEOMR141
603	IF(BETA(L)-1.5707963)640,640,660	GEOMR142
640	IF(K-NX)650,680,680	GEOMR143
650	N=K+1	GEOMR144
	GOTO700	GEOMR145
660	IF(K-NMIN)690,690,670	GEOMR146
670	N=K-1	GEOMR147
	GOTO730	GEOMR148
680	N=NX	GEOMR149
	GOTO720	GEOMR150
690	IF(K-1)650,650,695	GEOMR151
695	N=NMIN	GEOMR152
	GOTO700	GEOMR153
700	X=X+DL(N)	GEOMR154
	IF(X-5.)705,705,702	GEOMR155
702	T(N,K,I)=T(N,K,I)+CA/XTM(N,I)	GEOMR156
	GOTO760	GEOMR157
705	LP=1.+X/DH	GEOMR158
	CB=FNA(LP)+X*FNB(LP)	GEOMR159
	IF(CA-CB-1.E-6)703,703,706	GEOMR160
706	T(N,K,I)=T(N,K,I)+(CA-CB)/XTM(N,I)	GEOMR161
	CA=CB	GEOMR162
	GO TO 704	GEOMR163
703	X1=X-DL(N)	GEOMR164
	LP=1.+X1/DH	GEOMR165
	T(N,K,I)=T(N,K,I)+(FNA1(LP)+X1*FNB1(LP))*DX(N)	GEOMR166
	CA=CB	GEOMR167
704	IF(N-NX)710,720,720	GEOMR168
710	N=N+1	GEOMR169
	GOTO700	GEOMR170
720	IF(LEAKT)730,730,760	GEOMR171
730	X=X+DL(N)	GEOMR172
	IF(X-5.)735,735,732	GEOMR173
732	T(N,K,I)=T(N,K,I)+CA/XTM(N,I)	GEOMR174
	GOTO760	GEOMR175
735	LP=1.+X/DH	GEOMR176
	CB=FNA(LP)+X*FNB(LP)	GEOMR177
	IF(CA-CB-1.E-6)736,736,738	GEOMR178
738	T(N,K,I)=T(N,K,I)+(CA-CB)/XTM(N,I)	GEOMR179
	CA=CB	GEOMR180
	GO TO 737	GEOMR181
736	X1=X-DL(N)	GEOMR182
	LP=1.+X1/DH	GEOMR183
	T(N,K,I)=T(N,K,I)+(FNA1(LP)+X1*FNB1(LP))*DX(N)	GEOMR184

CA=CB	GEOMR185
737 IF(N=NM(N))700,700,740	GEOMR186
740 N=N-1	GEOMR187
GO TO 730	GEOMR188
760 CONTINUE	GEOMR189
IF(L-2)790,770,790	GEOMR190
770 DO 780 N=1,NX	GEOMR191
DO 780 I=1,IX	GEOMR192
780 T(N,K,I)=0.5*T(N,K,I)	GEOMR193
790 CONTINUE	GEOMR194
800 CONTINUE	GEOMR195
DO 820 I=1,IX	GEOMR196
DO 820 K=1,NX	GEOMR197
DO 820 N=K,NX	GEOMR198
T(N,K,I)=T(N,K,I)*0.05	GEOMR199
T(K,N,I)=T(N,K,I)	GEOMR200
820 T(N,K,I)=T(N,K,I)*VOL(K)/VOL(N)	GEOMR201
DO 860 I=1,IX	GEOMR202
DO 860 K=1,NX	GEOMR203
Q(K,I)=0.	GEOMR204
DO 840 N=1,NX	GEOMR205
840 Q(K,I)=Q(K,I)+VOL(N)*XTM(N,I)*T(N,K,I)	GEOMR206
860 Q(K,I)=Q(K,I)/VOL(K)	GEOMR207
IF(LEAKT)830,830,870	GEOMR208
830 DO 850 N=1,NX	GEOMR209
850 T(N,K,I)=T(N,K,I)/Q(K,I)	GEOMR210
870 NPAGE=NPAGE+1	GEOMR211
WRITEOUTPUTTAPENTOUT,2000,IDENT,NPAGE	GEOMR212
WRITEOUTPUTTAPENTOUT,865,((K,I,Q(K,I),K=1,NX),I=1,IX)	GEOMR213
865 FORMAT(11HOK,I,Q(K,I)/(7(2I3,F9.5)))	GEOMR214
2000 FORMAT(17H1THERMOS CASE NO.15,6H PAGE13)	GEOMR215
2010 FORMAT(34H0CYLINDRICAL GEOMETRY - NO LEAKAGE)	GEOMR216
2020 FORMAT(31H0CYLINDRICAL GEOMETRY - LEAKAGE)	GEOMR217
2030 FORMAT(64H0REGION THICKNESS POINT VOLUME R(CENTER)	GEOMR218
1R(INNER))	GEOMR219
2040 FORMAT(66H -----)	GEOMR220
1-----)	GEOMR221
2050 FORMAT(14, E16.5)	GEOMR222
2060 FORMAT(125, E15.5, 2E13.5)	GEOMR223
RETURN	GEOMR224
END	GEOMR225

SUBROUTINE XSTOP(K)	XSTOP000
C SUBROUTINE TO PRINT ERROR STOP NUMBERS	XSTOP001
NTOUT=61	XSTOP002
WRITEOUTPUTTAPENTOUT,1,K	XSTOP003
1 FORMAT(19H0PROGRAM ERROR STOP16)	XSTOP004
END	XSTOP005

```

C*****BEGIN OVERLAY 5*****
PROGRAM GEOMX
BANK,(0),/1000/
C SLAB TRANSPORT KERNEL -THERMOS- HONECK, BNL
DIMENSION ENX(3),DX(20),XT(21)
COMMON/1000/T(20,20,50)
COMMON/2000/DELTAJ,ICX
COMMON/BIG1/F(20,50),H(20,50),R(20,50),VOL(20),RAD(20),DV(50),V(50)
1) ,MTBL(20),Q(20,50),XTM(20,50),XAM(20,50),NRTBL(20),ISTBA(25),ISTBGEOMX000
28(25),ISTBE(25),ISTBG(25),CONCTA(25,5),CONCTE(25),XAT(25,50),XST(2GEOMX001
35,50),S(20,50),IX,NX,IXPM,ISOX,ISOXE,LEAKT,NPAGE,IDENT,MX,IBY,ITCGEOMX002
4NT,RENORM,EPSA,ROLD,RNEW,NTIN,NTOUT,NTLIB,NTPUN,NTEMP,FVSTR,NRX,XNGEOMX003
5U(50),XNUFT(25,50),FX(50),XFT(25,50),XMU(50),XMUFT(25,50),XA(50),GEOMX004
6ICXE,P(50,50,5)
MAX=3
LTST=LEAKT
15 FORMAT(9I5)
25 NPAGE=NPAGE+1
WRITEOUTPUTTAPENTOUT,30,IDENT,NPAGE
30 FORMAT(17H1THERMOS CASE NO.15,6H PAGE13)
IF(LTST)35,45,55
35 WRITEOUTPUTTAPENTOUT,40,NRX
40 FORMAT(21H FULL SLAB, REGIONS=13)
LEAKT=1
GOTO65
45 WRITEOUTPUTTAPENTOUT,50,NRX
50 FORMAT(20H HALF SLAB, REGIONS=13)
LEAKT=1
GOTO65
55 WRITEOUTPUTTAPENTOUT,60,NRX
60 FORMAT(20H SLAB CELL, REGIONS=13)
LEAKT=-1
65 N=1
WRITEOUTPUTTAPENTOUT,2000
WRITEOUTPUTTAPENTOUT,2010
X=0.
DO74NR=1,NRX
READINPUTTAPENTIN,67,NRXX,NP,TH
67 FORMAT(2I5,E10,5)
IF(NRXX-NR)68,69,68
68 CALL XSTOP(200)
69 WRITEOUTPUTTAPENTOUT,2020,NRXX,TH
NC=0
DXA=TH/FLOATF(NP)
X=X+0.5*DXA
70 VOL(N)=DXA
RAD(N)=X
WRITEOUTPUTTAPENTOUT,2030,N,DXA,X
IF(N-NX)71,75,75
71 N=N+1
NC=NC+1
IF(NC-NP)72,73,73
72 X=X+DXA
GOTO70
73 X=X+0.5*DXA
74 CONTINUE
75 DO80K=1,IX
DO80J=1,NX
DO80I=1,NX
80 T(I,J,K)=0.
NFT=0
CALLSLABK(X,X,X,X,NFT)

```

	NFT=1	GEOMX061
	DO1000K=1,IX	GEOMX062
	DO100I=1,NX	GEOMX063
100	DX(I)=VOL(I)*XTM(I,K)	GEOMX064
	XT(1)=0.	GEOMX065
	DO110I=1,NX	GEOMX066
110	XT(I+1)=XT(I)+DX(I)	GEOMX067
	ALAM=2.*XT(NX+1)	GEOMX068
	DO260I=1,NX	GEOMX069
	DO260J=1,NX	GEOMX070
	DI=DX(I)	GEOMX071
	DJ=DX(J)	GEOMX072
	DELTAJ=VOL(J)	GEOMX073
	X=XT(J)-XT(I)	GEOMX074
	IF(I-J)120,130,120	GEOMX075
120	CALL SLABK(X,DI,DJ,A,NFT)	GEOMX076
	T(I,J,K)=T(I,J,K)+A	GEOMX077
130	IF(LTST)260,150,140	GEOMX078
140	X=X+ALAM	GEOMX079
	IF(X-6.)120,150,150	GEOMX080
150	X=XT(J)+XT(I+1)	GEOMX081
160	CALL SLABK(X,DI,DJ,A,NFT)	GEOMX082
	T(I,J,K)=T(I,J,K)+A	GEOMX083
170	IF(LTST)250,250,180	GEOMX084
180	X=X+ALAM	GEOMX085
	IF(X-6.)160,190,190	GEOMX086
190	X=ALAM-XT(J+1)+XT(I+1)	GEOMX087
200	CALL SLABK(X,DI,DJ,A,NFT)	GEOMX088
	T(I,J,K)=T(I,J,K)+A	GEOMX089
210	X=X+ALAM	GEOMX090
	IF(X-6.)200,220,220	GEOMX091
220	X=ALAM-XT(J+1)-XT(I)	GEOMX092
230	CALL SLABK(X,DI,DJ,A,NFT)	GEOMX093
	T(I,J,K)=T(I,J,K)+A	GEOMX094
240	X=X+ALAM	GEOMX095
	IF(X-6.)230,250,250	GEOMX096
250	CONTINUE	GEOMX097
260	CONTINUE	GEOMX098
	MAX=3	GEOMX099
	DO270I=1,NX	GEOMX100
	X=DX(I)	GEOMX101
276	CALLEI(X,MAX,ENX)	GEOMX102
	IF(X)277,278,277	GEOMX103
277	T(I,I,K)=T(I,I,K)+VOL(I)*(X-0.5*ENX(3))/(X*X)	GEOMX104
	GO TO 270	GEOMX105
278	T(I,I,K)=T(I,I,K)+VOL(I)*ENX(1)/2.	GEOMX106
270	CONTINUE	GEOMX107
	DO 300 I=1,NX	GEOMX108
	DO 300 J=1,NX	GEOMX109
300	T(J,I,K)=T(I,J,K)*VOL(I)/VOL(J)	GEOMX110
1000	CONTINUE	GEOMX111
	DO1110K=1,IX	GEOMX112
	DO1110J=1,NX	GEOMX113
	F(J,K)=0.	GEOMX114
	DO1100I=1,NX	GEOMX115
1100	F(J,K)=F(J,K)+XTM(I,K)*VOL(I)*T(I,J,K)	GEOMX116
1110	F(J,K)=F(J,K)/VOL(J)	GEOMX117
	NPAGE=NPAGE+1	GEOMX118
	WRITEOUTPUTTAPENTOUT,30,IDENT,NPAGE	GEOMX119
	WRITEOUTPUTTAPENTOUT,1120,((J,K,F(J,K),J=1,NX),K=1,IX)	GEOMX120
1120	FORMAT(11HOK,I,Q(K,I)/(7(2I3,F9,5)))	GEOMX121
	IF(LEAKT)1010,1010,1160	GEOMX122

1010	DO1150K=1,IX	GEOMX123
	DO1150J=1,NX	GEOMX124
	DO1150I=1,NX	GEOMX125
1150	T(I,J,K)=T(I,J,K)/F(J,K)	GEOMX126
1160	CONTINUE	GEOMX127
	RETURN	GEOMX128
2000	FORMAT(51HOREGION THICKNESS POINT VOLUME POSITION)	GEOMX129
2010	FORMAT(53H -----)	GEOMX130
2020	FORMAT(I4,1PE16.5)	GEOMX131
2030	FORMAT(I25,1PE15.5,1PE13.5)	GEOMX132
	END	GEOMX133

	SUBROUTINE EI(X,NX,ENX)	EI	000
	DIMENSIONENX(10)	EI	001
5	IF(NX)6,6,10	EI	002
6	NX=1	EI	003
10	IF(X)30,30,50	EI	004
30	ENX(1)=1.0E+30	EI	005
	IF(NX-1)150,150,35	EI	006
35	DO40I=2,NX	EI	007
	A=FLOATF(I)	EI	008
40	ENX(I)=1./(A+1.)	EI	009
	GOTO150	EI	010
50	IF(X-75.)80,60,60	EI	011
60	DO70I=1,10	EI	012
70	ENX(I)=0.	EI	013
	GOTO150	EI	014
80	A=EXP(-X)	EI	015
	IF(X-1.0)90,120,120	EI	016
90	B=LOGF(X)	EI	017
	IF(X-0.001)100,100,110	EI	018
100	ENX(1)=X-B-0.577215665	EI	019
	GOTO130	EI	020
110	ENX(1)=-.577215665-B+X*(1.+X*(-.25+X*(.055555555+X*(-.010416666+X*EI	EI	021
	1(.16666666E-2+X*(-.23148147E-3+X*(.28344669E-4+X*(-.31001981E-5+X*EI	EI	022
	2.30619240E-6))))))	EI	023
	GOTO130	EI	024
120	B=.2372905+X*(4.53079235+X*(5.1266902+X))	EI	025
	C=2.4766331+X*(8.6660126+X*(6.1265272+X))	EI	026
	ENX(1)=((A/X)*B)/C	EI	027
130	IF(NX-1)150,150,135	EI	028
135	DO140I=2,NX	EI	029
	B=FLOATF(I)-1.	EI	030
140	ENX(I)=(A-X*ENX(I-1))/B	EI	031
150	CONTINUE	EI	032
	RETURN	EI	033
	END	EI	034

	SUBROUTINE SLABK(X,DI,DJ,E,NFT)	SLABK000
	BANK,(0),/1000/	SLABK001
	DIMENSION CA(500),CB(500),CC(500),CD(500),ENX(10)	SLABK002
	COMMON/1000/T(20,20,50)	SLABK003
	COMMON/2000/DELTAJ,ICX	SLABK004
	COMMON/BIG1/CA,CB,CC,CD, R(20,50),VOL(20),RAD(20),DV(50),V(50)	SLABK005
	1),MTBL(20),Q(20,50),XTM(20,50),XAM(20,50),NRTBL(20),ISTBA(25),ISTB	SLABK006
	28(25),ISTBE(25),ISTBG(25),CONCTA(25,5),CONCTE(25),XAT(25,50),XST(2	SLABK007
	35,50),S(20,50),IX,NX,IXPCM,ISOX,ISOXE,LEAKT,NPAGE,IDENT,MX,IBY,ITC	SLABK008
	4NT,RENORM,EPSA,ROLD,RNEW,NTIN,NTOUT,NTLIB,NTPUN,NTMP,FVSTR,NRX,XNS	SLABK009
	5U(50),XNUFT(25,50),FX(50),XFT(25,50),XMU(50),XMUFT(25,50),XA(50),	SLABK010
	6ICXE,P(50,50,5)	SLABK011
10	IF(NFT)100,20,100	SLABK012
20	MAX=3	SLABK013
	H=0.01	SLABK014
	TH=0.02	SLABK015
	THS=2.E-4	SLABK016
	XA=0.	SLABK017
	FA=0.5	SLABK018
	DO30N=1,300	SLABK019
	XB=XA+H	SLABK020
	XC=XA+TH	SLABK021
	CALLEI(XB,MAX,ENX)	SLABK022
	FB=ENX(3)	SLABK023
	CALLEI(XC,MAX,ENX)	SLABK024
	FC=ENX(3)	SLABK025
	CA(N)=FA	SLABK026
	CB(N)=(4.*(FB-FA)-FC+FA)/TH	SLABK027
	CC(N)=(FC+FA-FB-FR)/THS	SLABK028
	CD(N)=XA	SLABK029
	XA=XC	SLABK030
30	FA=FC	SLABK031
	GO TO 250	SLABK032
100	E=0.	SLABK033
	IF(DJ)101,102,101	SLABK034
102	IF(DI)105,230,105	SLABK035
105	XP=X-DI	SLABK036
	CALLEI(XP,MAX,ENX)	SLABK037
	E=ENX(2)	SLABK038
	CALLEI(X,MAX,ENX)	SLABK039
	E=DELTAJ*(E-ENX(2))/(2.*DI)	SLABK040
	GO TO 250	SLABK041
101	IF(DI)103,104,103	SLABK042
104	CALLEI(X,MAX,ENX)	SLABK043
	E=ENX(2)	SLABK044
	XP=X+DJ	SLABK045
	CALLEI(XP,MAX,ENX)	SLABK046
	E=DELTAJ*(E-ENX(2))/(2.*DJ)	SLABK047
	GO TO 250	SLABK048
103	XP=X-DI	SLABK049
	N=1.+50.*XP	SLABK050
	IF(N)120,120,130	SLABK051
120	N=1	SLABK052
130	IF(N=300)140,140,250	SLABK053
140	E=CA(N)+(XP-CD(N))*(CB(N)+(XP-CD(N))*CC(N))	SLABK054
150	XP=X+DJ	SLABK055
	N=1.+50.*XP	SLABK056
	IF(N=300)160,160,165	SLABK057
160	E=E+CA(N)+(XP-CD(N))*(CB(N)+(XP-CD(N))*CC(N))	SLABK058
	GOTO170	SLABK059
165	CALL EI(XP,MAX,ENX)	SLABK060
	E=E+ENX(3)	SLABK061

170	XP=XP-DI	SLABK062
	N=1.+50.*XP	SLABK063
	IF(N-300)180,180,185	SLABK064
180	E=E-CA(N)-(XP-CD(N))*(CB(N)+(XP-CD(N))*CC(N))	SLABK065
	GOTO190	SLABK066
185	CALL EI(XP,MAX,ENX)	SLABK067
	E=E-ENX(3)	SLABK068
190	N=1.+50.*X	SLABK069
	IF(N-300)200,200,210	SLABK070
200	E=E-CA(N)-(X-CD(N))*(CB(N)+(X-CD(N))*CC(N))	SLABK071
	GOTO220	SLABK072
210	CALL EI(X,MAX,ENX)	SLABK073
	E=E-ENX(3)	SLABK074
220	IF(E-1.E-6)230,230,240	SLABK075
230	XP=X+0.5*(DJ-DI)	SLABK076
	CALLEI(XP,MAX,ENX)	SLABK077
	E=ENX(1)*DELTAJ/2.	SLABK078
	GO TO 250	SLABK079
240	E=E*DELTAJ/(2.*DI*DJ)	SLABK080
250	RETURN	SLABK081
	END	SLABK082

	SUBROUTINE XSTOP(K)	XSTOP000
C	SUBROUTINE TO PRINT ERROR STOP NUMBERS	XSTOP001
	NTOUT=61	XSTOP002
	WRITEOUTPUTTAPENTOUT,1,K	XSTOP003
1	FORMAT(19H0PROGRAM ERROR STOP16)	XSTOP004
	END	XSTOP005

C*****BEGIN OVERLAY 6*****

	PROGRAM ITER	ITER 000
	BANK,(0),/1000/	ITER 001
	COMMON/1000/T(20,20,50)	ITER 002
	COMMON/2000/DELTAJ,ICX	ITER 003
	COMMON/BIG1/F(20,50),H(20,50),R(20,50),VOL(20),RAD(20),DV(50),V(50)	ITER 004
	1),MTBL(20),Q(20,50),XTM(20,50),XAM(20,50),NRTBL(20),ISTBA(25),ISTB	ITER 005
	28(25),ISTBE(25),ISTBG(25),CONCTA(25,5),CONCTE(25),XAT(25,50),XST(2	ITER 006
	35,50),S(20,50),IX,NX,IXPCM,ISOX,ISOXE,LEAKT,NPAGE,IDENT,MX,IBY,ITC	ITER 007
	4NT,RENORM,EPSA,ROLD,RNEW,NTIN,NTOUT,NTL[B,NTPUN,NTMP,FVSTR,NRX,XN	ITER 008
	5U(50),XNUFT(25,50),FX(50),XFT(25,50),XMU(50),XMUFT(25,50),XA(50),	ITER 009
	6ICXE,P(50,50,5)	ITER 010
	ITCNT=-1	ITER 011
	NPAGE=NPAGE+1	ITER 012
	WRITEOUTPUTTAPENTOUT,2000,IDENT,NPAGE	ITER 013
	CALL RELAX(ITCNT,RNEW,OVER,EPS,ITMAX,RENORM)	ITER 014
30	FORMAT(1215)	ITER 015
40	FORMAT(7E10.5)	ITER 016
100	IF(LEAKT)140,140,110	ITER 017
110	DO130I=1,IX	ITER 018
	DO130K=1,NX	ITER 019
	F(K,I)=0	ITER 020
	DO120N=1,NX	ITER 021
120	F(K,I)=F(K,I)+XTM(N,I)*T(N,K,I)*VOL(N)/VOL(K)	ITER 022
130	F(K,I)=F(K,I)*V(I)	ITER 023
	GOTO160	ITER 024
140	DO150I=1,IX	ITER 025
	DO150K=1,NX	ITER 026
150	F(K,I)=V(I)	ITER 027
160	A=0.	ITER 028
	DO170I=1,IX	ITER 029
	DO170N=1,NX	ITER 030
170	A=A+F(N,I)*S(N,I)*VOL(N)*DV(I)	ITER 031
	IF(A)175,185,175	ITER 032
175	A=1./A	ITER 033
	DO180I=1,IX	ITER 034
	DO180N=1,NX	ITER 035
180	S(N,I)=S(N,I)*A	ITER 036
	FVSTR=A/(V(IX)+0.5*DV(IX))**2	ITER 037
185	IF(LEAKT)220,220,190	ITER 038
190	DO200I=1,IX	ITER 039
	DO200N=1,NX	ITER 040
	Q(N,I)=0.	ITER 041
	M=MTBL(N)	ITER 042
	DO200J=1,IX	ITER 043
200	Q(N,I)=Q(N,I)+F(N,J)*P(J,I,M)*DV(J)	ITER 044
	DO210I=1,IX	ITER 045
	DO210N=1,NX	ITER 046
210	Q(N,I)=(V(I)*XTM(N,I)*DV(I)-Q(N,I))*VOL(N)	ITER 047
	GOTO240	ITER 048
220	DO230I=1,IX	ITER 049
	DO230N=1,NX	ITER 050
230	Q(N,I)=V(I)*XAM(N,I)*DV(I)*VOL(N)	ITER 051
240	A=0.	ITER 052
	DO250I=1,IX	ITER 053
	B=V(I)*V(I)	ITER 054
	B=B*EXP(-B)	ITER 055
	DO250N=1,NX	ITER 056
	F(N,I)=B	ITER 057
250	A=A+B*Q(N,I)	ITER 058
	A=1./A	ITER 059
	DO260I=1,IX	ITER 060

	D0260N=1,NX	ITER 061
260	F(N,I)=A*F(N,I)	ITER 062
	FMAX = F(1,1)	ITER 063
	DO 3000 I=1,IX	ITER 064
	DO 3000 N=1,NX	ITER 065
	IF (F(N,I) - FMAX) 3000,3000,3001	ITER 066
3001	FMAX = F(N,I)	ITER 067
3000	CONTINUE	ITER 068
	EPSA = EPS*FMAX	ITER 069
	QBAR=0	ITER 070
	D0270I=1,IX	ITER 071
	D0270N=1,NX	ITER 072
270	QBAR=QBAR+Q(N,I)**2	ITER 073
	RNEW=0.	ITER 074
	ITCNT=0	ITER 075
	CALL RELAX(ITCNT,RNEW,OVER,EPS,ITMAX,RENORM)	ITER 076
280	IF (ITCNT=ITMAX)300,360,360	ITER 077
300	D0310I=1,IX	ITER 078
	D0310K=1,NX	ITER 079
	M=MTBL(K)	ITER 080
	H(K,I)=S(K,I)	ITER 081
	D0310J=1,IX	ITER 082
310	H(K,I)=H(K,I)+P(I,J,M)*F(K,J)	ITER 083
	A=0.	ITER 084
	D0330I=1,IX	ITER 085
	D0330N=1,NX	ITER 086
	R(N,I)=0.	ITER 087
	D0320K=1,NX	ITER 088
320	R(N,I)=R(N,I)+H(K,I)*T(N,K,I)	ITER 089
330	A=A+R(N,I)*Q(N,I)	ITER 090
	RENORM=1./A	ITER 091
	D0340I=1,IX	ITER 092
	D0340N=1,NX	ITER 093
340	R(N,I)=RENORM*R(N,I)-F(N,I)	ITER 094
	ITCNT=ITCNT+1	ITER 095
	RNEW=0.	ITER 096
	D0345I=1,IX	ITER 097
	D0345N=1,NX	ITER 098
345	RNEW=RNEW+(Q(N,I)*R(N,I))**2	ITER 099
	RNEW=SQRTF(RNEW/QBAR)	ITER 100
	CALL RELAX(ITCNT,RNEW,OVER,EPS,ITMAX,RENORM)	ITER 101
3110	D03120I=1,IX	ITER 102
	D03120N=1,NX	ITER 103
3120	F(N,I)=F(N,I)+OVER*R(N,I)	ITER 104
	D0350I=1,IX	ITER 105
	D0350N=1,NX	ITER 106
	IF (ABS(F(N,I))-EPSA)350,350,280	ITER 107
350	CONTINUE	ITER 108
360	CONTINUE	ITER 109
	ROLD=0.	ITER 110
	D0410I=1,IX	ITER 111
	D0410N=1,NX	ITER 112
	IF (ABS(F(N,I))-ROLD)410,410,400	ITER 113
400	ROLD=ABS(F(N,I))	ITER 114
410	CONTINUE	ITER 115
1000	NC=1	ITER 116
	ND=7	ITER 117
1010	IF (NX-ND)1020,1030,1030	ITER 118
1020	ND=NX	ITER 119
1030	NPAGE=NPAGE+1	ITER 120
	WRITEOUTPUTTAPENTOUT,2000,IDENT,NPAGE	ITER 121
2000	FORMAT(17H1THERMOS CASE NO.15,6H PAGE13)	ITER 122

	WRITEOUTPUTTAPENTOUT,2020,ITCNT,RENORM,EPSA	ITER 123
2020	FORMAT(7H0ITCNT=I5,8H RENORM= E12.5,5H EPS= E12.5)	ITER 124
	WRITEOUTPUTTAPENTOUT,1035,ROLD,RNEW,FVSTR	ITER 125
1035	FORMAT(13H LARGEST RES= E12.5,13H MEAN RES= E12.5,9H N(V*)=	ITER 126
1	E12.5)	ITER 127
	WRITEOUTPUTTAPENTOUT,2030,((N,I,F(N,I),I=1,IX),N=NC,ND)	ITER 128
2030	FORMAT(11H0K,I,N(K,I)/(5(2I3, E12.4)))	ITER 129
	IF(NX-ND)1050,1050,1040	ITER 130
1040	NC=NC+7	ITER 131
	ND=ND+7	ITER 132
	GOTO1010	ITER 133
1050	RETURN	ITER 134
	END	ITER 135

	SUBROUTINE RELAX(ITCNT,RNEW,OVER,EPS,ITMAX,RENORM)	RELAX000
	DIMENSION RBS(20)	RELAX001
	NTIN=60	RELAX002
	NTOUT=61	RELAX003
10	IF(ITCNT)20,100,2900	RELAX004
20	READINPUTTAPENTIN,30,EPS,RELC,EPSC,OVERX,FACTOR,ITBG, 1LCMX,ITDM,ITMAX,IPT	RELAX005
30	FORMAT(5E10.5,4I5,12)	RELAX006
	IF(ITMAX)35,35,40	RELAX007
35	EPS=1.E-5	RELAX008
	RELC=1.2	RELAX009
	EPSC=.05	RELAX010
	OVERX=100.	RELAX011
	FACTOR=1.	RELAX012
	ITBG=5	RELAX013
	LCMX=5	RELAX014
	ITDM=5	RELAX015
	ITMAX=100	RELAX016
	IPT=-1	RELAX017
40	CONTINUE	RELAX018
	RELCA=RELC	RELAX019
	WRITEOUTPUTTAPENTOUT,50,ITBG,LCMX,ITDM,ITMAX,EPS,RELC,	RELAX020
	1EPSC,OVERX,FACTOR	RELAX021
50	FORMAT(17H0EARLIEST EXTRAP=13/12H NO, TESTED=13/11H INCREMENT=13/9	RELAX022
	1H MAX ITS=13/11H CONV CRIT= E12.5/16H OVERRELAXATION= E12.5/13H	RELAX023
	2EXTRAP CRIT= E12.5/12H MAX EXTRAP= E12.5/8H FACTOR= E12.5)	RELAX024
60	IF(IPT)3110,3110,60	RELAX025
	WRITEOUTPUTTAPENTOUT,70	RELAX026
70	FORMAT(37H IT RENORM RMS RES RATIO)	RELAX027
	GOTO3110	RELAX028
100	LCNT=0	RELAX029
	RELC=RELCA	RELAX030
	GOTO3110	RELAX031
2900	RATIO=RNEW/ROLD	RELAX032
	ROLD=RNEW	RELAX033
	IF(IPT)2990,2990,2910	RELAX034
2910	WRITEOUTPUTTAPENTOUT,2920,ITCNT,RENORM,RNEW,RATIO	RELAX035
2920	FORMAT(16,F10.5, E13.4,0PF9.4)	RELAX036
2990	IF(ITCNT-ITBG)3100,3000,3000	RELAX037
3000	LCNT=LCNT+1	RELAX038
	RBS(LCNT)=1./(1.-RATIO)	RELAX039
	IF EXPONENT FAULT5000,5000	RELAX040
5000	IF(RBS(LCNT)) 3050,5010,5010	RELAX041
5010	IF(LCNT-LCMX) 3100,3020,3020	RELAX042
3020	LCMXP = LCMX	RELAX043
	D03040M=1,LCMXP	RELAX044
	IF(ABS(RBS(M)-RBS(LCMXP))/RBS(LCMXP)-EPSC)3040,3040,3050	RELAX045
3040	CONTINUE	RELAX046
	GOTO3060	RELAX047
3050	LCNT=0	RELAX048
	GOTO3100	RELAX049
3060	OVER=FACTOR*RBS(LCMXP)	RELAX050
	IF(OVER-OVERX)3080,3080,3070	RELAX051
3070	OVER=OVERX	RELAX052
3080	ALAM=(RATIO+RELC-1.)/RELC	RELAX053
	RELCB=2./(2.-ALAM)	RELAX054
	IF(RELCB-2.)3082,3083,3083	RELAX055
3082	RELC=RELCB	RELAX056
3083	WRITEOUTPUTTAPENTOUT,3085,ITCNT,OVER,RATIO,ALAM,RELC	RELAX057
3085	FORMAT(17H0EXTRAPOLATION AT14.4H BYF9.4/6H MU=F8.5,7H LAM=F8.	RELAX058
	15.9H OMEGA=F8.5)	RELAX059
	ITBG=ITCNT+ITDM+1	RELAX060
	LCNT=0	RELAX061
	GOTO3110	RELAX062
3100	OVER=RELC	RELAX063
3110	RETURN	RELAX064
	END	RELAX065

C*****BEGIN OVERLAY 7*****

PROGRAM EDIT1	EDIT1000
BANK,(0),/1000/	EDIT1001
COMMON/1000/PP(50,50),XATE(25,50),XSTE(25,50),XNUFTE(25,50),XFTE(25,50),XMFTE(25,50),XFM(20,50),XTR(20,50),XFMNU(20,50),IXPTL(50),I	EDIT1002
15,50),XMFTE(25,50),XFM(20,50),XTR(20,50),XFMNU(20,50),IXPTL(50),I	EDIT1003
2XFTU(50),TEMTA(11),TEMTB(10),TEMT(10),SUMVOL(20),SUMDV(20),SUMFV(EDIT1004	
320),AVEDV(20),AVEFV(20),XMUM(20,50),NA(20),SIGA(50),SIGS(50),SIGEDIT1005	
4F(50),SIGMU(50),SIGNU(50),IXPC,NRI,NRF,NXS,VOLBAR,PHIBAR,ICOME,EDIT1006	
5ID,NXLAST,TT(6740)	EDIT1007
COMMON/2000/DELTAJ,ICX	EDIT1008
COMMON/RIG1/F(20,50),H(20,50),R(20,50),VOL(20),RAD(20),DV(50),V(50)EDIT1009	
1),MTRL(20),Q(20,50),XTM(20,50),XAM(20,50),NRTBL(20),ISTBA(25),ISTBEDIT1010	
2B(25),ISTBE(25),ISTBG(25),CONCTA(25,5),CONCTE(25),XAT(25,50),XST(25,50),S(20,50),IX,NX,IXPCM,ISOX,ISOXE,LEAKT,NPAGE,IDENT,MX,IBY,ITCEDIT1012	
4NT,RENORM,EPSA,ROLD,RNEW,NTIN,NTOUT,NTLIB,NTPUN,NTMP,FVSTR,NRX,XNEDIT1013	
5U(50),XNUFT(25,50),FX(50),XFT(25,50),XMU(50),XMUFT(25,50),XA(50),	EDIT1014
6ICXE,P(50,50,5)	EDIT1015
100 DO 105 N=1,NX	EDIT1016
DO 105 I=1,IX	EDIT1017
105 F(N,I)=F(N,I)*V(I)	EDIT1018
NC=1	EDIT1019
ND=7	EDIT1020
110 IF(NX-ND)120,130,130	EDIT1021
120 ND=NX	EDIT1022
130 NPAGE=NPAGE+1	EDIT1023
WRITE OUTPUT TAPE NTOUT,2000,IDENT,NPAGE	EDIT1024
WRITE OUTPUT TAPE NTOUT,132,ITCNT,RENORM,EPSA	EDIT1025
132 FORMAT(7H0ITCNT=I5,8H RENORM=E12.5,5H EPS=E12.5)	EDIT1026
WRITE OUTPUT TAPE NTOUT,1035,ROLD,RNEW,FVSTR	EDIT1027
1035 FORMAT(13H LARGEST RES=E12.5,13H MEAN RES=E12.5,9H N(V*)=E12,	EDIT1028
15)	EDIT1029
WRITE OUTPUT TAPE NTOUT,133,((N,I,F(N,I),I=1,IX),N=NC,ND)	EDIT1030
133 FORMAT(24H0K,I,F(K,I) POINT FLUXES/(5(2I3,E12.4)))	EDIT1031
IF(NX-ND)150,150,140	EDIT1032
140 NC=NC+7	EDIT1033
ND=ND+7	EDIT1034
GO TO 110	EDIT1035
150 DO 160 N=1,NX	EDIT1036
DO 160 I=1,IX	EDIT1037
160 F(N,I)=F(N,I)*DV(I)*VOL(N)	EDIT1038
REWIND NTEMP	EDIT1039
200 DO 205 J=1,17500	EDIT1040
205 XATE(J,1)=0.0	EDIT1041
210 ISOC=0	EDIT1042
IF(ISOXE)300,300,220	EDIT1043
220 READ INPUT TAPE NTIN,221,(ISTBE(J),ISTBG(J),CONCTE(J),J=1,ISOXE)	EDIT1044
221 FORMAT(2I5,E10.5)	EDIT1045
DO 222 I=1,3	EDIT1046
222 READ TAPE NTLIB	EDIT1047
NPAGE=NPAGE+1	EDIT1048
WRITE OUTPUT TAPE NTOUT,2010,IDENT,NPAGE	EDIT1049
2010 FORMAT(17H1THERMOS CASE NO.15,6H PAGEI3)	EDIT1050
225 READ TAPE NTLIB,IDM,IDMA,IDB,IDA	EDIT1051
DO 240 J=1,ISOXE	EDIT1052
L=J	EDIT1053
IF(ISTBE(J)-IDM)240,230,240	EDIT1054
230 IF(ISTBG(J)-IDMA)240,270,240	EDIT1055
240 CONTINUE	EDIT1056
IF(IDB)250,260,260	EDIT1057
C ===== ISOTOPE NOT ON TAPE 10=====	EDIT1058
250 CALLXSTOP(101)	EDIT1059
STOP	EDIT1060

260	L=IDA+4	EDIT1061
	DO 265 J=1,L	EDIT1062
265	READ TAPE NTLIB	EDIT1063
	GO TO 225	EDIT1064
270	ISOC=ISOC+1	EDIT1065
	READ TAPE NTLIB,XA	EDIT1066
	DO 272 I=1,IX	EDIT1067
272	XATE(L,I)=XA(I)	EDIT1068
	IF(IDA)280,280,275	EDIT1069
275	READ TAPE NTLIB,PP	EDIT1070
	DO 277 J=1,IX	EDIT1071
	DO 276 I=1,IX	EDIT1072
276	XSTE(L,J)=XSTE(L,J)+PP(I,J)*DV(I)	EDIT1073
277	XSTE(L,J)=XSTE(L,J)/(V(J)*DV(J))	EDIT1074
	IF(IDA-1)280,280,278	EDIT1075
278	N=IDA-1	EDIT1076
	DO 279 J=1,N	EDIT1077
279	READ TAPE NTLIB	EDIT1078
280	READ TAPE NTLIB,XNU	EDIT1079
	READ TAPE NTLIB,FX	EDIT1080
	READ TAPE NTLIB,XMU	EDIT1081
	DO 285 J=1,IX	EDIT1082
	XNUFTE(L,J)=XNU(J)	EDIT1083
	XFTE(L,J)=FX(J)	EDIT1084
285	XMUFTE(L,J)=XMU(J)	EDIT1085
	IF(ISOC-ISOXE)225,290,290	EDIT1086
290	REWIND NTLIB	EDIT1087
	IF(ICXE)1190,1190,300	EDIT1088
1190	WRITE OUTPUT TAPE NTOUT,2020	EDIT1089
	ISOXE=ISOXE+ICXE	EDIT1090
2020	FORMAT(24H0 ISOTOPE CONC MIX 1)	EDIT1091
	WRITE OUTPUT TAPE NTOUT,2030	EDIT1092
2030	FORMAT(2HH -----)	EDIT1093
	WRITE OUTPUT TAPE NTOUT,2060	EDIT1094
2060	FORMAT(13H USED IN EDIT)	EDIT1095
	WRITE OUTPUT TAPE NTOUT,2070,(ISTBE(I),ISTBG(I),CONCTE(I),I=1,	EDIT1096
	XISOXE)	EDIT1097
2070	FORMAT(16,1H-15,E12.5)	EDIT1098
300	CONTINUE	EDIT1099
2000	FORMAT(17H1THERMOS CASE NO.15,6H PAGE13)	EDIT1100
	END	EDIT1101

	SUBROUTINE XSTOP(K)	XSTOP000
C	SUBROUTINE	
HT++VP	ERROR STOP NUMBERS	XSTOP001
	NTOUT=61	XSTOP002
	WRITEOUTPUTTAPENTOUT,1,K	XSTOP003
1	FORMAT(19H0PROGRAM ERROR STOP16)	XSTOP004
	END	XSTOP005

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C*****BEGIN OVERLAY 8*****
PROGRAM EDIT2                                EDIT2000
BANK,(0),/1000/                             EDIT2001
COMMON/1000/PP(50,50),XATE(25,50),XSTE(25,50),XNUFTE(25,50),XFTE(25,50),XMFTE(25,50),XFM(20,50),XTR(20,50),XFMNU(20,50),IXPTL(50),IEDIT2002
15,50),XMFTE(25,50),XFM(20,50),XTR(20,50),XFMNU(20,50),IXPTL(50),IEDIT2003
2XPTU(50),TEMTA(11),TEMTB(10),TEMT(10),SUMVOL(20),SUMDV(20),SUMFV(EDIT2004
320),AVEDV(20),AVEFV(20),XMUM(20,50),NA(20),SIGA(50),SIG(50),SIGEDIT2005
4F(50),SIGMU(50),SIGNU(50),IXPC,NRI,NRF,NXS,VOLBAR,PHIBAR,ICOME,EDIT2006
5ID,NXLAST,TT(6740)                             EDIT2007
COMMON/2000/DELTAJ,ICX                         EDIT2008
COMMON/3000/AT(10),AMT(10),AKT(10)             EDIT2009
COMMON/BIG1/F(20,50),H(20,50),R(20,50),VOL(20),RAD(20),DV(50),V(50)EDIT2010
1),MTBL(20),Q(20,50),XTM(20,50),XAM(20,50),NRTBL(20),ISTBA(25),ISTBEDIT2011
28(25),ISTBE(25),ISTBG(25),CONCTA(25,5),CONCTE(25),XAT(25,50),XST(25,50),S(20,50),IX,NX,IXPCM,ISOX,ISOXE,LEAKT,NPAGE,IDENT,MX,IBY,ITCEDIT2013
4NT,RENORM,EPSA,ROLD,RNEW,NTIN,NTOUT,NTLIB,NTUN,NTMP,FVSTR,NRX,XNEDIT2014
5U(50),XNUFT(25,50),FX(50),XFT(25,50),XMU(50),XMUFT(25,50),XA(50),EDIT2015
6ICXE,P(50,50,5)                             EDIT2016
300 DO 1080 L=1,ICXE                           EDIT2017
    LP=L+ISOXE                                EDIT2018
    READ INPUT TAPE NTIN,221,ISTBE(LP),ISTBG(LP),CONCTE(LP)    EDIT2019
221 FORMAT(2I5,E10,5)                         EDIT2020
    READ INPUT TAPE NTIN,301,NXAT,NKERT,IDNU,IDAF,IDMU,TP    EDIT2021
301 FORMAT(5I5,E10,5)                         EDIT2022
    IF(ISTBG(LP))302,303,303                  EDIT2023
302 READ TAPE NTEMP, (XATE(LP,I),I=1,IX)      EDIT2024
    READ TAPE NTEMP, (XNUFTE(LP,I),I=1,IX)    EDIT2025
    READ TAPE NTEMP, (XFTE(LP,I),I=1,IX)      EDIT2026
    READ TAPE NTEMP, (XMFTE(LP,I),I=1,IX)    EDIT2027
    READ TAPE NTEMP, (XA(I),I=1,IX)          EDIT2028
    READ TAPE NTEMP                          EDIT2029
    GO TO 960                                EDIT2030
303 IF(NXAT)305,310,305                       EDIT2031
305 READ INPUT TAPE NTIN,306,VALXA            EDIT2032
306 FORMAT(6E12,5)                           EDIT2033
    DO 307 I=1,IX                           EDIT2034
307 XATE(LP,I)=VALXA/V(I)                    EDIT2035
    GO TO 320                                EDIT2036
310 READ INPUT TAPE NTIN,306,(XATE(LP,I),I=1,IX)    EDIT2037
320 IF(IDAF)900,910,910                      EDIT2038
900 DO 905 I=1,50                            EDIT2039
    XNUFTE(LP,I)=0.0                         EDIT2040
905 XFTE(LP,I)=0.0                           EDIT2041
    GO TO 930                                EDIT2042
910 IF(IDNU)900,915,925                      EDIT2043
915 READ INPUT TAPE NTIN,140,(XNUFTE(LP,I),I=1,IX)    EDIT2044
    IF(IDAF)900,920,927                      EDIT2045
920 READ INPUT TAPE NTIN,140,(XFTE(LP,I),I=1,IX)    EDIT2046
    GO TO 930                                EDIT2047
925 READ INPUT TAPE NTIN,140,XNU(1)          EDIT2048
    DO 926 I=1,IX                           EDIT2049
926 XNUFTE(LP,I)=XNU(1)                     EDIT2050
    IF(IDAF)900,920,927                      EDIT2051
927 READ INPUT TAPE NTIN,140,XF             EDIT2052
    DO 928 I=1,IX                           EDIT2053
928 XFTE(LP,I)=XF/V(I)                      EDIT2054
930 IF(IDMU)940,950,940                      EDIT2055
940 READ INPUT TAPE NTIN,306,XMUX            EDIT2056
    DO 945 I=1,IX                           EDIT2057
945 XMUFT(LP,I)=XMUX                        EDIT2058
    GO TO 960                                EDIT2059
950 READ INPUT TAPE NTIN,306,(XMUFT(LP,I),I=1,IX)    EDIT2060

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140	FORMAT(6E12.5)	EDIT2061
960	NPAGE=NPAGE+1	EDIT2062
	WRITE OUTPUT TAPE NTOUT,2010,IDENT,NPAGE	EDIT2063
2010	FORMAT(17H1THERMOS CASE NO.15,6H PAGE13)	EDIT2064
	WRITE OUTPUT TAPE NTOUT,1140,ISTBE(LP),ISTBG(LP)	EDIT2065
1140	FORMAT(14H0ADDED ISOTOPE17,1H-15,9H IN EDIT)	EDIT2066
	WRITE OUTPUT TAPE NTOUT,1145,(XATE(LP,I),I=1,IX)	EDIT2067
1144	FORMAT(3H0NU/(6E12.5))	EDIT2068
1145	FORMAT(3H0XA/(6E12.5))	EDIT2069
	WRITE OUTPUT TAPE NTOUT,1144,(XNUFTE(LP,I),I=1,IX)	EDIT2070
	WRITE OUTPUT TAPE NTOUT,1146,(XFTE(LP,I),I=1,IX)	EDIT2071
	WRITE OUTPUT TAPE NTOUT,1147,(XMUFTE(LP,I),I=1,IX)	EDIT2072
	IF(ISTBG(LP))1076,1050,1050	EDIT2073
1146	FORMAT(3H0XF/(6E12.5))	EDIT2074
1147	FORMAT(6H0MUBAR/(6E12.5))	EDIT2075
1050	READ INPUT TAPE NTIN,1055,(AT(I),AMT(I),AKT(I),I=1,NKERT)	EDIT2076
1055	FORMAT(3E10.5)	EDIT2077
	WRITE OUTPUT TAPE NTOUT,1056,(AT(I),AMT(I),AKT(I),I=1,NKERT)	EDIT2078
1056	FORMAT(6H0 XS=E12.5,6H M=E12.5,10H KAPPA=E12.5)	EDIT2079
	CALLBASK(PP,V,DV,XA,AT,AKT,AMT,TP,IX,NKERT)	EDIT2080
1076	DO 1077 I=1,IX	EDIT2081
1077	XSTE(LP,I)=XA(I)	EDIT2082
	WRITE OUTPUT TAPE NTOUT,1079,(XSTE(LP,I),I=1,IX)	EDIT2083
1079	FORMAT(3H0XS/(6E12.5))	EDIT2084
1080	CONTINUE	EDIT2085
	REWIND NTEMP	EDIT2086
	NPAGE=NPAGE+1	EDIT2087
	WRITE OUTPUT TAPE NTOUT,2010,IDENT,NPAGE	EDIT2088
2000	WRITE OUTPUT TAPE NTOUT,2020	EDIT2089
	ISOXE=ISOXE+ICXE	EDIT2090
2020	FORMAT(24H0 ISOTOPE CONC MIX 1)	EDIT2091
	WRITE OUTPUT TAPE NTOUT,2030	EDIT2092
2030	FORMAT(2HH -----)	EDIT2093
	WRITE OUTPUT TAPE NTOUT,2060	EDIT2094
2060	FORMAT(13H USED IN EDIT)	EDIT2095
	WRITE OUTPUT TAPE NTOUT,2070,(ISTBE(I),ISTBG(I),CONCTE(I),I=1,XISOXE)	EDIT2096
		EDIT2097
2070	FORMAT(16,1H-15,E12.5)	EDIT2098
	END	EDIT2099

	SUBROUTINE BASK(P,V,DV,XS,AT,AKT,AMT,T,IX,NISO)	BASK 000
	DIMENSION P(50,50),V(50),DV(50),XS(50),X(50),E(50),AT(10),AKT(10),ABASK	BASK 001
	1MT(10)	BASK 002
10	D015I=1,IX	BASK 003
	XS(I)=0.	BASK 004
	D015J=1,IX	BASK 005
15	P(I,J)=0.	BASK 006
100	D0500N=1,NISO	BASK 007
	IF(AT(N))110,500,110	BASK 008
110	AM=AMT(N)	BASK 009
	BETS=AM/T	BASK 010
	BET=SQRTF(BETS)	BASK 011
	D0120I=1,IX	BASK 012
	X(I)=BET*V(I)	BASK 013
120	E(I)=X(I)*X(I)	BASK 014
	TAUS=BETS/(BETS+AKT(N))	BASK 015
	TAU=SQRTF(TAUS)	BASK 016
	ALPHA=AKT(N)*TAUS/BETS	BASK 017
	THETA=(AM+1.)/(2.*AM*TAU)	BASK 018
	ZETA=TAU-THETA	BASK 019
	OMEG=TAUS*(BETS*(AM+1.)*AKT(N))/BETS	BASK 020
	CONST=(AT(N)*TAU*TAUS*(AM+1.)*(AM+1.))/(4.*AM*OMEG)	BASK 021
200	D0400I=1,IX	BASK 022
	D0300J=1,IX	BASK 023
	IF EXPONENT FAULT 250,250	BASK 024
250	EA=ERF((THETA*X(I))+(ZETA*X(J)))*ERF((THETA*X(I))-(ZETA*X(J)))	BASK 025
	EB=ERF((THETA*X(J))-(ZETA*X(I)))*ERF((ZETA*X(I))+(THETA*X(J)))	BASK 026
	WA=ALPHA*E(J)	BASK 027
	IF(WA-50.)252,251,251	BASK 028
251	WA=0.	BASK 029
	GOTO253	BASK 030
252	WA=EXP(-WA)	BASK 031
253	WB=(E(J)-OMEG*E(I))/AM	BASK 032
	TEM=CONST*(X(I)/X(J))*(EA*WA+EB*EXP(WB))	BASK 033
	IF EXPONENT FAULT 300,260	BASK 034
260	IF(TEM-1.E-15)350,350,270	BASK 035
270	P(I,J)=P(I,J)+TEM	BASK 036
300	CONTINUE	BASK 037
350	EA=TAU*X(I)	BASK 038
	WA=ALPHA*E(I)	BASK 039
	IF(WA-50.)352,351,351	BASK 040
351	WA=0.	BASK 041
	GOTO353	BASK 042
352	WA=EXP(-WA)	BASK 043
353	EB=WA*ERF(EA)*(EA+(0.5/EA))	BASK 044
	IF(E(I)-50.)355,354,354	BASK 045
354	WB=0.	BASK 046
	GOTO703	BASK 047
355	WB=EXP(-E(I))	BASK 048
703	XS(I)=XS(I)+(AT(N)*TAUS*TAUS/BET)*(EB+0.5641896*WB)	BASK 049
400	CONTINUE	BASK 050
500	CONTINUE	BASK 051
600	D0610I=1,IX	BASK 052
610	E(I)=(V(I)*V(I))*EXP(-(V(I)*V(I))/T)	BASK 053
	D0620I=1,IX	BASK 054
	D0620J=1,IX	BASK 055
620	P(J,I)=P(I,J)*E(J)/E(I)	BASK 056
	D0650J=1,IX	BASK 057
	TEM=0.	BASK 058
	D0640I=1,IX	BASK 059
640	TEM=TEM+P(I,J)*DV(I)	BASK 060
650	P(J,J)=((XS(J)-TEM)/DV(J))+P(J,J)	BASK 061
	D0680I=1,IX	BASK 062
	XS(I)=XS(I)/V(I)	BASK 063
	D0680J=1,IX	BASK 064
680	P(I,J)=P(I,J)*DV(J)	BASK 065
	RETURN	BASK 066
	END	BASK 067

FUNCTION ERF(X)		ERF	000
CERF		ERF	001
10	IF(ABS(X)-3.7)30,20,20	ERF	002
20	ERF=1.	ERF	003
	GOTO55	ERF	004
30	XX=ABS(X)	ERF	005
	IF(XX-1.E-5)40,40,50	ERF	006
40	ERF=1.12838*XX	ERF	007
	GOTO55	ERF	008
50	ERF=1.-1./(1.+XX*(.14112821+XX*(.08864027+XX*(.02743349+XX*	ERF	009
	1*(-.00039446+XX*.00328975)))))*.8	ERF	010
55	IF(X)60,70,70	ERF	011
60	ERF=-ERF	ERF	012
70	RETURN	ERF	013
	END	ERF	014

C*****BEGIN OVERLAY 9*****

PROGRAM EDPREP	EDPRP000
BANK,(0),/1000/	EDPRP001
COMMON/1000/PP(50,50),XATE(25,50),XSTE(25,50),XNUFTE(25,50),XFTE(25,50),	EDPRP002
15,50),XMUFTE(25,50),XFM(20,50),XTR(20,50),XFMNU(20,50),IXPTL(50),	EDPRP003
2XPTU(50),TEMTA(11),TEMTB(10),TEMT(10),SUMVOL(20),SUMDV(20),SUMFV(	EDPRP004
320),AVEDV(20),AVEFV(20),XMUM(20,50),NA(20),SIGA(50),SIGS(50),SIGEDPRP005	
4F(50),SIGMU(50),SIGNU(50),IXPC,NRI,NRF,NXS,VOLBAR,PHIBAR,ICOME,EDPRP006	
5ID,NXLAST,TT(6740)	EDPRP007
COMMON/2000/DELTAJ,ICX	EDPRP008
COMMON/BIG1/F(20,50),H(20,50),R(20,50),VOL(20),RAD(20),DV(50),V(50)	EDPRP009
1),MTBL(20),Q(20,50),XTM(20,50),XAM(20,50),NRTBL(20),ISTBA(25),ISTBEDPRP010	
28(25),ISTBE(25),ISTBG(25),CONCTA(25,5),CONCTE(25),XAT(25,50),XST(25,50),	EDPRP011
35,50),S(20,50),IX,NX,IXPCM,ISOX,ISOXE,LEAKT,NPAGE,IDENT,MX,IBY,ITCEDPRP012	
4NT,RENORM,EPSA,ROLD,RNEW,NTIN,NTOUT,NTLIB,NTPUN,NTMP,FVSTR,NRX,XNEDPRP013	
5U(50),XNUFT(25,50),FX(50),XFT(25,50),XMU(50),XMUFT(25,50),XA(50),	EDPRP014
6ICXE,P(50,50,5)	EDPRP015
DO 340 J=1,ISOX	EDPRP016
DO 340 M=1,MX	EDPRP017
IF(CONCTA(J,M))333,340,333	EDPRP018
333 DO 340 N=1,NX	EDPRP019
MP=MTBL(N)	EDPRP020
IF(MP-M)340,330,340	EDPRP021
330 DO 340 I=1,IX	EDPRP022
XFM(N,I)=XFM(N,I)+CONCTA(J,M)*XFT(J,I)	EDPRP023
XFMNU(N,I)=XFMNU(N,I)+CONCTA(J,M)*XFT(J,I)*XNUFT(J,I)	EDPRP024
XTR(N,I)=XTR(N,I)+CONCTA(J,M)*(XAT(J,I)+(1.0-XMUFT(J,I))*XST(J,I))	EDPRP025
340 CONTINUE	EDPRP026
DO 332 N=1,NX	EDPRP027
DO 332 I=1,IX	EDPRP028
IF(XTR(N,I))332,331,332	EDPRP029
331 XTR(N,I)=1.0E-100	EDPRP030
332 CONTINUE	EDPRP031
END	EDPRP032

```

C*****BEGIN OVERLAY 10*****
PROGRAM EDIT3 EDIT3000
BANK,(0),/1000/ EDIT3001
COMMON/1000/PP(50,50),XATE(25,50),XSTE(25,50),XNUFTE(25,50),XFTE(25,50),XFM(20,50),XTR(20,50),XFMNU(20,50),IXPTL(50),I(50) EDIT3002
15,50),XMFTE(25,50),XFM(20,50),XTR(20,50),XFMNU(20,50),IXPTL(50),I(50) EDIT3003
2XPTU(50),TEMPTA(11),TEMPTB(10),TEMPTC(10),SUMVOL(20),SUMDV(20),SUMFV(EDIT3004
320),AVEDV(20),AVEFV(20),XMUM(20,50),NA(20),SIGA(50),SIGS(50),SIGEDIT3005
4F(50),SIGMU(50),SIGNU(50),IXPC,NRI,NRF,NXS,VOLBAR,PHIBAR,ICOME,EDIT3006
5ID,NXLAST,TT(6740) EDIT3007
COMMON/2000/DELTAJ,ICX EDIT3008
COMMON/BIG1/F(20,50),H(20,50),R(20,50),VOL(20),RAD(20),DV(50),V(50) EDIT3009
1),MTBL(20),Q(20,50),XTM(20,50),XAM(20,50),NRTBL(20),ISTBA(25),ISTBEDIT3010
28(25),ISTBE(25),ISTBG(25),CONCTA(25,5),CONCTE(25),XAT(25,50),XST(25,50),XST(25,50),S(20,50),IX,NX,IXPCM,ISOX,ISOXE,LEAKT,NPAGE,IDENT,MX,IBY,ITCEDIT3012
4NT,RENORM,EPSA,ROLD,RNEW,NTIN,NTOUT,NTLIB,NTPUN,NTMP,FVSTR,NRX,XNEDIT3013
5U(50),XNUFT(25,50),FX(50),XFT(25,50),XMU(50),XMUFT(25,50),XA(50), EDIT3014
6ICXE,P(50,50,5) EDIT3015
1056 READINPUTTAPENTIN,1057,IXPCM,((IXPTL(J),IXPTU(J)),J=1,IXPCM) EDIT3016
READ INPUT TAPE NTIN,1057,NRI,NRF,NXS,NXLAST EDIT3017
ICOME=0 EDIT3018
1057 FORMAT(14I5) EDIT3019
READINPUTTAPENTIN,1058,(NRTBL(N),N=1,NX) EDIT3020
1058 FORMAT(50I1) EDIT3021
IF(IXPCM)1000,1000,1059 EDIT3022
1000 IXPCM=IX EDIT3023
IXPTL(1)=0 EDIT3024
1059 DO 1480 IXPC=1,IXPCM EDIT3025
IF(IXPTL(1))1010,1010,1015 EDIT3026
1010 IXP1=IXPC EDIT3027
IXP2=IXPC EDIT3028
GO TO 1020 EDIT3029
1015 IXP1=IXPTL(IXPC) EDIT3030
IXP2=IXPTU(IXPC) EDIT3031
1020 A1=V(IXP1)-0.5*DV(IXP1) EDIT3032
A2=V(IXP2)+0.5*DV(IXP2) EDIT3033
B1=0.0253*A1*A1 EDIT3034
B2=0.0253*A2*A2 EDIT3035
NPAGE=NPAGE+1 EDIT3036
WRITEOUTPUTTAPENTOUT,2000,IDENT,NPAGE EDIT3037
WRITE OUTPUT TAPE NTOUT, 2100, IXP1,IXP2,A1,A2,B1,B2 EDIT3038
WRITEOUTPUTTAPENTOUT,2110 EDIT3039
WRITEOUTPUTTAPENTOUT,2120 EDIT3040
N=1 EDIT3041
1060 NR=NRTBL(N) EDIT3042
DO 1061 J=1,5 EDIT3043
1061 TEMTA(J)=0.0 EDIT3044
1062 DO 1063 J=1,5 EDIT3045
1063 TEMTB(J)=0.0 EDIT3046
DO 1065 I=IXP1,IXP2 EDIT3047
TEMTB(3)=TEMTB(3)+F(N,I)/V(I) EDIT3048
1065 TEMTB(5)=TEMTB(5)+F(N,I) EDIT3049
TEMTB(1)=VOL(N) EDIT3050
TEMTB(2)=TEMTB(3)/VOL(N) EDIT3051
TEMTB(4)=TEMTB(5)/VOL(N) EDIT3052
DO 1066 J=1,5 EDIT3053
1066 TEMTA(J)=TEMPTA(J)+TEMTB(J) EDIT3054
M=MTBL(N) EDIT3055
WRITE OUTPUT TAPE NTOUT,2130,N,NR,M,(TEMTB(J),J=1,5) EDIT3056
N=N+1 EDIT3057
IF(N-NX)1067,1067,1068 EDIT3058
1067 IF(NRTBL(N)-NR)1068,1062,1068 EDIT3059
1068 WRITE OUTPUT TAPE NTOUT,2140,NR, (TEMTA(J),J=1,5) EDIT3060

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	SUMVOL(NR)=TEMTA(1)	EDIT3061
	SUMDV(NR)=TEMTA(3)	EDIT3062
	SUMFV(NR)=TEMTA(5)	EDIT3063
	TEMTA(3)=TEMTA(3)/TEMTA(1)	EDIT3064
	TEMTA(5)=TEMTA(5)/TEMTA(1)	EDIT3065
	WRITE OUTPUT TAPE NTOUT,2330,NR, TEMTA(3),TEMTA(5)	EDIT3066
	AVEDV(NR)=TEMTA(3)	EDIT3067
	AVEFV(NR)=TEMTA(5)	EDIT3068
	IF(N-NX)1060,1060,3000	EDIT3069
3000	IF(NR1)1070,1070,3010	EDIT3070
3010	DO 3015 I=1,3	EDIT3071
3015	TEMTA(I)=0.0	EDIT3072
	DO 3020 I=NR1,NRF	EDIT3073
	TEMTA(1)=TEMTA(1)+SUMVOL(I)	EDIT3074
	TEMTA(2)=TEMTA(2)+SUMDV(I)	EDIT3075
3020	TEMTA(3)=TEMTA(3)+SUMFV(I)	EDIT3076
	PHIBAR=TEMTA(3)/TEMTA(1)	EDIT3077
	FNBAR=TEMTA(2)/TEMTA(1)	EDIT3078
	WRITE OUTPUT TAPE NTOUT,2390,NR1,NRF,PHIBAR,FNBAR	EDIT3079
	WRITE OUTPUT TAPE NTOUT, 2395	EDIT3080
	DO 3025 I=NR1,NRF	EDIT3081
	TEMTB(2)=AVEFV(I)/PHIBAR	EDIT3082
	TEMTB(1)=AVEDV(I)/FNBAR	EDIT3083
	WRITE OUTPUT TAPE NTOUT,2400,I,TEMTB(1),TEMTB(2)	EDIT3084
3025	CONTINUE	EDIT3085
1070	NPAGE=NPAGE+1	EDIT3086
	WRITE OUTPUT TAPE NTOUT,2000,IDENT,NPAGE	EDIT3087
	WRITE OUTPUT TAPE NTOUT,2100,IXP1,IXP2,A1,A2,B1,B2	EDIT3088
	WRITE OUTPUT TAPE NTOUT,2350	EDIT3089
	WRITE OUTPUT TAPE NTOUT,2360	EDIT3090
	N=1	EDIT3091
1080	NR=NRTBL(N)	EDIT3092
	DO 1090 J=1,9	EDIT3093
1090	TEMTA(J)=0.0	EDIT3094
1091	DO 1092 J=1,9	EDIT3095
1092	TEMTB(J)=0.0	EDIT3096
	DO 1100 I=IXP1,IXP2	EDIT3097
	TEMTB(1)=TEMTB(1)+F(N,I)	EDIT3098
	TEMTB(2)=TEMTB(2)+F(N,I)*V(I)	EDIT3099
	TEMTB(3)=TEMTB(3)+F(N,I)*V(I)*V(I)	EDIT3100
	TEMTB(4)=TEMTB(4)+F(N,I)*XAM(N,I)	EDIT3101
	TEMTB(5)=TEMTB(5)+F(N,I)*XFM(N,I)	EDIT3102
	TEMTB(6)=TEMTB(6)+F(N,I)*(XTM(N,I)-XAM(N,I))	EDIT3103
	TEMTB(7)=TEMTB(7)+F(N,I)*XFMNU(N,I)	EDIT3104
	TEMTB(8)=TEMTB(8)+(1.0/(3.0*XTR(N,I)))*F(N,I)	EDIT3105
1100	TEMTB(9)=TEMTB(9)+F(N,I)/V(I)	EDIT3106
	DO 1110 J=1,8	EDIT3107
1110	TEMTA(J)=TEMTA(J)+TEMTB(J)	EDIT3108
	DO 1101 J=1,3	EDIT3109
1101	TEMTB(J)=TEMTB(J)/TEMTB(9)	EDIT3110
	M=MTRL(N)	EDIT3111
	WRITE OUTPUT TAPE NTOUT,2370,N,NR,M,(TEMTB(J),J=1,8)	EDIT3112
	N=N+1	EDIT3113
	IF(N-NX)1130,1130,1140	EDIT3114
1130	IF(NRTBL(N)-NR)1140,1091,1140	EDIT3115
1140	WRITE OUTPUT TAPE NTOUT,2380,NR, (TEMTA(J),J=4,8)	EDIT3116
	DO 1150 J=1,3	EDIT3117
1150	TEMTC(J)=TEMTA(J)/SUMDV(NR)	EDIT3118
	DO 1160 J=4,8	EDIT3119
1160	TEMTC(J)=TEMTA(J)/SUMVOL(NR)	EDIT3120
	WRITE OUTPUT TAPE NTOUT,2150,NR, (TEMTC(J),J=1,3)	EDIT3121
	WRITE OUTPUT TAPE NTOUT,2151,NR, (TEMTC(J),J=4,8)	EDIT3122

DO 1151 J=4,8	EDIT3123
1151 TEMTA(J)=TEMTA(J)/SUMFV(NR)	EDIT3124
WRITE OUTPUT TAPE NTOUT,2340,NR, (TEMTA(J),J=4,8)	EDIT3125
IF(N-NX)1080,1080,1170	EDIT3126
1170 IF(IXPTL(1))1171,1172,1171	EDIT3127
1172 IF(NXS)1173,1480,1173	EDIT3128
1173 CALL XSECTION	EDIT3129
ICOME=ICOME+1	EDIT3130
GO TO 1480	EDIT3131
1171 DO 1310 II=1,ISOX	EDIT3132
1190 NPAGE=NPAGE+1	EDIT3133
WRITE OUTPUT TAPE NTOUT,2000,IDENT,NPAGE	EDIT3134
WRITE OUTPUT TAPE NTOUT,2100,IXP1,IXP2,A1,A2,B1,B2	EDIT3135
WRITE OUTPUT TAPE NTOUT,2240	EDIT3136
WRITE OUTPUT TAPE NTOUT,2160,ISTBA(II),ISTBB(II)	EDIT3137
WRITE OUTPUT TAPE NTOUT,2170	EDIT3138
WRITE OUTPUT TAPE NTOUT,2180	EDIT3139
WRITE OUTPUT TAPE NTOUT,2190	EDIT3140
N=1	EDIT3141
1200 M=MTBL(N)	EDIT3142
NR=NRTBL(N)	EDIT3143
WRITE OUTPUT TAPE NTOUT,2200,NR,M,CONCTA(II,M)	EDIT3144
DO 1210 J=1,6	EDIT3145
1210 TEMTA(J)=0.0	EDIT3146
GO TO 1230	EDIT3147
1220 IF(MTBL(N)-MTBL(N-1))1225,1230,1225	EDIT3148
1225 M=MTBL(N)	EDIT3149
WRITE OUTPUT TAPE NTOUT,2200,NR,M,CONCTA(II,M)	EDIT3150
1230 DO 1235 J=1,6	EDIT3151
1235 TEMTB(J)=0.0	EDIT3152
DO 1250 I=IXP1,IXP2	EDIT3153
TEMTB(1)=TEMTB(1)+F(N,I)*XAT(II,I)*CONCTA(II,M)	EDIT3154
TEMTB(2)=TEMTB(2)+F(N,I)*XFT(II,I)*CONCTA(II,M)	EDIT3155
TEMTB(4)=TEMTB(4)+F(N,I)*XST(II,I)*CONCTA(II,M)	EDIT3156
TEMTB(5)=TEMTB(5)+F(N,I)*(XAT(II,I)+(1.0-XMUFT(II,I))*XST(II,I))	EDIT3157
1*CONCTA(II,M)	EDIT3158
TEMTB(3)=TEMTB(2)*XNUFT(II,I)	EDIT3159
1250 TEMTB(6)=TEMTB(6)+F(N,I)	EDIT3160
DO 1260 J=1,6	EDIT3161
1260 TEMTA(J)=TEMTA(J)+TEMTB(J)	EDIT3162
DO 1270 J=1,5	EDIT3163
1270 TEMTB(J)=TEMTB(J)/TEMTB(6)	EDIT3164
WRITE OUTPUT TAPE NTOUT,2210,N,NR,M,(TEMTB(J),J=1,5)	EDIT3165
N=N+1	EDIT3166
IF(N-NX)1280,1280,1290	EDIT3167
1280 IF(NRTBL(N)-NR)1290,1220,1290	EDIT3168
1290 WRITE OUTPUT TAPE NTOUT,2230,NR, (TEMTA(J),J=1,5)	EDIT3169
DO 1300 J=1,5	EDIT3170
1300 TEMTA(J)=TEMTA(J)/TEMTA(6)	EDIT3171
WRITE OUTPUT TAPE NTOUT,2220,NR, (TEMTA(J),J=1,5)	EDIT3172
IF(N-NX)1200,1200,1310	EDIT3173
1310 CONTINUE	EDIT3174
DO 1460 II=1,ISOXE	EDIT3175
1350 NPAGE=NPAGE+1	EDIT3176
WRITE OUTPUT TAPE NTOUT,2000,IDENT,NPAGE	EDIT3177
WRITE OUTPUT TAPE NTOUT,2100,IXP1,IXP2,A1,A2,B1,B2	EDIT3178
WRITE OUTPUT TAPE NTOUT,2250	EDIT3179
WRITE OUTPUT TAPE NTOUT,2460,ISTBE(II),ISTBQ(II)	EDIT3180
WRITE OUTPUT TAPE NTOUT,2470	EDIT3181
WRITE OUTPUT TAPE NTOUT,2260	EDIT3182
WRITE OUTPUT TAPE NTOUT,2490	EDIT3183
N=1	EDIT3184

1360	NR=NRTBL(N)	EDIT3185
	M=MTBL(N)	EDIT3186
	WRITE OUTPUT TAPE NTOUT,2430, NR,M,CONCTE(II)	EDIT3187
	DO 1370 J=1,7	EDIT3188
1370	TEMTA(J)=0.0	EDIT3189
1380	DO 1390 J=1,8	EDIT3190
1390	TEMTB(J)=0.0	EDIT3191
	M=MTBL(N)	EDIT3192
	DO 1400 I=IXP1,IXP2	EDIT3193
	TEMTB(1)=TEMTB(1)+F(N,I)*XATE(II,I)*CONCTE(II)	EDIT3194
	TEMTB(3)=TEMTB(3)+F(N,I)*XFTE(II,I)*CONCTE(II)	EDIT3195
	TEMTB(5)=TEMTB(5)+F(N,I)*XSTE(II,I)*CONCTE(II)	EDIT3196
	TEMTB(6)=TEMTB(6)+F(N,I)*(XATE(II,I)+(1.0-XMUFT(II,I))*XSTE(II,I)	EDIT3197
	1)*CONCTE(II)	EDIT3198
	TEMTB(4)=TEMTB(3)*XNUFTE(II,I)	EDIT3199
1400	TEMTB(7)=TEMTB(7)+F(N,I)	EDIT3200
	TEMTB(2)=TEMTB(1)	EDIT3201
	TEMTB(8)=VOL(N)	EDIT3202
	DO 1410 J=1,8	EDIT3203
1410	TEMTA(J)=TEMTA(J)+TEMTB(J)	EDIT3204
	TEMTB(1)=TEMTB(1)/TEMTB(7)	EDIT3205
	TEMTB(2)=TEMTB(2)/TEMTB(8)	EDIT3206
	DO 1415 J=3,6	EDIT3207
1415	TEMTB(J)=TEMTB(J)/TEMTB(7)	EDIT3208
	IF(N=1)1430,1420,1430	EDIT3209
1420	TEMTC=TEMTB(2)	EDIT3210
1430	TEMTB(2)=TEMTB(2)/TEMTC	EDIT3211
	WRITE OUTPUT TAPE NTOUT,2410,N,NR,M,(TEMTB(J),J=1,6)	EDIT3212
	N=N+1	EDIT3213
	IF(N=NX)1440,1440,1445	EDIT3214
1440	IF(NRTBL(N)-NR)1445,1380,1445	EDIT3215
1445	TEMTA(1)=TEMTA(1)/TEMTA(7)	EDIT3216
	TEMTA(2)=TEMTA(2)/(TEMTA(8)*TEMTC)	EDIT3217
	DO 1450 J=3,6	EDIT3218
1450	TEMTA(J)=TEMTA(J)/TEMTA(7)	EDIT3219
	WRITE OUTPUT TAPE NTOUT,2420,NR,(TEMTA(J),J=1,6)	EDIT3220
	IF(N=NX)1360,1360,1460	EDIT3221
1460	CONTINUE	EDIT3222
1480	CONTINUE	EDIT3223
	IF(NXS-NXLAST)1056,1490,1490	EDIT3224
1490	REWIND NTEMP	EDIT3225
	RETURN	EDIT3226
2000	FORMAT(17H1THERMOS CASE NO.15,6H PAGE13)	EDIT3227
2010	FORMAT(1H /1H)	EDIT3228
2100	FORMAT(16H AVERAGES FOR I=12,6H TO I=12,4H V= E12,5,6H TO V=	EDIT3229
	1E12,5,4H E= E12,5,6H TO E= E12,5)	EDIT3230
2110	FORMAT(72H0POINT REG MIX VOLUME NDEN NDEN*VOL NFLE	EDIT3231
	XX NFX*VOL)	EDIT3232
2120	FORMAT(73H -----)	EDIT3233
	1-----)	EDIT3234
2130	FORMAT(14,15,14,5E12,4)	EDIT3235
2140	FORMAT(5H0 SUM14,4X,5E12,4)	EDIT3236
2150	FORMAT(6H0N AVE13,4X,0P3F12,5)	EDIT3237
2151	FORMAT(6H0V AVE13,4X,E48,4,4E12,4)	EDIT3238
2160	FORMAT(38H0ISO TOPE 15,2H--15)	EDIT3239
2170	FORMAT(73H =====)	EDIT3240
	X=====)	EDIT3241
2180	FORMAT(72H POINT REG MIX SIGMA A SIGMA F SIGMA F*NU SIGMED	EDIT3242
	XA S SIGMA TR)	EDIT3243
2190	FORMAT(73H -----)	EDIT3244
	X-----)	EDIT3245
2200	FORMAT(5H0CONCI4,14,24X,E12,4/)	EDIT3246

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2210 FORMAT(I4,I5,I4,5E12.4) EDIT3247
2220 FORMAT(5H0 AVEI4,4X,5E12.4) EDIT3248
2230 FORMAT(7H0EVENTSI2,4X,5E12.4) EDIT3249
2240 FORMAT(23H0MATERIALS USED IN CELL) EDIT3250
2250 FORMAT(23H0MATERIALS USED IN EDIT) EDIT3251
2260 FORMAT(84H POINT REG MIX SIGMA A REL ABS SIGMA F SIGMA EDIT3252
X F*NU SIGMA S SIGMA TR) EDIT3253
2330 FORMAT(6H0V AVEI3,4X,12H 2E24,4/) EDIT3254
2340 FORMAT(6H0F AVEI3,4X,36H 5E12,4) EDIT3255
X/) EDIT3256
2350 FORMAT(105H0POINT REG MIX AVE V AVE V**2 AVE V**3 ABSOEDIT3257
XRPTION FISSION SCATTERING NU*FISSION D) EDIT3258
2360 FORMAT(109H -----) EDIT3259
X-----) EDIT3260
2370 FORMAT(I4,I5,I4,0P3F12.5,5E12.4) EDIT3261
2380 FORMAT(5H0 SUMI4,4X,E48,4,4E12.4) EDIT3262
2390 FORMAT(31H0V AVE AVERAGE OVER REGIONS NR=I3,7H TO NR=I3/8H0PHIBAR=EDIT3263
XE12.4,8H NBAR=E12.4) EDIT3264
2395 FORMAT(60H0REGION REGION AVE. DENSITY/NBAR REGION AVE. FLUX/PHEDIT3265
XIBAR/) EDIT3266
2400 FORMAT(I5,E22.4,E27.4) EDIT3267
2410 FORMAT(I4,I5,I4,6E12.4) EDIT3268
2420 FORMAT(5H0 AVEI4,4X,6E12.4) EDIT3269
2430 FORMAT(5H0CONCI4,I4,30X,E12.4/) EDIT3270
2460 FORMAT(44H0ISOTOPE 15,2H**15) EDIT3271
2470 FORMAT(85H =====) EDIT3272
X=====) EDIT3273
2490 FORMAT(85H -----) EDIT3274
X-----) EDIT3275
END EDIT3276

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SUBROUTINE XSECTION	XSECT000
BANK,(0),/1000/	XSECT001
DIMENSION PSVFR(20)	XSECT002
COMMON/1000/PP(50,50),XATE(25,50),XSTE(25,50),XNUFTE(25,50),XFIE(25,50)	XSECT003
15,50),XMUFT(25,50),XFM(20,50),XTR(20,50),XFMNU(20,50),IXPTL(50),IXSECT004	
2XPTU(50),TEMTA(11),TEMTB(10),TEMTC(10),SUMVOL(20),SUMDV(20),SUMFV(XSECT005	
320),AVEDV(20),AVEFV(20),XMUM(20,50),NA(20),SIGA(50),SIGS(50),SIGXSECT006	
4F(50),SIGMU(50),SIGNU(50),IXPC,NRI,NRF,NXS,VOLBAR,PHIBAR,ICOME,XSECT007	
510,NXLAST,TT(6740)	XSECT008
COMMON/BIG1/F(20,50),H(20,50),R(20,50),VOL(20),RAD(20),DV(50),V(50)	XSECT009
1),MTBL(20),Q(20,50),XTM(20,50),XAM(20,50),NRTBL(20),ISTBA(25),ISTBXSECT010	
28(25),ISTBE(25),ISTBG(25),CONCTA(25,5),CONCTE(25),XAT(25,50),XST(25,50)	XSECT011
35,50),S(20,50),IX,NX,IXPCM,ISOX,ISOXE,LEAKT,NPAGE,IDENT,MX,IBY,ITCXSECT012	
4NT,RENORM,EPISA,ROLD,RNEW,NTIN,NTOUT,NTLIB,NTPUN,NTEMP,FVSTR,NRX,XNXSECT013	
5U(50),XNUFT(25,50),FX(50),XFT(25,50),XMU(50),XMUFT(25,50),XA(50),	XSECT014
6ICXE,P(50,50,5)	XSECT015
100 IF(ICOME)170,101,170	XSECT016
101 N=1	XSECT017
KFORM=0	XSECT018
DO 102 I=1,IX	XSECT019
SIGA(I)=0.	XSECT020
SIGNU(I)=0.	XSECT021
SIGF(I)=0.	XSECT022
SIGMU(I)=0.	XSECT023
SIGS(I)=0.	XSECT024
DO 102 J=1,IX	XSECT025
102 PP(I,J)=0.	XSECT026
DO 130 J=NRI,NRF	XSECT027
105 IF(NRTBL(N)-J)115,120,110	XSECT028
110 CALL Q8QERROR(0,1H.)	XSECT029
115 N=N+1	XSECT030
GO TO 105	XSECT031
120 NA(J)=N	XSECT032
IF(J=NRF)125,130,130	XSECT033
125 N=N+1	XSECT034
IF(NRTBL(N)-J)125,125,130	XSECT035
130 CONTINUE	XSECT036
IF(NXS)140,135,145	XSECT037
135 STOP	XSECT038
140 READ INPUT TAPE NTIN,141,(SUMVOL(J),J=NRI,NRF)	XSECT039
NXS=-NXS	XSECT040
KFORM=1	XSECT041
141 FORMAT(7E10.5)	XSECT042
145 VOLBAR=0.0	XSECT043
DO 150 K=NRI,NRF	XSECT044
150 VOLBAR=VOLBAR+SUMVOL(K)	XSECT045
DO 151 K=NRI,NRF	XSECT046
151 PSVFR(K)=SUMVOL(K)/VOLBAR	XSECT047
170 ND=IXPC	XSECT048
D=0.0	XSECT049
DO 175 N=NRI,NRF	XSECT050
J=NA(N)	XSECT051
TEMP=(AVEFV(N)/PHIBAR)*PSVFR(N)	XSECT052
SIGA(ND)=SIGA(ND)+XAM(J,ND)*TEMP	XSECT053
SIGS(ND)=SIGS(ND)+(XTM(J,ND)-XAM(J,ND))*TEMP	XSECT054
SIGF(ND)=SIGF(ND)+XFM(J,ND)*TEMP	XSECT055
D=D+TEMP/(3.0*XTR(J,ND))	XSECT056
SIGNU(ND)=SIGNU(ND)+(XFMNU(J,ND)*TEMP)/(XFM(J,ND)*TEMP)	XSECT057
175 CONTINUE	XSECT058
SIGMU(ND)=1.0-(1.0/(3.0*D)-SIGA(ND))/SIGS(ND)	XSECT059
DO 185 I=1,IX	XSECT060
DO 185 N=NRI,NRF	XSECT061

TEMP=(AVEFV(N)/PHIBAR)*PSVFR(N)	XSECT062
J=NA(N)	XSECT063
M=MTBL(J)	XSECT064
185 PP(I,ND)=PP(I,ND)+P(I,ND,M)*V(I)*TEMP	XSECT065
IF(IXPC-IX)195,180,180	XSECT066
190 FORMAT(6E12.5)	XSECT067
180 WRITE TAPE NTEMP,(SIGA(M),M=1,IX)	XSECT068
WRITE TAPE NTEMP,(SIGNU(M),M=1,IX)	XSECT069
WRITE TAPE NTEMP,(SIGF(M),M=1,IX)	XSECT070
WRITE TAPE NTEMP,(SIGMU(M),M=1,IX)	XSECT071
WRITE TAPE NTEMP,(SIGS(M),M=1,IX)	XSECT072
WRITE TAPE NTEMP,((PP(I,J),I=1,IX),J=1,IX)	XSECT073
NPAGE=NPAGE+1	XSECT074
WRITE OUTPUT TAPE NTOUT,191,IDENT,NPAGE	XSECT075
191 FORMAT(17H1THERMOS CASE NO.15,6H PAGE13)	XSECT076
WRITE OUTPUT TAPE NTOUT,200,NRI,NRF	XSECT077
200 FORMAT(78H PSEUDO MATERIAL CROSS SECTIONS OBTAINED FROM AVERAGING REGIONS 12,4H TO 12)	FXSECT078
WRITE OUTPUT TAPE NTOUT,192	XSECT079
192 FORMAT(100H GROUP ABSORPTION MU BAR NU FISSXSECT081	
1ION MU BAR SCATTERING)	XSECT082
I=0	XSECT083
DO 193 N=1,IX	XSECT084
I=I+1	XSECT085
193 WRITE OUTPUT TAPE NTOUT,194,I,SIGA(N),SIGNU(N),SIGF(N),SIGMU(N),SIGXSECT086	
1GS(N)	XSECT087
194 FORMAT(14,E16.5,4E20.5)	XSECT088
IF(KFORM)160,161,160	XSECT089
161 WRITE OUTPUT TAPE NTOUT,162	XSECT090
GO TO 195	XSECT091
160 WRITE OUTPUT TAPE NTOUT, 163	XSECT092
WRITE OUTPUT TAPE NTOUT, 164,(I,PSVFR(I),I=NRI,NRF)	XSECT093
162 FORMAT(1H /1H /77H THE ABOVE PSEUDO MATERIAL WAS OBTAINED USING TXSECT094	
THE PROBLEM REGIONAL VOLUMES)	XSECT095
163 FORMAT(1H /1H /88H THE ABOVE PSEUDO MATERIAL WAS OBTAINED USING TXSECT096	
THE FOLLOWING REGIONAL VOLUME FRACTIONS /1H /59H	XSECT097
2 REGION VOLUME FRACTION /1H)	XSECT098
164 FORMAT(135,E21.7)	XSECT099
195 RETURN	XSECT100
END	XSECT101

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APPENDIX B
CODE LISTING FOR LIBP

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PROGRAM LIBP
DIMENSION ZAY(10),ZAKT(10),ZAMT(10),NIDM(100),NIDMA(100),XS(50), LIBP 000
1PP(50,50) LIBP 001
COMMON IDM, IDMA, IDB, IDA, XA(50), PA(50,50), PB(50,50), PC(50,50), PD(50,50) LIBP 002
1,50), IDNU, IDMF, IDMU, XNU(50), FX(50), XMU(50), V(50), DV(50) LIBP 003
COMMON NTIN, NTOUT, NTLIB, NTPUN, NTEMP LIBP 004
DO 111 I=1,10308 LIBP 005
111 XA(I)=0.0 LIBP 006
NTIN=60 LIBP 007
NTOUT=61 LIBP 008
NTLIB=10 LIBP 009
NTPUN=1 LIBP 010
NTEMP=51 LIBP 011
REWIND NTPUN LIBP 012
REWINDNTEMP LIBP 013
100 FORMAT(10I5) LIBP 014
110 FORMAT(7E10.5) LIBP 015
115 FORMAT(21H1THERMOS LIBRARY TAPE) LIBP 016
120 FORMAT(72H) LIBP 017
1) LIBP 018
130 READINPUTTAPENTIN,120 LIBP 019
WRITEOUTPUTTAPENTOUT,115 LIBP 020
WRITEOUTPUTTAPENTOUT,120 LIBP 021
READINPUTTAPENTIN,100,ITAG,IX,NISA,NISD LIBP 022
WRITEOUTPUTTAPENTOUT,135,IX,NISA,NISD LIBP 023
135 FORMAT(8H GROUPS=13/16H ADDED ISOTOPES=13/16H DELETED ISOTOPES=13) LIBP 024
IF(NISD)145,145,140 LIBP 025
140 READINPUTTAPENTIN,142,(NIDM(L),NIDMA(L),L=1,NIS0) LIBP 026
142 FORMAT(2I5) LIBP 027
145 IF(ITAG)160,150,150 LIBP 028
150 READINPUTTAPENTIN,110,(V(I),I=1,IX) LIBP 029
READINPUTTAPENTIN,110,(DV(I),I=1,IX) LIBP 030
WRITETAPENTLIB ,IX LIBP 031
WRITETAPENTLIB ,V LIBP 032
WRITETAPENTLIB ,DV LIBP 033
GOTO300 LIBP 034
160 READTAPENTLIB, IXA LIBP 035
IF(IXA-IX)165,170,165 LIBP 036
165 CALL XSTOP(50) LIBP 037
170 READTAPENTLIB, V LIBP 038
READTAPENTLIB, DV LIBP 039
175 CALLRT10 LIBP 040
CALLWT8 LIBP 041
IF(IDB)180,175,175 LIBP 042
180 REWINDNTEMP LIBP 043
REWINDNTLIB LIBP 044
185 WRITETAPENTLIB ,IX LIBP 045
WRITETAPENTLIB ,V LIBP 046
WRITETAPENTLIB ,DV LIBP 047
WRITEOUTPUTTAPENTOUT,190 LIBP 048
WRITEOUTPUTTAPENTOUT,195 LIBP 049
WRITEOUTPUTTAPENTOUT,200 LIBP 050
190 FORMAT(28H0ISOTOPES PREVIOUSLY ON TAPE) LIBP 051
195 FORMAT(22H0 IDENT P-DECKS) LIBP 052
200 FORMAT(22H -----) LIBP 053
M=0 LIBP 054
210 CALLRT8 LIBP 055
IF(IDB)215,220,220 LIBP 056
215 IDB=IDB LIBP 057
M=1 LIBP 058
220 IF(NISD)250,250,225 LIBP 059
225 DO235L=1,NISD LIBP 060

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	<u>IF(NIDM(L)=IDM)235,230,235</u>	LIBP 062
230	<u>IF(NIDMA(L)=IDMA)235,240,235</u>	LIBP 063
235	CONTINUE	LIBP 064
	GOTO250	LIBP 065
240	<u>WRITEOUTPUTTAPENTOUT,245,IDM,IDMA</u>	LIBP 066
245	<u>FORMAT(I7,1H=I5,9H DELETED)</u>	LIBP 067
	GOTO260	LIBP 068
250	<u>WRITEOUTPUTTAPENTOUT,255,IDM,IDMA,IDA</u>	LIBP 069
255	<u>FORMAT(I7,1H=I5,I6)</u>	LIBP 070
	CALLWT10	LIBP 071
260	<u>IF(M)210,210,270</u>	LIBP 072
270	REWINDNTEMP	LIBP 073
300	<u>WRITEOUTPUTTAPENTOUT,310</u>	LIBP 074
310	<u>FORMAT(13H0NEW ISOTOPES)</u>	LIBP 075
	D0650N=1,NISA	LIBP 076
	<u>READ INPUT TAPE NTIN,100,IDM,IDMA,IDA,IDAP,IDNU,IDMF,IDMU</u>	LIBP 077
	<u>IF(IDM)315,315,320</u>	LIBP 078
315	CALL XSTOP(51)	LIBP 079
320	<u>WRITEOUTPUTTAPENTOUT,195</u>	LIBP 080
	<u>WRITEOUTPUTTAPENTOUT,200</u>	LIBP 081
	<u>WRITEOUTPUTTAPENTOUT,255,IDM,IDMA,IDA</u>	LIBP 082
	<u>IF(IDAP)325,335,325</u>	LIBP 083
325	<u>READINPUTTAPENTIN,110,A</u>	LIBP 084
	D0330I=1,IX	LIBP 085
330	<u>XA(I)=A/V(I)</u>	LIBP 086
	GOTO340	LIBP 087
335	<u>READINPUTTAPENTIN,110,(XA(I),I=1,IX)</u>	LIBP 088
340	<u>WRITEOUTPUTTAPENTOUT,345,(XA(I),I=1,IX)</u>	LIBP 089
	CALL FXFMU(IX)	LIBP 090
	<u>WRITE OUTPUT TAPE NTOUT,348,(XNU(I),I=1,IX)</u>	LIBP 091
	<u>WRITE OUTPUT TAPE NTOUT,346,(FX(J),J=1,IX)</u>	LIBP 092
	<u>WRITE OUTPUT TAPE NTOUT,347,(XMU(I),I=1,IX)</u>	LIBP 093
345	<u>FORMAT(4H XA/(5E13.5))</u>	LIBP 094
346	<u>FORMAT(4H XF/(5E13.5))</u>	LIBP 095
347	<u>FORMAT(8H MU BAR/(5E13.5))</u>	LIBP 096
348	<u>FORMAT(4H NU/(5E13.5))</u>	LIBP 097
	IDB=1	LIBP 098
	<u>IF(N=NISA)355,350,350</u>	LIBP 099
350	IDB=1	LIBP 100
355	<u>IF(IDA)400,600,500</u>	LIBP 101
400	<u>READINPUTTAPENTIN,1310,NK,T,(ZAT(NN),ZAMT(NN),ZAKT(NN),NN=1,NK)</u>	LIBP 102
1310	<u>FORMAT(I5,E10.5/(3E10.5))</u>	LIBP 103
	<u>CALLBASK(PA,V,DV,XS,ZAT,ZAKT,ZAMT,T,IX,NK)</u>	LIBP 104
	<u>WRITEOUTPUTTAPENTOUT,1320,NK,T,(ZAT(NN),ZAMT(NN),ZAKT(NN),NN=1,NK)</u>	LIBP 105
1320	<u>FORMAT(8H TERMS=I2,5H T=E13.5/(6H SIG=E13.5,5H M=E13.5,7H</u>	LIBP 106
	<u>XKAP=E13.5))</u>	LIBP 107
	<u>WRITEOUTPUTTAPENTOUT,1330,(XS(I),I=1,IX)</u>	LIBP 108
1330	<u>FORMAT(4H XS/(5E13.5))</u>	LIBP 109
	<u>IF(IDA+1)1340,1350,1350</u>	LIBP 110
1340	MAX=50	LIBP 111
	IO=1	LIBP 112
	<u>CALLPUNCH(PA,IX,IDM,T,IDMA,IO,MAX)</u>	LIBP 113
1350	IDA=1	LIBP 114
	GOTO600	LIBP 115
500	C=1.	LIBP 116
	LT=1	LIBP 117
	<u>CALL PVV(PP,V,DV,XS,T,C,LT)</u>	LIBP 118
	<u>D0505I=1,IX</u>	LIBP 119
	<u>D0505J=1,IX</u>	LIBP 120
505	<u>PA(I,J)=PP(I,J)</u>	LIBP 121
	<u>WRITEOUTPUTTAPENTOUT,1330,(XS(I),I=1,IX)</u>	LIBP 122
	<u>IF(IDA-1)600,600,510</u>	LIBP 123

510	CALL PVV(PP,V,DV,XS,T,C,LT)	LIBP 124
	D0515I=1,IX	LIBP 125
	D0515J=1,IX	LIBP 126
515	PB(I,J)=PP(I,J)	LIBP 127
	WRITEOUTPUTTAPENOUT,1330,(XS(I),I=1,IX)	LIBP 128
	IF(IDA-2)600,600,520	LIBP 129
520	CALL PVV(PP,V,DV,XS,T,C,LT)	LIBP 130
	D0525I=1,IX	LIBP 131
	D0525J=1,IX	LIBP 132
525	PC(I,J)=PP(I,J)	LIBP 133
	WRITEOUTPUTTAPENOUT,1330,(XS(I),I=1,IX)	LIBP 134
	IF(IDA-3)600,600,530	LIBP 135
530	CALL PVV(PP,V,DV,XS,T,C,LT)	LIBP 136
	D0535I=1,IX	LIBP 137
	D0535J=1,IX	LIBP 138
535	PD(I,J)=PP(I,J)	LIBP 139
	WRITEOUTPUTTAPENOUT,1330,(XS(I),I=1,IX)	LIBP 140
600	CALLWT10	LIBP 141
650	CONTINUE	LIBP 142
	ENDFILENTLIB	LIBP 143
	REWINDNTLIB	LIBP 144
	END	LIBP 145

SUBROUTINE FXFMU(IX)	FXFMU000
COMMON IDM, IDMA, IDB, IDA, XA(50), PA(50,50), PB(50,50), PC(50,50), PD(50	FXFMU001
1,50), IDNU, IDMF, IDMU, XNU(50), FX(50), XMU(50), V(50), DV(50)	FXFMU002
COMMON NTIN, NTOUT, NTLIB, NTPUN, NTEMP	FXFMU003
IF(IDMF)10,20,20	FXFMU004
10 DO 15 I=1,50	FXFMU005
XNU(I)=0.0	FXFMU006
15 FX(I)=0.0	FXFMU007
GO TO 40	FXFMU008
20 IF(IDNU)10,24,30	FXFMU009
24 READ INPUT TAPE NTIN,21,(XNU(J),J=1,IX)	FXFMU010
25 READ INPUT TAPE NTIN,21,(FX(J),J=1,IX)	FXFMU011
21 FORMAT(7E10.5)	FXFMU012
GO TO 40	FXFMU013
30 READ INPUT TAPE NTIN,21,XNUX	FXFMU014
DO 31 K=1,IX	FXFMU015
31 XNU(K)=XNUX	FXFMU016
IF(IDMF)10,25,32	FXFMU017
32 READ INPUT TAPE NTIN,21,XF	FXFMU018
DO 35 I=1,IX	FXFMU019
35 FX(I)=XF/V(I)	FXFMU020
40 IF(IDMU)50,60,50	FXFMU021
50 READ INPUT TAPE NTIN,21,XMUX	FXFMU022
DO 55 J=1,IX	FXFMU023
55 XMU(J)=XMUX	FXFMU024
GO TO 70	FXFMU025
60 READ INPUT TAPE NTIN,21,(XMU(I),I=1,IX)	FXFMU026
70 RETURN	FXFMU027
END	FXFMU028

SUBROUTINE PVV(P,V,DV,XS,T,SCALE,LT)	PVV 000
DIMENSIONP(50,50),V(50),DV(50),XS(50)	PVV 001
NTOUT=61	PVV 002
MAX=50	PVV 003
CALL LDC(P,K,ID,T,IDA,IO,MAX)	PVV 004
WRITEOUTPUTTAPENTOUT,20,ID,IDA,K,IO,T	PVV 005
20 FORMAT(8H P DECK15,1H-11,5H K=12,6H JO=12,5H T=E12,5)	PVV 006
KA=K-1	PVV 007
DO50 I=1,KA	PVV 008
KB=I+1	PVV 009
A=V(I)*V(I)	PVV 010
DO50 J=KB,K	PVV 011
B=V(J)*V(J)	PVV 012
50 P(J,I)=B*DV(I)*P(I,J)*EXP((A-B)/T)/(A*DV(J))	PVV 013
DO70 J=1,K	PVV 014
XS(J)=0.	PVV 015
DO60 I=1,K	PVV 016
P(I,J)=SCALE*P(I,J)	PVV 017
60 XS(J)=XS(J)*P(I,J)*DV(I)/DV(J)	PVV 018
70 XS(J)=XS(J)/V(J)	PVV 019
C IF(LT) .,0, NO PRINT, PRINT XS, PRINT XS AND P	PVV 020
IF(LT)120,100,80	PVV 021
80 WRITEOUTPUTTAPENTOUT,90,((I,J,P(I,J),J=1,K),I=1,K)	PVV 022
90 FORMAT(11H01,J,P(I,J)/(5(213,E13.5)))	PVV 023
100 WRITEOUTPUTTAPENTOUT,110,(I,XS(I),I=1,K)	PVV 024
110 FORMAT(6H0XS(I)/(5(13,E13.5)))	PVV 025
120 CONTINUE	PVV 026
RETURN	PVV 027
END	PVV 028

	SUBROUTINE RT8	RT8 000
	COMMON IDM, IDMA, IDB, IDA, XA(50), PA(50,50), PB(50,50), PC(50,50), PD(50,50), IDNU, IDMF, IDMU, XNU(50), FX(50), XMU(50), V(50), DV(50)	RT8 001
	COMMON NTIN, NTOUT, NTLIB, NTPUN, NTEMP	RT8 002
10	READTAPENTEMP, IDM, IDMA, IDB, IDA	RT8 003
	READTAPENTEMP, XA	RT8 004
	IF(IDA)60,60,20	RT8 005
20	READTAPENTEMP, PA	RT8 006
	IF(IDA-1)60,60,30	RT8 007
30	READTAPENTEMP, PB	RT8 008
	IF(IDA-2)60,60,40	RT8 009
40	READTAPENTEMP, PC	RT8 010
	IF(IDA-3)60,60,50	RT8 011
50	READTAPENTEMP, PD	RT8 012
60	READTAPENTEMP, XNU	RT8 013
	READTAPENTEMP, FX	RT8 014
	READTAPENTEMP, XMU	RT8 015
	RETURN	RT8 016
	END	RT8 017
		RT8 018

	SUBROUTINE RT10	RT10 000
	COMMON IDM, IDMA, IDB, IDA, XA(50), PA(50,50), PB(50,50), PC(50,50), PD(50,50), IDNU, IDMF, IDMU, XNU(50), FX(50), XMU(50), V(50), DV(50)	RT10 001
	COMMON NTIN, NTOUT, NTLIB, NTPUN, NTEMP	RT10 002
10	READTAPENTLIB, IDM, IDMA, IDB, IDA	RT10 003
	READTAPENTLIB, XA	RT10 004
	IF(IDA)60,60,20	RT10 005
20	READTAPENTLIB, PA	RT10 006
	IF(IDA-1)60,60,30	RT10 007
30	READTAPENTLIB, PB	RT10 008
	IF(IDA-2)60,60,40	RT10 009
40	READTAPENTLIB, PC	RT10 010
	IF(IDA-3)60,60,50	RT10 011
50	READTAPENTLIB, PD	RT10 012
60	READTAPENTLIB, XNU	RT10 013
	READTAPENTLIB, FX	RT10 014
	READTAPENTLIB, XMU	RT10 015
	RETURN	RT10 016
	END	RT10 017
		RT10 018

	SUBROUTINE WT8	WT8 000
	COMMON IDM, IDMA, IDB, IDA, XA(50), PA(50,50), PB(50,50), PC(50,50), PD(50,50), IDNU, IDMF, IDMU, XNU(50), FX(50), XMU(50), V(50), DV(50)	WT8 001
	COMMON NTIN, NTOUT, NTLIB, NTPUN, NTEMP	WT8 002
10	WRITETAPENTEMP, IDM, IDMA, IDB, IDA	WT8 003
	WRITETAPENTEMP, XA	WT8 004
	IF(IDA)60,60,20	WT8 005
20	WRITETAPENTEMP, PA	WT8 006
	IF(IDA-1)60,60,30	WT8 007
30	WRITETAPENTEMP, PB	WT8 008
	IF(IDA-2)60,60,40	WT8 009
40	WRITETAPENTEMP, PC	WT8 010
	IF(IDA-3)60,60,50	WT8 011
50	WRITETAPENTEMP, PD	WT8 012
60	WRITETAPENTEMP, XNU	WT8 013
	WRITETAPENTEMP, FX	WT8 014
	WRITETAPENTEMP, XMU	WT8 015
	RETURN	WT8 016
	END	WT8 017
		WT8 018


```

SUBROUTINE WT10
COMMON IDM, IDMA, IDB, IDA, XA(50), PA(50,50), PB(50,50), PC(50,50), PD(50
1,50), IDNU, IDMF, IDMU, XNU(50), FX(50), XMU(50), V(50), DV(50)
COMMON NTIN, NTOUT, NTLIB, NTPUN, NTEMP
10 WRITETAPENTLIB ,IDM, IDMA, IDB, IDA
   WRITETAPENTLIB ,XA
   IF(IDA)60,60,20
20 WRITETAPENTLIB ,PA
   IF(IDA-1)60,60,30
30 WRITETAPENTLIB ,PB
   IF(IDA-2)60,60,40
40 WRITETAPENTLIB ,PC
   IF(IDA-3)60,60,50
50 WRITETAPENTLIB ,PD
60 WRITETAPENTLIB ,XNU
   WRITETAPENTLIB ,FX
   WRITETAPENTLIB ,XMU
   RETURN
   END

```

WT10 000
WT10 001
WT10 002
WT10 003
WT10 004
WT10 005
WT10 006
WT10 007
WT10 008
WT10 009
WT10 010
WT10 011
WT10 012
WT10 013
WT10 014
WT10 015
WT10 016
WT10 017
WT10 018

```

FUNCTION ERF(X)
10 IF(ABS(X)-3.7)30,20,20
20 ERF=1.
   GOT055
30 XX=ARSF(X)
   IF(XX-1.E-5)40,40,50
40 ERF=1.12838*XX
   GOT055
50 ERF=1.-1./((1.+XX*(.14112821+XX*(.08864027+XX*(.02743349+XX*
1(-.00039446+XX*.00328975))))))*.8
55 IF(X)60,70,70
60 ERF=-ERF
70 RETURN
   END

```

ERF 000
ERF 001
ERF 002
ERF 003
ERF 004
ERF 005
ERF 006
ERF 007
ERF 008
ERF 009
ERF 010
ERF 011
ERF 012
ERF 013

```

SUBROUTINE BASK(P,V,DV,XS,AT,AKT,AMT,T,IX,NISO)      BASK 000
DIMENSION NP(50,50),V(50),DV(50),XS(50),X(50),E(50),AT(10),AKT(10),ABASK 001
1MT(10)      BASK 002
10 D015I=1,IX      BASK 003
   XS(I)=0.      BASK 004
   D015J=1,IX      BASK 005
15 P(I,J)=0.      BASK 006
100 D0500N=1,NISO      BASK 007
   IF(AT(N))110,500,110      BASK 008
110 AM=AMT(N)      BASK 009
   BETS=AM/T      BASK 010
   BET=SQRTF(BETS)      BASK 011
   D0120I=1,IX      BASK 012
   X(I)=BET*V(I)      BASK 013
120 E(I)=X(I)*X(I)      BASK 014
   TAUS=BETS/(BETS+AKT(N))      BASK 015
   TAU=SQRTF(TAUS)      BASK 016
   ALPHA=AKT(N)*TAUS/BETS      BASK 017
   THETA=(AM+1.)/(2.*AM*TAU)      BASK 018
   ZETA=TAU*THETA      BASK 019
   OMEG=TAUS*(BETS+(AM+1.)*AKT(N))/BETS      BASK 020
   CONST=(AT(N)*TAU*TAUS*(AM+1.)*(AM+1.))/(4.*AM*OMEG)      BASK 021
200 D0400I=1,IX      BASK 022
   D0300J=1,IX      BASK 023
250 EA=ERF((THETA*X(I))+(ZETA*X(J)))+ERF((THETA*X(I))-(ZETA*X(J)))      BASK 024
   EB=ERF((THETA*X(J))-(ZETA*X(I)))+ERF((ZETA*X(I))+(THETA*X(J)))      BASK 025
   WA=ALPHA*E(J)      BASK 026
   IF(WA-50.)252,251,251      BASK 027
251 WA=0.      BASK 028
   GOT0253      BASK 029
252 WA=EXP(-WA)      BASK 030
253 WB=(E(J)-OMEG*E(I))/AM      BASK 031
   TEM=CONST*(X(I)/X(J))*(EA*WA+EB*EXP(WB))      BASK 032
260 IF(TEM-1.E-15)350,350,270      BASK 033
270 P(I,J)=P(I,J)+TEM      BASK 034
300 CONTINUE      BASK 035
350 EA=TAU*X(I)      BASK 036
   WA=ALPHA*E(I)      BASK 037
   IF(WA-50.)352,351,351      BASK 038
351 WA=0.      BASK 039
   GOT0353      BASK 040
352 WA=EXP(-WA)      BASK 041
353 EB=WA*ERF(EA)*(EA+(0.5/EA))      BASK 042
   IF(E(I)-50.)355,354,354      BASK 043
354 WB=0.      BASK 044
   GOT0356      BASK 045
355 WB=EXP(-E(I))      BASK 046
356 XS(I)=XS(I)+(AT(N)*TAUS*TAUS/BET)*(EB+0.5641896*WB)      BASK 047
400 CONTINUE      BASK 048
500 CONTINUE      BASK 049
600 D0610I=1,IX      BASK 050
610 E(I)=(V(I)*V(I))*EXP(-(V(I)*V(I))/T)      BASK 051
   D0620I=1,IX      BASK 052
   D0620J=1,IX      BASK 053
620 P(J,I)=P(I,J)+E(J)/E(I)      BASK 054
   D0650J=1,IX      BASK 055
   TEM=0.      BASK 056
   D0640I=1,IX      BASK 057
640 TEM=TEM+P(I,J)*DV(I)      BASK 058
650 P(J,J)=(XS(J)-TEM)/DV(J)+P(J,J)      BASK 059
   D0680I=1,IX      BASK 060
   XS(I)=XS(I)/V(I)      BASK 061
   D0680J=1,IX      BASK 062
680 P(I,J)=P(I,J)*DV(J)      BASK 063
   RETURN      BASK 064
   END      BASK 065

```

SUBROUTINE PUNCH(P,K,ID,T,IDA,J0,MAX)	PUNCH000
DIMENSION P(1),CARD(20),B(16)	PUNCH001
EQUIVALENCE(IDWD,CARD(5)),(IDAWD,CARD(6)),(WDJ,J),	PUNCH002
X(WDIUP,IUP),(WDJ0,J01),(WDK,K1)	PUNCH003
DATA(B=4000000000000000B,0005000000000000B,4001440144014761B,	PUNCH004
X4761440144014001B,4761476141014101B,4101476147614001B,476147614521	PUNCH005
X4521B,4521452140014761B,4761450145414561B,4721470140014761B,476142	PUNCH006
X0141014201B,4761476140014341B,4761442144214421B,4761434140014721B,	PUNCH007
X4721452145214521B,4561456100000000B)	PUNCH008
100 NTOUT=61	PUNCH009
NTPUN=1	PUNCH010
J01=J0	PUNCH011
K1=K	PUNCH012
CARD(2)=WDJ0	PUNCH013
CARD(3)=WDK	PUNCH014
CARD(4)=T	PUNCH015
CARD(5)=0.0	PUNCH016
CARD(6)=0.0	PUNCH017
IDWD=ID	PUNCH018
IDAWD=IDA	PUNCH019
CARD(1)=B(1),OR.B(2)	PUNCH020
101 I=7	PUNCH021
DO 102 L=3,16	PUNCH022
CARD(I)=B(L)	PUNCH023
I=I+1	PUNCH024
102 CONTINUE	PUNCH025
NWORDS=(K1*(K1+1)-J01*(J01-1))/2	PUNCH026
NFULL=NWORDS/16+1	PUNCH027
NDONE=1	PUNCH028
IUP=0	PUNCH029
J=J0	PUNCH030
GO TO 200	PUNCH031
105 NEED=16	PUNCH032
107 N=4	PUNCH033
CARD(1)=B(2)	PUNCH034
CARD(3)=WDJ	PUNCH035
CARD(4)=WDIUP	PUNCH036
110 LOC=(J-1)*MAX+IUP-N	PUNCH037
ILO=IUP+1	PUNCH038
IF(J=IUP-NEED)120,130,140	PUNCH039
120 IUP=J	PUNCH040
M=1	PUNCH041
GO TO 150	PUNCH042
130 IUP=J	PUNCH043
M=2	PUNCH044
GO TO 150	PUNCH045
140 IUP=IUP+NEED	PUNCH046
M=3	PUNCH047
150 DO 160 I=ILO,IUP	PUNCH048
N=N+1	PUNCH049
160 CARD(N)=P(LOC+N)	PUNCH050
GO TO(170,180,190),M	PUNCH051
170 NEED=20-N	PUNCH052
IUP=0	PUNCH053
J=J+1	PUNCH054
GO TO 110	PUNCH055
180 IUP=0	PUNCH056
J=J+1	PUNCH057
190 NDONE=NDONE+1	PUNCH058
SUM=0.0	PUNCH059
DO 191 I=3,20	PUNCH060
191 SUM=SUM+CARD(I)	PUNCH061

```

CARD(2)=SUM
200 BUFFER OUT(NTPUN,1)(CARD,CARD(20))
DO 201 I=5,20
201 CARD(I)=0.0
IF(NFULL=NDONE)240,210,105
210 NZERO=NWORDS*(NFULL-1)*16
IF(NZERO)220,240,220
220 NEED=NZERO
GO TO 107
240 RETURN
END

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PUNCH062
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PUNCH067
PUNCH068
PUNCH069
PUNCH070
PUNCH071
PUNCH072

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C SUBROUTINE XSTOP(K)
SUBROUTINE TO PRINT ERROR STOP NUMBERS
NTOUT=61
WRITEOUTPUTTAPENTOUT,1,K
1 FORMAT(19H0PROGRAM ERROR STOP I6)
END

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XSTOP000
XSTOP001
XSTOP002
XSTOP003
XSTOP004
XSTOP005

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APPENDIX C
CODE LISTING FOR GAKER

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PROGRAM GAKER                                GAKER000
DIMENSIONV(50),E(50),P0(50,50),P1(50,50),P2(50,50),P3(50,50),ANG(30,50),BF(50),W(50),S0(50),S1(50),S2(50),S3(50),TR(50,50),TRX(50),P(50,50),WV(50),XA(10),XB(10),XC(10),XD(10),XE(10),XF(10),XG(10)
10 READINPUTTAPENTIN,11,ID,NE,NA,I0,NR,TTA    GAKER001
11 FORMAT(9I5)                                GAKER002
    IF(ID)22,21,22                            GAKER003
21 STOP                                        GAKER004
22 MAX=50                                      GAKER005
    NLARG=11                                    GAKER006
    READINPUTTAPENTIN,12,T,EPSI,BARNS        GAKER007
12 FORMAT(7E10,5)                             GAKER008
    READINPUTTAPENTIN,12,(XA(I),XB(I),XC(I),XD(I),XE(I),XF(I),XG(I),I=1,NR)    GAKER009
    READINPUTTAPENTIN,12,(V(I),I=1,NE)        GAKER010
    READINPUTTAPENTIN,12,(WV(I),I=1,NE)      GAKER011
    READINPUTTAPENTIN,12,(ANG(K),K=1,NA)     GAKER012
    READINPUTTAPENTIN,12,(W(K),K=1,NA)       GAKER013
    XB(1)=T                                    GAKER014
    A1=1./(XF(1)*XG(1))                      GAKER015
    A2=1./(XF(2)*XG(2))                      GAKER016
    A3=1./XA(2)+1./XA(1)                    GAKER017
    A4=XE(1)*TANH(XE(1)/(2.*T))              GAKER018
    XC(1)=1./(A1+A2+A3/A4)                  GAKER019
    XD(1)=(1./A3)*XE(1)*(EXP(XE(1)/(2.*T))-EXP(-XE(1)/(2.*T)))/2. GAKER020
    E1=T/XA(1)                                GAKER021
    E2=EXP(XE(1)/T)+1.                      GAKER022
    XB(2)=(E1+A3*XE(1)*(1./E2+0.5))*XA(2)    GAKER023
    A5=TANH(XG(2)/(2.*T))                   GAKER024
    XC(2)=1./(A1+A2/A5)                     GAKER025
    XD(2)=(1./A1)*(EXP(XG(1)/(2.*T))-EXP(-XG(1)/(2.*T)))/2. GAKER026
    WRITEOUTTAPENTOUT,13,ID,NE,NA,I0,NR,TTA,T,EPSI,BARNS GAKER027
13 WRITEOUTTAPENTOUT,13,18H11TRAN 2.95 HONECK15/5H NE=13/5H NA=13/5H I0=13/5H NGAKER028
    1R=12/6H TTA=12/4H T=E13.5/7H EPSI=E13.5/8H BARNS=E13.5 GAKER029
    WRITEOUTTAPENTOUT,14,(XA(I),XB(I),XC(I),XD(I),XE(I),XF(I),XG(I),I=1,NR) GAKER030
14 FORMAT(3H M=1P1E12.4,4H E=1P1E12.4,4H A=1P1E12.4,4H B=1P1E12.4,4H GAKER031
    18H OMEGA=1P1E12.4,5H MS=1P1E12.4,7H BIGO=1P1E12.4) GAKER032
    WRITEOUTTAPENTOUT,15,(I,V(I),I=1,NE)     GAKER033
15 FORMAT(6H V(I)/(5(I3,E13.5)))            GAKER034
    WRITEOUTTAPENTOUT,16,(I,WV(I),I=1,NE)    GAKER035
16 FORMAT(7H DV(I)/(5(I3,E13.5)))           GAKER036
    WRITEOUTTAPENTOUT,17,(K,ANG(K),K=1,NA)   GAKER037
17 FORMAT(8H ANK(K)/(5(I3,E13.5)))          GAKER038
    WRITEOUTTAPENTOUT,18,(K,W(K),K=1,NA)     GAKER039
18 FORMAT(6H W(K)/(5(I3,E13.5)))            GAKER040
    TT2=2.*T                                  GAKER041
    D020I=1,NE                                GAKER042
20 E(I)=V(I)*V(I)                            GAKER043
    WRITEOUTTAPENTOUT,33,(I,E(I),I=1,NE)     GAKER044
33 FORMAT(5H E(I)/(5(I3,E13.5)))            GAKER045
    D035I=1,NE                                GAKER046
    D035J=1,NE                                GAKER047
    P0(I,J)=0.                                GAKER048
    P1(I,J)=0.                                GAKER049
    P2(I,J)=0.                                GAKER050

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35	P3(I,J)=0.	GAKER062
	D0175K=1,NA	GAKER063
	D0170I=1,NE	GAKER064
	M=XMAXOF(I,I0)	GAKER065
	D0170J=M,NE	GAKER066
	VI=V(I)	GAKER067
	VJ=V(J)	GAKER068
	NDG=0	GAKER069
	IF(I-J)1045,1035,1045	GAKER070
1035	VI=V(J)-0.625*WV(J)	GAKER071
	STOR=0.	GAKER072
1040	NDG=NDG+1	GAKER073
	VI=VI+0.25*WV(J)	GAKER074
1045	EI=VI*VI	GAKER075
	EJ=VJ*VJ	GAKER076
	Z=EI+EJ-2.*ANG(K)*VI*VJ	GAKER077
	MZ=1	GAKER078
	IF(E(J)-12.65)38,38,37	GAKER079
37	MZ=2	GAKER080
38	BIGO=XG(MZ)	GAKER081
	BIGM=XF(MZ)	GAKER082
41	EM=XA(MZ)	GAKER083
	EBAR=XB(MZ)	GAKER084
	A=XC(MZ)	GAKER085
	B=XD(MZ)	GAKER086
	OMEGA=XE(MZ)	GAKER087
45	ZX=Z	GAKER088
	ZP=Z/B	GAKER089
	ZBC=Z/(BIGO*BIGM)	GAKER090
80	CONST=SQRTF(EM*EI/(12.56637*EBAR*Z*EJ))	GAKER091
	CA=EI-EJ+Z/EM	GAKER092
	CB=4.*EBAR*Z/EM	GAKER093
	CALLBESSL(ZP,BF,NLARG,NERR)	GAKER094
81	TERMA=0	GAKER095
	TERMB=0	GAKER096
	TERMC=0	GAKER097
	CC=-10.*OMEGA	GAKER098
	D090N=1,21	GAKER099
	NP=N-11	GAKER100
	NPA=1+XABSF(NP)	GAKER101
	CAP=CA-CC	GAKER102
	CCA=(CC/TT2)*(Z/A)	GAKER103
	ARG=CCA+(CAP*CAP/CB)	GAKER104
	IF(ARG-15.)82,84,84	GAKER105
82	TERM=EXPF(-ARG)*BF(NPA)	GAKER106
83	TERMA=TERMA+TERM	GAKER107
84	ARG=CCA+((CAP+BIGO)*(CAP+BIGO)/CB)	GAKER108
	IF(ARG-15.)85,87,87	GAKER109
85	TERM=EXPF(-ARG)*BF(NPA)	GAKER110
86	TERMB=TERMB+TERM	GAKER111
87	ARG=CCA+((CAP+BIGO+BIGO)*(CAP+BIGO+BIGO)/CB)	GAKER112
	IF(ARG-15.)88,90,90	GAKER113
88	TERM=EXPF(-ARG)*BF(NPA)	GAKER114
89	TERMC=TERMC+TERM	GAKER115
90	CC=CC+OMEGA	GAKER116
93	SUM2=CONST*(TERMA+(TERMB*ZBC)+(0.5*TERMC*ZBC*ZBC))	GAKER117
	IF(NDG)165,165,100	GAKER118
100	STOR=STOR+SUM2	GAKER119
	IF(NDG-4)1040,110,110	GAKER120
110	SUM2=0.25*STOR	GAKER121
165	P0(I,J)=P0(I,J)+W(K)*SUM2	GAKER122
	P1(I,J)=P1(I,J)+W(K)*SUM2*ANG(K)	GAKER123

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P2(I,J)=P2(I,J)+W(K)*SUM2*(3.*ANG(K)**2-1.)/2,
P3(I,J)=P3(I,J)+W(K)*SUM2*(5.*ANG(K)**3-3.*ANG(K))/2.
P(I,J)=SUM2*BARN
170 CONTINUE
IF(TTA)172,175,172
172 WRITEOUTPUTTAPENTOUT,173,K,((I,J,P(I,J)),J=1,NE),I=1,NE)
173 FORMAT(12H P(I,J,K) K=12/(5(2I3,E13.5)))
175 CONTINUE
DO180I=1,NE
M=XMAXOF(I,I0)
DO180J=M,NE
FACT=2.*BARN*V(I)*V(J)
P0(I,J)=FACT*P0(I,J)
P1(I,J)=FACT*P1(I,J)
P2(I,J)=FACT*P2(I,J)
180 P3(I,J)=FACT*P3(I,J)
NEP=NE-1
DO190I=1,NEP
M=I+1
DO190J=M,NE
FACT=(E(J)/E(I))*EXPF((E(I)-E(J))/T)
P0(J,I)=FACT*P0(I,J)
P1(J,I)=FACT*P1(I,J)
P2(J,I)=FACT*P2(I,J)
190 P3(J,I)=FACT*P3(I,J)
DO202I=1,NE
S0(I)=0.
S1(I)=0.
S2(I)=0.
S3(I)=0.
DO200J=1,NE
S0(I)=S0(I)+P0(J,I)*WV(J)
S1(I)=S1(I)+P1(J,I)*WV(J)
S2(I)=S2(I)+P2(J,I)*WV(J)
200 S3(I)=S3(I)+P3(J,I)*WV(J)
S0(I)=S0(I)/V(I)
S1(I)=S1(I)/V(I)
TRX(I)=S0(I)-S1(I)
S2(I)=S2(I)/V(I)
202 S3(I)=S3(I)/V(I)
WRITEOUTPUTTAPENTOUT,230,(I,S0(I),I=1,NE)
230 FORMAT(8H SIG0(I)/(5(I3,E13.5)))
WRITEOUTPUTTAPENTOUT,235,(I,S1(I),I=1,NE)
235 FORMAT(8H SIG1(I)/(5(I3,E13.5)))
WRITEOUTPUTTAPENTOUT,240,(I,S2(I),I=1,NE)
240 FORMAT(8H SIG2(I)/(5(I3,E13.5)))
WRITEOUTPUTTAPENTOUT,245,(I,S3(I),I=1,NE)
245 FORMAT(8H SIG3(I)/(5(I3,E13.5)))
WRITEOUTPUTTAPENTOUT,250,(I,TRX(I),I=1,NE)
250 FORMAT(7H TRX(I)/(5(I3,E13.5)))
TA=0.
TB=0.
TC=0.
TD=0.
TE=0.
TF=0.
DO800I=1,NE
A=E(I)*V(I)*WV(I)*EXPF(-E(I)/T)
TA=TA+A*S0(I)
TB=TB+A*S1(I)
TC=TC+A*S2(I)
TD=TD+A*S3(I)

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      TE=TE+A/TRX(I)
      TF=TF+A
      TA=TA/TF
      TB=TB/TF
      TC=TC/TF
      TD=TD/TF
      TE=TE/TF
      WRITEOUTPUTTAPENTOUT,810,TA,TB,TC,TD,TE
800  FORMAT(10H AVE XSECT/6H XS0=E13.5/6H XS1=E13.5/6H XS2=E13.5/6H
      1 XS3=E13.5/6H LTR=E13.5)
      DO500J=1,NE
      S0(J)=0.
      FACT=2./V(J)
      DO500I=1,NE
500  S0(J)=S0(J)+FACT*P0(I,J)*WV(I)*LOGF(V(J)/V(I))
      WRITEOUTPUTTAPENTOUT,510,(I,S0(I),I=1,NE)
510  FORMAT(10H XI*SIG(I)/(5(I3,E13.5)))
      DO630N=1,3
      TA=0.
      TB=0.
      DO610J=1,NE
      S0(J)=0.
      S1(J)=0.
      DO600I=1,NE
      S0(J)=S0(J)+P0(I,J)*WV(I)*(E(J)-E(I))*N
600  S1(J)=S1(J)+P0(I,J)*WV(I)
      TA=TA+E(J)*EXP(-E(J)/T)*S0(J)*WV(J)
      TB=TB+E(J)*EXP(-E(J)/T)*S1(J)*WV(J)
610  S0(J)=S0(J)/S1(J)
      TA=TA/TB
      WRITEOUTPUTTAPENTOUT,620,N,TA,(I,S0(I),I=1,NE)
620  FORMAT(23H AVE ENERGY LOSS MOMENT I2/4H M=E13.5/6H H(I)/(5(I3,E13.5)))
630  CONTINUE
      DO195I=1,NE
      DO195J=1,NE
      P0(I,J)=P0(I,J)+WV(J)
      P1(I,J)=P1(I,J)+WV(J)
      TR(I,J)=P0(I,J)-P1(I,J)
      P2(I,J)=P2(I,J)+WV(J)
195  P3(I,J)=P3(I,J)+WV(J)
      WRITEOUTPUTTAPENTOUT,210,((I,J,P0(I,J),J=1,NE),I=1,NE)
210  FORMAT(8H P0(I,J)/(5(2I3,E13.5)))
      WRITEOUTPUTTAPENTOUT,215,((I,J,P1(I,J),J=1,NE),I=1,NE)
215  FORMAT(8H P1(I,J)/(5(2I3,E13.5)))
      WRITEOUTPUTTAPENTOUT,220,((I,J,P2(I,J),J=1,NE),I=1,NE)
220  FORMAT(8H P2(I,J)/(5(2I3,E13.5)))
      WRITEOUTPUTTAPENTOUT,225,((I,J,P3(I,J),J=1,NE),I=1,NE)
225  FORMAT(8H P3(I,J)/(5(2I3,E13.5)))
      IDA=0
      CALL PUNCH(P0,NE,ID,T,IDA,10,MAX)
      IDA=1
      CALL PUNCH(P1,NE,ID,T,IDA,10,MAX)
      IDA=2
      CALL PUNCH(P2,NE,ID,T,IDA,10,MAX)
      IDA=3
      CALL PUNCH(P3,NE,ID,T,IDA,10,MAX)
      END FILE NIPUN
      GO TO 10
      END

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	SUBROUTINE BESSL(X,B,NX,NERR)	BESSL000
	DIMENSION B(21),BF(50)	BESSL001
	D020L=1,21	BESSL002
20	B(L)=0.	BESSL003
	IF(X=1.)50,55,55	BESSL004
50	IORD=-37./(.43429*LOGF(.1*X))	BESSL005
	IF(IORD-1)51,51,60	BESSL006
51	B(1)=1.	BESSL007
	GOTO80	BESSL008
55	IORD=30	BESSL009
60	BF(IORD-1)=1,E-37	BESSL010
	BF(IORD)=0.	BESSL011
	TA=1.E-37	BESSL012
	IOTA=IORD-1	BESSL013
	D065L=2,IOTA	BESSL014
	IND=IORD-L	BESSL015
	BF(IND)=FLOATF(IND)*2.*BF(IND+1)/X*BF(IND+2)	BESSL016
65	TA=TA+BF(IND)	BESSL017
	TA=2.*TA-BF(1)	BESSL018
	FACT=EXP(X)/TA	BESSL019
	D070L=1,NX	BESSL020
	B(L)=FACT*BF(L)	BESSL021
	IF(B(L)-1.E-20)67,67,70	BESSL022
67	B(L)=0.	BESSL023
70	CONTINUE	BESSL024
90	NERR=1	BESSL025
	RETURN	BESSL026
	END	BESSL027

	SUBROUTINE PUNCH(P,K,ID,T,IDA,J0,MAX)	PUNCH000
	DIMENSION P(1),CARD(20),B(16)	PUNCH001
	EQUIVALENCE(IDWD,CARD(5)),(IDAWD,CARD(6)),(WDJ,J),	PUNCH002
	X(WDIUP,IUP),(WDJ0,J01),(WDK,K1)	PUNCH003
	DATA(B=40000000000000008,00050000000000008,4001440144014761B,	PUNCH004
	X4761440144014001B,4761476141014101B,4101476147614001B,476147614521PUNCH005	
	X4521B,4521452140014761B,4761450145414561B,4721470140014761B,476142PUNCH006	
	X0141014201B,4761476140014341B,4761442144214421B,4761434140014721B,PUNCH007	
	X4721452145214521B,4561456100000000B)	PUNCH008
100	NTOUT=61	PUNCH009
	NTPUN=1	PUNCH010
	J01=J0	PUNCH011
	K1=K	PUNCH012
	CARD(2)=WDJ0	PUNCH013
	CARD(3)=WDK	PUNCH014
	CARD(4)=T	PUNCH015
	CARD(5)=0.0	PUNCH016
	CARD(6)=0.0	PUNCH017
	IDWD=ID	PUNCH018
	IDAWD=IDA	PUNCH019
	CARD(1)=B(1).OR.B(2)	PUNCH020
101	I=7	PUNCH021
	DO 102 L=3,16	PUNCH022
	CARD(I)=B(L)	PUNCH023
	I=I+1	PUNCH024
102	CONTINUE	PUNCH025
	NWORDS=(K1*(K1+1)-J01*(J01-1))/2	PUNCH026
	NFULL=NWORDS/16+1..	PUNCH027
	NDONE=1	PUNCH028
	IUP=0	PUNCH029
	J=J0	PUNCH030
	GO TO 200	PUNCH031
105	NEED=16	PUNCH032
107	N=4	PUNCH033
	CARD(1)=B(2)	PUNCH034
	CARD(3)=WDJ	PUNCH035
	CARD(4)=WDIUP.	PUNCH036
110	LOC=(J-1)*MAX+IUP-N	PUNCH037
	ILO=IUP+1	PUNCH038
	IF(J-IUP-NEED)120,130,140	PUNCH039
120	IUP=J	PUNCH040
	M=1	PUNCH041
	GO TO 150	PUNCH042
130	IUP=J	PUNCH043
	M=2	PUNCH044
	GO TO 150	PUNCH045
140	IUP=IUP+NEED	PUNCH046
	M=3	PUNCH047
150	DO 160 I=ILO,IUP	PUNCH048
	N=N+1	PUNCH049
160	CARD(N)=P(LOC+N)	PUNCH050
	GO TO(170,180,190),M	PUNCH051
170	NEED=20-N	PUNCH052
	IUP=0	PUNCH053
	J=J+1	PUNCH054
	GO TO 110	PUNCH055
180	IUP=0	PUNCH056
	J=J+1	PUNCH057
190	NDONE=NDONE+1	PUNCH058
	SUM=0.0	PUNCH059
	DO 191 I=3,20	PUNCH060
191	SUM=SUM+CARD(I)	PUNCH061

CARD(2)=SUM
200 BUFFER OUT(NYPUN,1)(CARD,CARD(20))
DO 201 I=5,20
201 CARD(I)=0.0
IF(NFULL*NDONE)240,210,105
210 NZERO=NWORDS=(NFULL-1)*16
IF(NZERO)220,240,220
220 NEED=NZERO
GO TO 107
240 RETURN
END

PUNCH062
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References

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