11
BNWL-516

2-

**THERMOS/BATTELLE:
THE BATTELLE VERSION
OF THE THERMOS CODE**

D. R. SKEEN AND L. J. PAGE

SEPTEMBER, 1967

**AEC RESEARCH &
DEVELOPMENT REPORT**

PROJECT NO.	PROJECT NAME	PROJECT LOCATION	PROJECT STATUS
U.E. HANSEN - 32607 28 OCT 1967			

3 3679 00060 6642

BNWL-516
UC-80, Reactor
Technology
Special Distribution

THERMOS/BATTELLE:
THE BATTELLE VERSION OF THE THERMOS CODE

By

D. R. Skeen
Theoretical Physics Section
Reactor Physics Department

L. J. Page
Nuclear Experiments and Analyses Section
Reactor Physics Department

September, 1967

Fin
DS

PACIFIC NORTHWEST LABORATORY
RICHLAND, WASHINGTON

Printed in the United States of America
Available from
Clearinghouse for Federal Scientific and Technical Information
National Bureau of Standards, U.S. Department of Commerce
Springfield, Virginia 22151
Price: Printed Copy \$3.00; Microfiche \$0.65

TABLE OF CONTENTS

INTRODUCTION	1
INCLUSIONS AND REVISIONS INTRODUCED.	1
INPUT TO THERMOS/BATTELLE	3
OUTPUT FROM THERMOS/BATTELLE	10
REFERENCES	13
APPENDICES	
A. Sample Case.	A-1
B. Program Listing	B-1
C. Library Update Program	C-1
1. Library for Thermal Energy Calculations	C-1
2. The Present THERMOS Library	C-6

THERMOS/BATTELLE:
THE BATTELLE VERSION OF THE THERMOS CODE

INTRODUCTION

The many revisions which have been made to program THERMOS⁽¹⁾ by various authors^(2,3) have been introduced into one program, THERMOS/BATTELLE. These revisions and some additional revisions by the authors are described. The program input is listed and the program output is described.

INCLUSIONS AND REVISIONS INTRODUCED

LIBRARY TAPE

An improved library tape has been included which contains the first moment scatter matrices for a number of elements and contains the free atom scattering cross section for all elements. Any one THERMOS case will allow up to 30 elements (including 9 containing first moment kernels).

TRANSPORT KERNEL CALCULATION IN VOIDS⁽³⁾

The transport kernel modifications for the treatment of void regions has been added to the standard treatment.

TRANSPORT KERNEL--COSINE CURRENT⁽²⁾

The cosine current calculation of the transport kernel has been added and modified to allow for the input of a right hand albedo.

CYCLINDRICAL AND RECTANGULAR GEOMETRY

The transport kernel calculations in both cylindrical and rectangular geometry for up to 30 space points have been placed at the users option.

CELL SMEAR

A smear option has been added which gives punched card output of a smeared cell which can be used for region input

to a later THERMOS case. The cross sections are averaged as,

$$\Sigma(v) = \frac{\int_{\text{cell}} \Sigma(v,r) \phi(v,r) dV}{\int_{\text{cell}} \phi(v,r) dV} \quad (1)$$

where V is the cell volume and $\phi(v,r)$ is the cell flux at velocity v and space point r .

ANISOTROPY CORRECTION

The anisotropy correction to the scattering kernel has been placed at the users option. This correction replaces the $E \rightarrow E$ term of the scattering matrix by,

$$\bar{\sigma}_S^0(E \rightarrow E) = \sigma_S^0(E \rightarrow E) - \int_{E'} \sigma_S^1(E \rightarrow E') dE'. \quad (2)$$

Under this correction, the scattering cross section is then revised to

$$\sigma_S^R(E) = \int_{E'} \bar{\sigma}_S^0(E \rightarrow E') dE' = \sigma_S^0(E) [1 - \bar{\mu}(E)] \quad (3)$$

For materials which do not have a first moment kernel in the library, this correction is made by assuming

$$\bar{\mu}(E) \approx \frac{2}{3A} \quad \text{and} \quad \int_{E'} \sigma_S^1(E \rightarrow E') dE' \approx \bar{\mu}(E) \sigma_S^0(E). \quad (4)$$

RELAXATION CORRECTION

The relaxation routine internal to the flux iteration calculation has been modified to switch the calculation to a standard power iteration in case of numeric difficulties (as in the use of Anisotropy Correction, above).

CELL EDITING

The cell editing routine has been rewritten and expanded to include the calculation of the diffusion approximation to the current as,

$$\phi_1(v,r) = \frac{\nabla\phi_o(v,r)}{\Sigma_{TR}(v,r)} \quad (5)$$

where $\nabla\phi(v,r)$ is calculated by a least squares fit of the log of three neighboring flux points. The subsequent calculation of current and flux weighted quantities is as described in the Output from THERMOS/BATTELLE.

INPUT TO THERMOS/BATTELLE

PROBLEM IDENTIFICATION AND BYPASS

1.	(72H)	-----	72 Hollerith character identification with a one in column 1 for program control of printer.
2.	(3I5)	IDENT,	Identification number. If negative or zero, program exits.
		IBY	Bypass, normally zero. If >0, the cross sections used for the last case will be used again. If <0, the edit from the last case will be repeated with new parameters.
		NTLIB	Tape unit library mounted on (normally 8).
		If IBY >0, go to item 19.	If IBY <0, go to item 22.
3.	(8I5)	NX,	Number of space points ≤ 30
		IX,	Number of speed groups ≤ 30
		MX,	Number of mixtures ≤ 5
		ISOX,	Number of isotopes used in cell from library $\leq 10^*$

*The only restriction on this is that ISOX + ICX + ISOXE + ICXE ≤ 30 .

	ISOXE,	Number of isotopes used in edit from library $\leq 10^*$
	ICX,	Number of isotopes used in cell not from library $\leq 10 - \text{ISOX}^*$
	ICXE,	Number of isotopes used in edit not from library $\leq 10 - \text{ISOXE}^*$
	NANI	= 1 for anisotropy correction to the scattering kernel.
4.	(5011) (MTBL(N), N=1,NX)	Mixture number (1-5) assigned to each space point N.

DESCRIPTION OF ISOTOPES TAKEN FROM LIBRARY TAPE

5.	(OP2F5.0 (WSTBA(J), WSTBB(J),	First ident of J^{th} isotope used in cell. Second ident of J^{th} isotope used in cell.
	6E10.5) (CONCTA(J,M), M=1,5),	Concentration of the J^{th} isotope used in the cell in the M^{th} mixture.
	AMAS(J), J=1,ISOX)	Isotope mass used in mubar calculation if first moment kernel is not available.
6.	(OP2F5.0 (WSTBE(J), WSTBG(J),	First ident of J^{th} isotope used in edit. Second ident of J^{th} isotope used in edit.
	E10.5) CONCTE(J), J=1,ISOXE)	Concentration of J^{th} isotope used in edit.

* The only restriction on this is that $\text{ISOX} + \text{ICX} + \text{ISOXE} + \text{ICXE} \leq 30$.

SPEED MESH. IF ISOX + ISOXE $\neq$ 0 IGNORE THIS ITEM

7.	(7E10.5)	(V(I),
I=1,IX)	Speed mesh points v_i in increasing order.
8.	(7E10.5)	(DV(I),
I=1,IX)	Integration weights for speed mesh.

DESCRIPTION OF ISOTOPES USED IN CELL NOT FROM LIBRARY.
IGNORE IF ICX = 0

9.	(OP2F5.0	WSTBA(LP),	First ident of LP^{th} isotope used in cell.
		WSTBB(LP),	Second ident of LP^{th} isotope used in cell.
	6E10.5)	(CONCTA(LP,M)
M=1,5)	Concentration of LP^{th} isotope used in mixture M.
		AMAS(LP)	Mass of the LP^{th} isotope.
10.	(2I5,	NXAT,	If zero, σ_a for the LP^{th} isotope is tabular. If non-zero, σ_a is $1/v$.
		NKERT,	Number of terms in sum for LP^{th} scattering kernel.
	E10.5)	TP	Temperature for isotope LP^{th} scattering kernel.
11.	(7E10.5)	(VALXA(I),

I=1,IX) | Microscopic absorption cross section for LP^{th} isotope.

If $NXAT \neq 0$, only one number, $\sigma_a(kT_o)$, is read. |
| 12. | (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), Value X_n used in n^{th} term of
 N=1,NKERT) LP^{th} isotope scattering kernel.

Items 9-12 are repeated ICX times so that $LP = ISOX$,
 $ISOX + ICX$.

DESCRIPTION OF ISOTOPES USED IN EDIT NOT FROM LIBRARY. IGNORE
 IF ICXE = 0

13. (OP2F5.0	WSTBE(LP),	First ident of LP^{th} isotope
used in edit.
	WSTBG(LP),	Second ident of LP^{th} isotope
used in edit.
E10.5)	CONCTE(LP)	Concentration of LP^{th} isotope
used in edit.
14. (I5)	NXAT	If zero, σ_a for the LP^{th}
isotope is tabular. If non-
zero, σ_a is $1/v$.
15. (7E10.5)	(VALXA(I),	Microscopic absorption cross
section for LP^{th} isotope.
	I=1,IX)	If $NXAT \neq 0$, only one number,
$\sigma_a(kT_0)$, is read.

Items 13-15 are repeated ICXE times so that $LP = ISOXE$,
 $ISOXE + ICXE$.

SLOWING DOWN SOURCE DATA

16. (4I5)	NSC,*	Number of source cards used of
type 18.
	NST	If ≤ 0 , a spatially flat source
is used. If > 0 , the distribu-
tion $S_d(r_i)$ is read

* Normally = 0 since the source for library isotopes is stored
 on the library tape. If $\neq 0$, these sources are added on to
 those from tape.

17. (7E10.5) (SD(N), Spatial source distribution
 $S_d(r_i)$.
N=1,NX) Omit if NST ≤ 0 .
18. (I5, M, Mixture numbers (I-5) in which
this source is used.
4E10.5,I5) AM, Mass used in the calculation
of this source.
HXS, Microscopic high energy cross
for source.
HCON, Concentration of isotope for
this source.
TP Effective temperature of pro-
tons. If this error function
correction is not used, TP = 0.

Item 18 is repeated until NSC cards have been read.

GEOMETRY DATA FOR EITHER SLAB OR CYLINDRICAL GEOMETRY

19. (4I5) LEAKT, a. <0, Full slab with vacuum
boundaries
b. = 0, Half slab with symmetry
and right vacuum boundary or
cylinder with vacuum boundary
c. = 1, slab or cylinder with
reflecting boundaries
d. = 2, Right hand albedoes
will be input*
- NXA, Number of regions.

* This option is currently available only in the fast cosine
current routines.

NGEOM,	a. = 1, Regular cylindrical geometry with Argonne corrections. b. = 2, Fast cosine currents; cylindrical geometry; from SRL. c. = 3, Regular slab geometry with Argonne corrections. d. = 4, Fast cosine currents; slab geometry; from SRL.
NSMR	≠ 0 gives punched card output of a smeared cell which can be used for region input to a later case.
20. (7E10.5) (REFL(I), I=1,IX)	Right hand boundary albedoes for LEAKT = 2. Input from low to high velocities; as many cards as necessary.
21. (2I5, NRXA, NP,	Region number in increasing order. Number of space points in this region.
E10.5) TH	Thickness of this region.

Item 21 is repeated until NRX cards have been read.

ITERATION PARAMETERS

22. (5E10.5, EPS,	Neutron density convergence criterion, $\epsilon_r (= 10^{-5})$.
RELX,	Initial overrelaxation factor, $\omega_0 (= 1.2)$. (If the anisotropy scattering is made RELC = 1.0)

	EPSC,	Extrapolation criterion, $\epsilon_e (= 0.05)$.
	OVERX,	Maximum extrapolation factor (= 100.).
	FACTOR,	Under extrapolation factor (= 1.00).
4I5,	ITBG,	Minimum iterations before extrapolation, $\ell_b (= 5)$. (If anisotropy corr. ITBG = ITMAX + 1 shuts off all extrapolation.)
	LCMX,	Number of overrelaxation factors tested, $\ell_e (= 5)$.
	ITDM,	Minimum delay between extrapo- lations, $\ell_d (= 5)$.
	ITMAX,	Maximum number of iterations allowed (= 100).
I2)	IPT	If >0, record of each iteration is printed (= 0). If ≤ 0 , print is omitted.

If item 22 is a blank card, the values in parenthesis will be used.

EDIT DATA

23. (11I5)	IXPCM,	Number of edit points v^* used ≤ 5 .
	(NLOW(J),	Index of lower bound for edit integral.
	IXPT(J),	Index of upper bound for edit integral.
	J-1,IXPCM)	These indices are input in pairs LOWER - UPPER cutoff

- ## TERMINATION

26. ----- Blank card.

The output from the cell averaging section of the code is shown in equation form on the following pages. This section is divided into two sections with the microscopic cross sections (per isotope) for each region and the cell printed first. The macroscopic region and cell values are printed next. The edit section of the output routine, which follows the cell averaging section has been left unchanged from the original THERMOS code.

MICROSCOPIC VALUES PER ISOTOPE

<u>Quantity</u>	<u>Edit</u>	<u>Calculation Output</u>
Density	Region	N (region)
Partial Density	Region	$\frac{\int_{\text{reg}} N(r) dV}{\int_{\text{cell}} dV}$

<u>Quantity</u>	<u>Edit</u>	<u>Calculation Output</u>
	Region Smear	$\frac{\int_{\text{cell}} N(r) \phi_0(v, r) dv dV}{\int_{\text{cell}} \phi_0(v, r) dv dV}$
	Cell Smear	$\frac{\int_{\text{cell}} N(r) dV}{\int_{\text{cell}} dV}$
Cross Sections ^(a)	Region	$\frac{\int_{\text{reg}} \sigma(v) \phi_i(v, r) dv dV}{\int_{\text{reg}} \phi_i(v, r) dv dV}$
	Region Smear	$\frac{\int_{\text{cell}} \Sigma(v, r) \phi_i(v, r) dv dV}{\int_{\text{cell}} N(r) \phi_i(v, r) dv dV}$
	Cell Smear	$\frac{\int_{\text{cell}} \Sigma(v, r) \phi_i(v, r) dv dV}{\int_{\text{cell}} \phi_i(v, r) dv dV \frac{\int_{\text{cell}} N(r) dV}{\int_{\text{cell}} dV}}$
D	All Types	$1/3 \sigma_{\text{TR}}$

MACROSCOPIC CELL VALUES

<u>Quantity</u>	<u>Edit</u>	<u>Calculation Output</u>
Radius	Region	$R(\text{region})$
Volume Fraction	Region	$\int_{\text{reg}} dV / \int_{\text{cell}} dV$
Flux (ϕ_0) ξ Depression		$\frac{\int_{\text{reg}} \phi_i(v,r) dv dV}{\int_{\text{reg}} dV}$
Current (ϕ_1)		$\frac{\int_{\text{cell}} \phi_i(v,r) dv dV}{\int_{\text{cell}} dV}$
Cross Sections ^(a) ξ Inverse Velocities ^(b)	Region	$\frac{\int_{\text{reg}} \Sigma(v,r) \phi_i(v,r) dv dV}{\int_{\text{reg}} \phi_i(v,r) dv dV}$
	Cell Smear	$\frac{\int_{\text{cell}} \Sigma(v,r) \phi_i(v,r) dv dV}{\int_{\text{cell}} \phi_i(v,r) dv dV}$
D	All Types	$1/3 \Sigma_{\text{TR}}$

(a) Absorption, scattering and fission cross sections are flux (ϕ_0) weighted and the transport and first moment scattering cross sections are current (ϕ_1) weighted.

(b) The inverse velocities are flux (ϕ_0) weighted values.
(NOTE: In this case $\Sigma(v,r) = 1/v$).

REFERENCES

1. H. C. Honeck. THERMOS, A Thermalization Transport Theory Code for Reactor Lattice Calculations, BNL-5826. Brookhaven National Laboratory, Upton, New York, September 1961.
2. J. E. Suich and H. C. Honeck. The HAMMER System, DP 1064. Savannah River Laboratory, Aiken, South Carolina, January 1967.
3. B. J. Toppel and I. Baksys. The Argonne-Revised THERMOS Code, ANL-7023. Argonne National Laboratory, Lemont, Illinois, March 1965.

APPENDIX A
A SAMPLE CASE

INPUT LISTINGS

1 EBWR KINETICS TEST CASE

1 0 8
20 30 3 8 1 0 0 0

11111112223333333333

1001.1029. 6.686 -2

92238110292.0991 -2

94240110292.4969 -5

9424131029 2.3279 -6

8000. 10294.269 -2 3.343 -2

40000 1029 4.226 -2

9223531029 3.4693 -5

9423931029 2.9150 -4

1001.1029.1.

0 0 0 0

1 3 2

1 7 .47245

2 3 .06858

3 10 .40584

1. -5 1.0 .05 100. 1.

1 1 30

11111112223333333333

THERMOS CALCULATION COMPLETED

1.008
238.0
240.
241.
15.9994
91.22
235.
239.

60 5 5 55 1

A-1

BNWL-516

REACT KINETICS TEST CASE

* THERMOS / BATTELLE *

IDENT 1
SPACE POINTS= 20
GROUPS= 30
MINUTES= 0
LIBRARY ISOTOPES IN CELL= 0
LIBRARY ISOTOPES IN ELITE= 1
ADDED ISOTOPES IN CELL= 0
ADDED ISOTOPES IN ELITE= 0
LIBRARY TYPE LABELED AT AUGUST 3, 1966

TRIMOS CASE NO. 1 PAGE 2

ISOTOPE	CONC MIX 1	CONC MIX 2	CONC MIX 3	CONC MIX 4	CONC MIX 5
USED IN CELL					
1001.1029.	-0.00000	-0.00000	6.82800-02	-0.00000	-0.00000
92235.11029.	2.39910-02	-0.00000	-0.00000	-0.00000	-0.00000
94240.11029.	2.49690-03	-0.00000	-0.00000	-0.00000	-0.00000
94241.31029.	2.32790-03	-0.00000	-0.00000	-0.00000	-0.00000
8000.1029.	4.26900-02	-0.00000	3.34300-02	-0.00000	-0.00000
40000.1029.	-0.00000	4.22600-02	-0.00000	-0.00000	-0.00000
92235.31029.	3.46930-03	-0.00000	-0.00000	-0.00000	-0.00000
94239.31029.	2.91500-04	-0.00000	-0.00000	-0.00000	-0.00000
USED IN BOLT					
1001.1029.	1.00000+00				

REGION NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
MIXTURE NO	1	1	1	1	1	1	1	2	2	2	3	3	3	3	3	3	3	3	3	3

SOURCE DATA

NO. OF CARDS= 0

SPACE DIST					
1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00
1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00	1.00000+00

A-3

BNWL-516

TRIMMOS CASE NO. 1 PAGE 3

CYLINDRICAL GEOMETRY, COORDINATE CORRELATES

REGION	THICKNESS	POINT	VOLUME	R(CENTER)	R(INSIDE)
-----	-----	-----	-----	-----	-----
1	4.72450-01	1	4.14931-03	0.00000	0.00000
		2	3.31644-02	7.23646-02	3.63425-02
		3	6.63277-02	1.45389-01	1.00027-01
		4	9.95031-02	2.18054-01	1.61712-01
		5	1.32177-01	2.90730-01	2.54390-01
		6	1.65972-01	3.63423-01	3.27081-01
		7	1.99186-01	4.36100-01	3.90765-01
2	6.85300-02	8	8.95315-02	4.90980-01	4.72450-01
		9	7.27440-02	5.06740-01	4.95310-01
		10	7.60683-02	5.29600-01	5.18170-01
3	4.05540-01	11	1.43135-01	5.61322-01	5.41030-01
		12	1.53604-01	6.01903-01	5.81614-01
		13	1.63533-01	6.42490-01	6.22198-01
		14	1.74132-01	6.83074-01	6.62782-01
		15	1.84530-01	7.23658-01	7.03366-01
		16	1.94879-01	7.64242-01	7.43950-01
		17	2.05228-01	8.04826-01	7.84534-01
		18	2.15577-01	8.45410-01	8.25118-01
		19	2.25926-01	8.85994-01	8.65702-01
		20	2.36274-01	9.26578-01	9.06286-01

A-4

BNWL-516

THERMOS CASE NO. 1 PAGE 4

K,1/2(R,I)

1	1	1.00000	2	1	1.00000	3	1	1.00000	4	1	1.00000	5	1	1.00000	6	1	1.00000	7	1	1.00000
8	1	1.00000	9	1	1.00000	10	1	1.00000	11	1	1.00000	12	1	1.00000	13	1	1.00000	14	1	1.00000
15	1	1.00000	16	1	1.00000	17	1	1.00000	18	1	1.00000	19	1	1.00000	20	1	1.00000	1	2	1.00000
2	2	1.00000	3	2	1.00000	4	2	1.00000	5	2	1.00000	6	2	1.00000	7	2	1.00000	8	2	1.00000
9	2	1.00000	10	2	1.00000	11	2	1.00000	12	2	1.00000	13	2	1.00000	14	2	1.00000	15	2	1.00000
16	2	1.00000	17	2	1.00000	18	2	1.00000	19	2	1.00000	20	2	1.00000	1	3	1.00000	2	3	1.00000
3	3	1.00000	4	3	1.00000	5	3	1.00000	6	3	1.00000	7	3	1.00000	8	3	1.00000	9	3	1.00000
10	3	1.00000	11	3	1.00000	12	3	1.00000	13	3	1.00000	14	3	1.00000	15	3	1.00000	16	3	1.00000
17	3	1.00000	18	3	1.00000	19	3	1.00000	20	3	1.00000	1	4	1.00000	2	4	1.00000	3	4	1.00000
4	4	1.00000	5	4	1.00000	6	4	1.00000	7	4	1.00000	8	4	1.00000	9	4	1.00000	10	4	1.00000
11	4	1.00000	12	4	1.00000	13	4	1.00000	14	4	1.00000	15	4	1.00000	16	4	1.00000	17	4	1.00000
18	4	1.00000	19	4	1.00000	20	4	1.00000	1	5	1.00000	2	5	1.00000	3	5	1.00000	4	5	1.00000
5	5	1.00000	6	5	1.00000	7	5	1.00000	8	5	1.00000	9	5	1.00000	10	5	1.00000	11	5	1.00000
12	5	1.00000	13	5	1.00000	14	5	1.00000	15	5	1.00000	16	5	1.00000	17	5	1.00000	18	5	1.00000
19	5	1.00000	20	5	1.00000	1	6	1.00000	2	6	1.00000	3	6	1.00000	4	6	1.00000	5	6	1.00000
6	6	1.00000	7	6	1.00000	8	6	1.00000	9	6	1.00000	10	6	1.00000	11	6	1.00000	12	6	1.00000
13	6	1.00000	14	6	1.00000	15	6	1.00000	16	6	1.00000	17	6	1.00000	18	6	1.00000	19	6	1.00000
20	6	1.00000	1	7	1.00000	2	7	1.00000	3	7	1.00000	4	7	1.00000	5	7	1.00000	6	7	1.00000
7	7	1.00000	8	7	1.00000	9	7	1.00000	10	7	1.00000	11	7	1.00000	12	7	1.00000	13	7	1.00000
14	7	1.00000	15	7	1.00000	16	7	1.00000	17	7	1.00000	18	7	1.00000	19	7	1.00000	20	7	1.00000
1	8	1.00000	2	8	1.00000	3	8	1.00000	4	8	1.00000	5	8	1.00000	6	8	1.00000	7	8	1.00000
8	8	1.00000	9	8	1.00000	10	8	1.00000	11	8	1.00000	12	8	1.00000	13	8	1.00000	14	8	1.00000
15	8	1.00000	16	8	1.00000	17	8	1.00000	18	8	1.00000	19	8	1.00000	20	8	1.00000	1	9	1.00000
2	9	1.00000	3	9	1.00000	4	9	1.00000	5	9	1.00000	6	9	1.00000	7	9	1.00000	8	9	1.00000
9	9	1.00000	10	9	1.00000	11	9	1.00000	12	9	1.00000	13	9	1.00000	14	9	1.00000	15	9	1.00000
16	9	1.00000	17	9	1.00000	18	9	1.00000	19	9	1.00000	20	9	1.00000	1	10	1.00000	2	10	1.00000
3	10	1.00000	4	10	1.00000	5	10	1.00000	6	10	1.00000	7	10	1.00000	8	10	1.00000	9	10	1.00000
10	10	1.00000	11	10	1.00000	12	10	1.00000	13	10	1.00000	14	10	1.00000	15	10	1.00000	16	10	1.00000
17	10	1.00000	18	10	1.00000	19	10	1.00000	20	10	1.00000	1	11	1.00000	2	11	1.00000	3	11	1.00000
4	11	1.00000	5	11	1.00000	6	11	1.00000	7	11	1.00000	8	11	1.00000	9	11	1.00000	10	11	1.00000
11	11	1.00000	12	11	1.00000	13	11	1.00000	14	11	1.00000	15	11	1.00000	16	11	1.00000	17	11	1.00000
18	11	1.00000	19	11	1.00000	20	11	1.00000	1	12	1.00000	2	12	1.00000	3	12	1.00000	4	12	1.00000
5	12	1.00000	6	12	1.00000	7	12	1.00000	8	12	1.00000	9	12	1.00000	10	12	1.00000	11	12	1.00000
12	12	1.00000	13	12	1.00000	14	12	1.00000	15	12	1.00000	16	12	1.00000	17	12	1.00000	18	12	1.00000
19	12	1.00000	20	12	1.00000	1	13	1.00000	2	13	1.00000	3	13	1.00000	4	13	1.00000	5	13	1.00000
6	13	1.00000	7	13	1.00000	8	13	1.00000	9	13	1.00000	10	13	1.00000	11	13	1.00000	12	13	1.00000
13	13	1.00000	14	13	1.00000	15	13	1.00000	16	13	1.00000	17	13	1.00000	18	13	1.00000	19	13	1.00000
20	13	1.00000	1	14	1.00000	2	14	1.00000	3	14	1.00000	4	14	1.00000	5	14	1.00000	6	14	1.00000
7	14	1.00000	8	14	1.00000	9	14	1.00000	10	14	1.00000	11	14	1.00000	12	14	1.00000	13	14	1.00000
14	14	1.00000	15	14	1.00000	16	14	1.00000	17	14	1.00000	18	14	1.00000	19	14	1.00000	20	14	1.00000
1	15	1.00000	2	15	1.00000	3	15	1.00000	4	15	1.00000	5	15	1.00000	6	15	1.00000	7	15	1.00000
8	15	1.00000	9	15	1.00000	10	15	1.00000	11	15	1.00000	12	15	1.00000	13	15	1.00000	14	15	1.00000
15	15	1.00000	16	15	1.00000	17	15	1.00000	18	15	1.00000	19	15	1.00000	20	15	1.00000	1	16	1.00000
2	16	1.00000	3	16	1.00000	4	16	1.00000	5	16	1.00000	6	16	1.00000	7	16	1.00000	8	16	1.00000
9	16	1.00000	10	16	1.00000	11	16	1.00000	12	16	1.00000	13	16	1.00000	14	16	1.00000	15	16	1.00000

A-5

BNWL-516

THERMOS CASE NO. 1 PAGE 5

EARLIEST EXTRAP= 50
 NO. TESTS= 5
 INCREMENT= 5
 MAX IFS= 55
 CONV CRIT= 1.00000-05
 OVERRELAXATION= 1.00000+00
 EXTRAP CRIT= 5.00000-02
 MAX EXTRAP= 1.00000+02
 FACTOR= 1.00000+00

IT	RENORM	RMS RES	RATIO
1	1.12957	1.5945-02	.6900
2	1.01041	1.3267-02	.6320
3	.99473	9.5242-03	.7028
4	.99443	8.0284-03	.6465
5	.99615	3.6226-03	.6341
6	.99761	2.4503-03	.6411
7	.99856	1.6065-03	.6556
8	.99914	1.0775-03	.6709
9	.99943	7.5695-04	.6837
10	.99968	5.1090-04	.6933
11	.99980	3.5750-04	.6999
12	.99988	2.5181-04	.7042
13	.99992	1.7604-04	.7070
14	.99995	1.2619-04	.7085
15	.99997	8.9569-05	.7093
16	.99998	6.3625-05	.7103
17	.99999	4.5212-05	.7106
18	.99999	3.2131-05	.7107
19	.99999	2.2633-05	.7106
20	1.00000	1.5223-05	.7105
21	1.00000	1.1524-05	.7103
22	1.00000	8.1845-06	.7102
23	1.00000	5.5110-06	.7100
24	1.00000	4.1252-06	.7099
25	1.00000	2.9272-06	.7096
26	1.00000	2.0775-06	.7097
27	1.00000	1.4740-06	.7095
28	1.00000	1.0455-06	.7093
29	1.00000	7.4235-07	.7101

A-7

BNWL-516

TRACONS CASE NO. 1 PAGE 3

ITCAY= 29 RENDOME= 1.00100+00 EPS= 2.50796-05
 LARGEST RES= 2.24202-00 SMALL RES= 7.42394-07 T(V*)= 2.07503-02

KOTR(N,I)

1	1	2.4713-03	1	2	5.1506-02	1	3	1.0504-01	1	4	3.8205-01	1	5	6.4154-01
1	6	9.2419-01	1	7	1.1971+00	1	8	1.4395+00	1	9	1.6335+00	1	10	1.7571+00
1	11	1.0644+00	1	12	1.7603+00	1	13	1.7103+00	1	14	1.5737+00	1	15	1.4102+00
1	16	1.2115+00	1	17	5.9202-01	1	18	7.7607-01	1	19	5.3040-01	1	20	4.1974-01
1	21	2.9272-01	1	22	1.5972-01	1	23	1.3242-01	1	24	5.0619-02	1	25	3.7287-02
1	26	2.2935-02	1	27	3.0301-02	1	28	4.0992-02	1	29	3.4908-02	1	30	3.4952-02
2	1	2.0165-03	2	2	6.0743-02	2	3	1.5954-01	2	4	3.6841-01	2	5	6.4957-01
2	6	9.3323-01	2	7	1.2608+00	2	8	1.4493+00	2	9	1.6431+00	2	10	1.7661+00
2	11	1.0126+00	2	12	1.7909+00	2	13	1.7169+00	2	14	1.5853+00	2	15	1.4158+00
2	16	1.2152+00	2	17	9.0507-01	2	18	7.7639-01	2	19	5.6211-01	2	20	4.2099-01
2	21	2.9306-01	2	22	1.5041-01	2	23	1.3300-01	2	24	5.1190-02	2	25	3.6057-02
2	26	2.0032-02	2	27	3.0005-02	2	28	4.1054-02	2	29	3.5021-02	2	30	3.4957-02
3	1	3.0042-03	3	2	6.6309-02	3	3	2.0110-01	3	4	4.0649-01	3	5	6.7210-01
3	6	9.5947-01	3	7	1.2608+00	3	8	1.4754+00	3	9	1.6730+00	3	10	1.7951+00
3	11	1.0401+00	3	12	1.2109+00	3	13	1.7391+00	3	14	1.6046+00	3	15	1.4314+00
3	16	1.2206+00	3	17	1.0300+00	3	18	7.8647-01	3	19	5.8819-01	3	20	4.2536-01
3	21	2.9690-01	3	22	1.4276-01	3	23	1.3494-01	3	24	8.2970-02	3	25	4.1109-02
3	26	2.5413-02	3	27	3.9007-02	3	28	4.1294-02	3	29	3.5120-02	3	30	3.4978-02
4	1	3.7309-03	4	2	7.4307-02	4	3	2.1734-01	4	4	4.3032-01	4	5	7.4193-01
4	6	9.9305-01	4	7	1.2701+00	4	8	1.5103+00	4	9	1.7116+00	4	10	1.8323+00
4	11	1.0705+00	4	12	1.2520+00	4	13	1.7075+00	4	14	1.6293+00	4	15	1.4524+00
4	16	1.2405+00	4	17	1.1904+00	4	18	7.9080-01	4	19	5.9573-01	4	20	4.3095-01
4	21	3.0100-01	4	22	1.5070-01	4	23	1.3742-01	4	24	5.5275-02	4	25	4.2893-02
4	26	2.7925-02	4	27	4.0000-02	4	28	4.1339-02	4	29	3.5247-02	4	30	3.1006-02
5	1	5.0420-03	5	2	6.5735-02	5	3	2.3809-01	5	4	4.6006-01	5	5	7.3841-01
5	6	1.0354+00	5	7	1.3101+00	5	8	1.5647+00	5	9	1.7573+00	5	10	1.8763+00
5	11	1.9166+00	5	12	1.3607+00	5	13	1.8001+00	5	14	1.6582+00	5	15	1.4770+00
5	16	1.2000+00	5	17	1.3304+00	5	18	8.0084-01	5	19	6.0462-01	5	20	4.3746-01
5	21	3.0589-01	5	22	1.9925-01	5	23	1.4034-01	5	24	8.2016-02	5	25	4.7389-02
5	26	3.1200-02	5	27	4.2005-02	5	28	4.1953-02	5	29	3.5392-02	5	30	3.1037-02
6	1	7.4021-03	6	2	1.0002-01	6	3	2.6400-01	6	4	4.9610-01	6	5	7.8170-01
6	6	1.0840+00	6	7	1.3702+00	6	8	1.6102+00	6	9	1.8097+00	6	10	1.9265+00
6	11	1.9037+00	6	12	1.3820+00	6	13	1.8635+00	6	14	1.6909+00	6	15	1.5047+00
6	16	1.2807+00	6	17	1.0302+00	6	18	8.2242-01	6	19	6.1466-01	6	20	4.4480-01
6	21	3.1130-01	6	22	2.3321-01	6	23	1.4366-01	6	24	9.1178-02	6	25	5.1651-02
6	26	3.5570-02	6	27	4.3477-02	6	28	4.2348-02	6	29	3.5553-02	6	30	3.1072-02
7	1	1.1703-02	7	2	1.1903-01	7	3	2.9503-01	7	4	5.3906-01	7	5	8.2222-01
7	6	1.1400+00	7	7	1.4200+00	7	8	1.6702+00	7	9	1.8609+00	7	10	1.9830+00
7	11	2.0160+00	7	12	1.9795+00	7	13	1.8807+00	7	14	1.7274+00	7	15	1.5356+00
7	16	1.3139+00	7	17	1.3700+00	7	18	8.3746-01	7	19	6.2578-01	7	20	4.5294-01
7	21	5.1743-01	7	22	2.0702-01	7	23	1.4736-01	7	24	9.4762-02	7	25	5.6764-02
7	26	4.0509-02	7	27	4.8000-02	7	28	4.2732-02	7	29	3.5729-02	7	30	3.1110-02

A-8

BNWL-516

TRIMMUS CASE NO. 1 PAGE 7

ITCMT= 29 RENORM= 1.00000+00 EPS= 2.50796-05
LARGEST RES= 2.24262-05 REA: RES= 7.42394-07 $\mu(V^*)$ = 2.87503-02

K,1;N(K,1)

8 1	1.7567-02	8 2	1.4183-01	8 3	3.3183-01	8 4	5.8810-01	8 5	8.0069-01
8 6	1.2057+00	8 7	1.5007+00	8 8	1.7519+00	8 9	1.9409+00	8 10	2.0523+00
8 11	2.0818+00	8 12	2.0392+00	8 13	1.9334+00	8 14	1.7732+00	8 15	1.5746+00
8 16	1.3459+00	8 17	1.0063+00	8 18	8.5671-01	8 19	6.4001-01	8 20	4.6335-01
8 21	3.2514-01	8 22	2.1316-01	8 23	1.5193-01	8 24	9.9051-02	8 25	6.2614-02
8 26	4.6539-02	8 27	4.6980-02	8 28	4.3558-02	8 29	3.5985-02	8 30	3.1214-02
9 1	1.6345-02	9 2	1.4530-01	9 3	3.3913-01	9 4	5.9873-01	9 5	9.0400-01
9 6	1.2211+00	9 7	1.5176+00	9 8	1.7695+00	9 9	1.9584+00	9 10	2.0693+00
9 11	2.0979+00	9 12	2.0539+00	9 13	1.9465+00	9 14	1.7846+00	9 15	1.5843+00
9 16	1.3539+00	9 17	1.1046+00	9 18	8.6150-01	9 19	6.4355-01	9 20	4.6594-01
9 21	3.2708-01	9 22	2.1454-01	9 23	1.5306-01	9 24	1.0008-01	9 25	6.2833-02
9 26	4.7662-02	9 27	4.7439-02	9 28	4.3504-02	9 29	3.6046-02	9 30	3.1225-02
10 1	1.9072-02	10 2	1.4950-01	10 3	3.4593-01	10 4	6.0881-01	10 5	9.1635-01
10 6	1.2354+00	10 7	1.6333+00	10 8	1.7858+00	10 9	1.9747+00	10 10	2.0851+00
10 11	2.1126+00	10 12	2.0676+00	10 13	1.9586+00	10 14	1.7952+00	10 15	1.5933+00
10 16	1.0613+00	10 17	1.1104+00	10 18	8.6595-01	10 19	6.4684-01	10 20	4.6834-01
10 21	3.2685-01	10 22	2.1582-01	10 23	1.5412-01	10 24	1.0193-01	10 25	6.4963-02
10 26	4.6703-02	10 27	4.7668-02	10 28	4.3640-02	10 29	3.6102-02	10 30	3.1232-02
11 1	2.4807-02	11 2	1.7006-01	11 3	3.7918-01	11 4	6.5243-01	11 5	9.6737-01
11 6	1.2911+00	11 7	1.5915+00	11 8	1.6439+00	11 9	2.0302+00	11 10	2.1369+00
11 11	2.1602+00	11 12	2.1097+00	11 13	1.9949+00	11 14	1.8260+00	11 15	1.6190+00
11 16	1.3820+00	11 17	1.1285+00	11 18	8.7814-01	11 19	6.5583-01	11 20	4.7458-01
11 21	3.3372-01	11 22	2.1936-01	11 23	1.5763-01	11 24	1.0377-01	11 25	6.8280-02
11 26	5.1824-02	11 27	4.9148-02	11 28	4.4050-02	11 29	3.6258-02	11 30	3.1193-02
12 1	2.9745-02	12 2	1.9568-01	12 3	4.2225-01	12 4	7.1186-01	12 5	1.0389+00
12 6	1.3706+00	12 7	1.6783+00	12 8	1.9275+00	12 9	2.1096+00	12 10	2.2100+00
12 11	2.2256+00	12 12	2.1667+00	12 13	2.0431+00	12 14	1.8663+00	12 15	1.6526+00
12 16	1.4094+00	12 17	1.1460+00	12 18	8.9428-01	12 19	6.6746-01	12 20	4.6303-01
12 21	3.3983-01	12 22	2.2349-01	12 23	1.6023-01	12 24	1.0659-01	12 25	7.1416-02
12 26	5.4572-02	12 27	5.0245-02	12 28	4.4393-02	12 29	3.6393-02	12 30	3.1203-02
13 1	3.2263-02	13 2	2.1344-01	13 3	4.5476-01	13 4	7.5863-01	13 5	1.0968+00
13 6	1.4364+00	13 7	1.7450+00	13 8	1.9976+00	13 9	2.1768+00	13 10	2.2720+00
13 11	2.2813+00	13 12	2.2192+00	13 13	2.0642+00	13 14	1.9009+00	13 15	1.7814+00
13 16	1.4336+00	13 17	1.1686+00	13 18	9.6026-01	13 19	6.7735-01	13 20	4.8002-01
13 21	3.4467-01	13 22	2.2701-01	13 23	1.6294-01	13 24	1.0695-01	13 25	7.3988-02
13 26	5.6801-02	13 27	5.1134-02	13 28	4.4676-02	13 29	3.6502-02	13 30	3.1210-02
14 1	3.3845-02	14 2	2.2599-01	14 3	4.7950-01	14 4	7.9517-01	14 5	1.1433+00
14 6	1.4900+00	14 7	1.7840+00	14 8	2.0559+00	14 9	2.2329+00	14 10	2.3241+00
14 11	2.3281+00	14 12	2.2551+00	14 13	2.1159+00	14 14	1.9300+00	14 15	1.7057+00
14 16	1.4536+00	14 17	1.1826+00	14 18	9.2094-01	14 19	6.8579-01	14 20	4.6594-01
14 21	3.4692-01	14 22	2.2995-01	14 23	1.6520-01	14 24	1.1039-01	14 25	7.6073-02
14 26	5.6595-02	14 27	5.1650-02	14 28	4.4594-02	14 29	3.6589-02	14 30	3.1216-02

A-9

BNWL-516

THEMOS CASE NO. 1 PAGE 6

ITCITE= 29 REMOR= 1.00104+00 EPS= 2.50795-05
LARGEST RES= 2.24202-05 LEAST RES= 7.42394-07 A(X*)= 2.87503-02

K,1,2(K,1)

15	1	3.4963-02	15	2	2.3511-01	15	3	4.9622-02	15	4	8.2404-01	15	5	1.1803+00
15	6	1.3331+00	15	7	1.1493+00	15	8	2.1036+00	15	9	2.2790+00	15	10	2.3670+00
15	11	2.3665+00	15	12	2.2799+00	15	13	2.1476+00	15	14	1.9542+00	15	15	1.7260+00
15	16	1.4097+00	15	17	1.1935+00	15	18	9.2991-01	15	19	6.9221-01	15	20	5.0086-01
15	21	3.3245-01	15	22	2.3239-01	15	23	1.6785-01	15	24	1.1247-01	15	25	7.7746-02
15	26	6.0026-02	15	27	5.2428-02	15	28	4.5072-02	15	29	3.6659-02	15	30	3.1221-02
16	1	3.5789-02	16	2	2.4178-01	16	3	5.1241-01	16	4	2.4606-01	16	5	1.2092+00
16	6	1.5071+00	16	7	1.1394+00	16	8	2.1417+00	16	9	2.3150+00	16	10	2.4015+00
16	11	2.3950+00	16	12	2.3172+00	16	13	2.1789+00	16	14	1.9738+00	16	15	1.7424+00
16	16	1.4032+00	16	17	1.1382+00	16	18	9.3793-01	16	19	6.9951-01	16	20	5.0403-01
16	21	3.5529-01	16	22	2.3634-01	16	23	1.6654-01	16	24	1.1373-01	16	25	7.6059-02
16	26	6.1145-02	16	27	5.3804-02	16	28	4.5211-02	16	29	3.6713-02	16	30	3.1225-02
17	1	3.6399-02	17	2	2.4695-01	17	3	5.2280-01	17	4	2.6251-01	17	5	1.2310+00
17	6	1.5939+00	17	7	1.1159+00	17	8	2.1710+00	17	9	2.3446+00	17	10	2.4282+00
17	11	2.4221+00	17	12	2.3303+00	17	13	2.1589+00	17	14	1.9829+00	17	15	1.7552+00
17	16	1.4937+00	17	17	1.1178+00	17	18	9.4417-01	17	19	7.0294-01	17	20	5.0793-01
17	21	3.5750-01	17	22	2.3306-01	17	23	1.6982-01	17	24	1.1469-01	17	25	2.0064-02
17	26	6.1950-02	17	27	5.3890-02	17	28	4.5316-02	17	29	3.6753-02	17	30	3.1227-02
18	1	3.6821-02	18	2	2.4525-01	18	3	5.3087-01	18	4	2.7415-01	18	5	1.2468+00
18	6	1.6110+00	18	7	1.1394+00	18	8	2.1922+00	18	9	2.3653+00	18	10	2.4477+00
18	11	2.4397+00	18	12	2.3501+00	18	13	2.2020+00	18	14	2.0001+00	18	15	1.7645+00
18	16	1.5014+00	18	17	1.2207+00	18	18	9.4874-01	18	19	7.0616-01	18	20	5.1018-01
18	21	3.5911-01	18	22	2.3698-01	18	23	1.7052-01	18	24	1.1538-01	18	25	2.6781-02
18	26	6.2389-02	18	27	5.3439-02	18	28	4.5391-02	18	29	3.6732-02	18	30	3.1229-02
19	1	3.7092-02	19	2	2.5198-01	19	3	5.3467-01	19	4	2.8155-01	19	5	1.2565+00
19	6	1.6235+00	19	7	1.1908+00	19	8	2.2089+00	19	9	2.3786+00	19	10	2.4603+00
19	11	2.4311+00	19	12	2.3398+00	19	13	2.2136+00	19	14	2.0073+00	19	15	1.7706+00
19	16	1.5064+00	19	17	1.2248+00	19	18	9.5172-01	19	19	7.0029-01	19	20	5.1165-01
19	21	3.6013-01	19	22	2.3707-01	19	23	1.7133-01	19	24	1.1543-01	19	25	2.1240-02
19	26	6.2974-02	19	27	5.3892-02	19	28	4.5459-02	19	29	3.6801-02	19	30	3.1231-02
20	1	3.7222-02	20	2	2.5290-01	20	3	5.3687-01	20	4	2.8513-01	20	5	1.2613+00
20	6	1.6293+00	20	7	1.1991+00	20	8	2.2128+00	20	9	2.3883+00	20	10	2.4664+00
20	11	2.4567+00	20	12	2.3657+00	20	13	2.2147+00	20	14	2.0106+00	20	15	1.7735+00
20	16	1.5089+00	20	17	1.2208+00	20	18	9.5317-01	20	19	7.0932-01	20	20	5.1237-01
20	21	3.6006-01	20	22	2.3682-01	20	23	1.7132-01	20	24	1.1605-01	20	25	2.1463-02
20	26	6.3169-02	20	27	5.3806-02	20	28	4.5422-02	20	29	3.6810-02	20	30	3.1231-02

A-10

BNWL-516

TRIMBUS CASE NO. 1 PAGE 9

K,1,COMMENT(K,1)

1 1	0.0000	1 2	0.0000	1 3	0.0000	1 4	0.0000	1 5	0.0000
1 6	0.0000	1 7	0.0000	1 8	0.0000	1 9	0.0000	1 10	0.0000
1 11	0.0000	1 12	0.0000	1 13	0.0000	1 14	0.0000	1 15	0.0000
1 16	0.0000	1 17	0.0000	1 18	0.0000	1 19	0.0000	1 20	0.0000
1 21	0.0000	1 22	0.0000	1 23	0.0000	1 24	0.0000	1 25	0.0000
1 26	0.0000	1 27	0.0000	1 28	0.0000	1 29	0.0000	1 30	0.0000
2 1	4.0685-05	2 2	4.0485-03	2 3	2.0033-02	2 4	4.9926-02	2 5	9.4415-02
2 6	1.4927-01	2 7	2.0922-01	2 8	2.8833-01	2 9	3.2042-01	2 10	3.6234-01
2 11	3.9073-01	2 12	4.0350-01	2 13	4.0049-01	2 14	3.8458-01	2 15	3.5723-01
2 16	3.1899-01	2 17	2.7293-01	2 18	2.2501-01	2 19	1.7934-01	2 20	1.4030-01
2 21	1.0971-01	2 22	2.1073-02	2 23	6.7560-02	2 24	5.6342-02	2 25	4.3955-02
2 26	3.2407-02	2 27	3.3979-02	2 28	1.8458-02	2 29	9.7591-03	2 30	2.3736-03
3 1	9.7895-05	3 2	8.2000-03	3 3	3.4579-02	3 4	8.5682-02	3 5	1.8205-01
3 6	2.5690-01	3 7	3.6127-01	3 8	4.6497-01	3 9	5.5732-01	3 10	6.3229-01
3 11	6.8367-01	3 12	7.0789-01	3 13	7.0450-01	3 14	6.7704-01	3 15	6.3078-01
3 16	5.6410-01	3 17	4.8325-01	3 18	3.9873-01	3 19	3.1793-01	3 20	2.4867-01
3 21	1.9411-01	3 22	1.0452-01	3 23	1.1846-01	3 24	9.7605-02	3 25	7.5514-02
3 26	5.6278-02	3 27	5.6944-02	3 28	3.3340-02	3 29	1.7949-02	3 30	4.3904-03
4 1	1.7756-04	4 2	1.1505-02	4 3	4.5904-02	4 4	1.1063-01	4 5	2.0528-01
4 6	3.2166-01	4 7	4.4899-01	4 8	5.7468-01	4 9	6.6573-01	4 10	7.7556-01
4 11	8.3673-01	4 12	6.8473-01	4 13	8.5905-01	4 14	8.2565-01	4 15	7.6752-01
4 16	6.8583-01	4 17	5.8716-01	4 18	4.8427-01	4 19	3.8605-01	4 20	3.0198-01
4 21	2.3593-01	4 22	1.7571-01	4 23	1.4470-01	4 24	1.2061-01	4 25	9.8075-02
4 26	7.5926-02	4 27	7.2873-02	4 28	4.0259-02	4 29	2.1609-02	4 30	5.2840-03
5 1	3.1697-04	5 2	1.6400-02	5 3	5.8031-02	5 4	1.3523-01	5 5	2.4695-01
5 6	3.6203-01	5 7	5.2863-01	5 8	6.7259-01	5 9	7.9833-01	5 10	8.4952-01
5 11	9.6787-01	5 12	9.9788-01	5 13	9.8909-01	5 14	9.4911-01	5 15	8.8126-01
5 16	7.8665-01	5 17	6.7288-01	5 18	5.5466-01	5 19	4.4204-01	5 20	3.4581-01
5 21	2.7050-01	5 22	2.0190-01	5 23	1.6694-01	5 24	1.4110-01	5 25	1.2117-01
5 26	9.7647-02	5 27	8.3329-02	5 28	4.5720-02	5 29	2.4406-02	5 30	5.9642-03
6 1	5.7056-04	6 2	2.0221-02	6 3	7.1804-02	6 4	1.6311-01	6 5	2.9043-01
6 6	4.4347-01	6 7	6.0866-01	6 8	7.6911-01	6 9	9.0793-01	6 10	1.0190+00
6 11	1.0934+00	6 12	1.1246+00	6 13	1.1120+00	6 14	1.0653+00	6 15	9.8789-01
6 16	8.8084-01	6 17	7.8276-01	6 18	6.2013-01	6 19	4.9408-01	6 20	3.8657-01
6 21	3.0275-01	6 22	2.2649-01	6 23	1.8306-01	6 24	1.6125-01	6 25	1.4641-01
6 26	1.2299-01	6 27	9.7642-02	6 28	5.0659-02	6 29	2.6878-02	6 30	6.5608-03
7 1	1.1253-03	7 2	3.0001-02	7 3	1.0206-01	7 4	2.2837-01	7 5	4.0392-01
7 6	6.1601-01	7 7	8.4639-01	7 8	1.0715+00	7 9	1.2674+00	7 10	1.4257+00
7 11	1.5331+00	7 12	1.5798+00	7 13	1.5647+00	7 14	1.5012+00	7 15	1.3942+00
7 16	1.2450+00	7 17	1.0655+00	7 18	8.7868-01	7 19	7.0041-01	7 20	5.4789-01
7 21	4.2608-01	7 22	3.1673-01	7 23	2.6382-01	7 24	2.2400-01	7 25	2.0623-01
7 26	1.7780-01	7 27	1.3682-01	7 28	7.2892-02	7 29	4.0446-02	7 30	1.4689-02

A-11

BNWL-516

Kr1,COEFF(Kr1)

8	1	1.1342-02	8	2	1.4113-01	8	3	5.1692-01	8	4	9.7772-01	8	5	1.6919+00
8	6	2.0423+00	8	7	2.0906+00	8	8	3.2735+00	8	9	3.4259+00	8	10	3.6827+00
8	11	3.8268+00	8	12	3.1204+00	8	13	3.6819+00	8	14	3.4367+00	8	15	3.1371+00
8	16	2.7596+00	8	17	2.3549+00	8	18	1.9008+00	8	19	1.5166+00	8	20	1.1902+00
8	21	9.4789-01	8	22	7.3846-01	8	23	6.4538-01	8	24	6.6011-01	8	25	9.9899-01
8	26	1.1160+00	8	27	4.5119-01	8	28	1.3356-01	8	29	6.5152-02	8	30	2.5840-02
9	1	3.4517-00	9	2	3.2532-00	9	3	2.4284-01	9	4	4.9023-01	9	5	7.8361-01
9	6	1.1030+00	9	7	1.3242+00	9	8	1.7087+00	9	9	1.9234+00	9	10	2.0813+00
9	11	2.1713+00	9	12	2.1701+00	9	13	2.0962+00	9	14	1.9707+00	9	15	1.8013+00
9	16	1.5849+00	9	17	1.3390+00	9	18	1.0958+00	9	19	9.7055-01	9	20	6.8282-01
9	21	5.4392-01	9	22	4.2002-01	9	23	3.6753-01	9	24	3.6445-01	9	25	4.8209-01
9	26	4.8882-01	9	27	2.2100-01	9	28	7.7681-02	9	29	3.5955-02	9	30	5.9229-03
10	1	1.2079-02	10	2	2.1704-01	10	3	5.8094-01	10	4	1.0858+00	10	5	1.6405+00
10	6	2.2075+00	10	7	2.7442+00	10	8	3.1826+00	10	9	3.4689+00	10	10	3.6462+00
10	11	3.7067+00	10	12	3.0272+00	10	13	3.4180+00	10	14	3.1507+00	10	15	2.8312+00
10	16	2.4548+00	10	17	2.1348+00	10	18	1.6752+00	10	19	1.3281+00	10	20	1.0371+00
10	21	3.2997-01	10	22	3.4805-01	10	23	5.6680-01	10	24	5.7478-01	10	25	7.7024-01
10	26	7.9184-01	10	27	3.0197-01	10	28	1.2878-01	10	29	5.5435-02	10	30	-0.7336-03
11	1	3.3654-00	11	2	1.4740-00	11	3	4.8384-02	11	4	1.0382-01	11	5	1.7467-01
11	6	2.5727-01	11	7	3.4702-01	11	8	4.3674-01	11	9	5.1523-01	11	10	5.8796-01
11	11	3.4874-01	11	12	3.1903-01	11	13	7.0427-01	11	14	6.6497-01	11	15	6.5647-01
11	16	5.8909-01	11	17	5.1541-01	11	18	4.2276-01	11	19	3.4792-01	11	20	2.8371-01
11	21	2.0449-01	11	22	1.3012-01	11	23	1.6905-01	11	24	1.7533-01	11	25	2.0503-01
11	26	2.6201-01	11	27	1.8376-01	11	28	4.7237-02	11	29	2.1730-02	11	30	-2.3223-03
12	1	3.8717-04	12	2	1.1410-02	12	3	4.3497-02	12	4	9.6438-02	12	5	1.6602-01
12	6	2.4787-01	12	7	3.3643-01	12	8	4.2339-01	12	9	5.0664-01	12	10	5.6873-01
12	11	6.2250-01	12	12	1.1600-01	12	13	6.6518-01	12	14	6.5396-01	12	15	6.1741-01
12	16	5.5772-01	12	17	4.8103-01	12	18	4.0045-01	12	19	3.2519-01	12	20	2.6143-01
12	21	2.1281-01	12	22	1.8771-01	12	23	1.4627-01	12	24	1.4674-01	12	25	1.0524-01
12	26	2.0067-01	12	27	9.4469-02	12	28	3.4995-02	12	29	1.6394-02	12	30	1.2661-03
13	1	1.8921-04	13	2	3.7114-03	13	3	3.2582-02	13	4	7.5773-02	13	5	1.3383-01
13	6	2.0321-01	13	7	2.7507-01	13	8	3.5379-01	13	9	4.2102-01	13	10	4.8016-01
13	11	5.2674-01	13	12	5.0605-01	13	13	5.6487-01	13	14	5.5558-01	13	15	5.2652-01
13	16	4.7715-01	13	17	4.1248-01	13	18	3.4319-01	13	19	2.7794-01	13	20	2.2285-01
13	21	1.6078-01	13	22	1.9166-01	13	23	1.2292-01	13	24	1.2171-01	13	25	1.5935-01
13	26	1.6224-01	13	27	7.6526-02	13	28	2.8295-02	13	29	1.3200-02	13	30	1.0210-03
14	1	1.2430-04	14	2	6.8623-02	14	3	2.4932-02	14	4	5.9320-02	14	5	1.0701-01
14	6	1.6483-01	14	7	2.1536-01	14	8	2.9179-01	14	9	3.4919-01	14	10	3.9963-01
14	11	4.5926-01	14	12	4.6445-01	14	13	4.7261-01	14	14	4.6552-01	14	15	4.0205-01
14	16	4.0160-01	14	17	3.4775-01	14	18	2.8928-01	14	19	2.3377-01	14	20	1.8700-01
14	21	1.5124-01	14	22	1.1794-01	14	23	1.0187-01	14	24	9.9743-02	14	25	1.2878-01
14	26	1.3902-01	14	27	6.1149-02	14	28	2.2671-02	14	29	1.0542-02	14	30	8.1507-04

A-12

BNWL-516

THERMOS CASE NO. 1 PAGE 11

K,1,CURRENT(K,1)

15 1	3.9374-03	15 2	4.5584-03	15 3	1.8879-02	15 4	4.5956-02	15 5	6.4347-02
15 6	1.3145-01	15 7	1.8363-01	15 8	2.3603-01	15 9	2.5332-01	15 10	3.2582-01
15 11	3.5877-01	15 12	3.7986-01	15 13	3.8707-01	15 14	3.8172-01	15 15	3.4301-01
15 16	3.3642-01	15 17	2.2634-01	15 18	2.3829-01	15 19	1.9224-01	15 20	1.5349-01
15 21	1.2382-01	15 22	9.0158-02	15 23	8.2734-02	15 24	8.0240-02	15 25	1.6236-01
15 26	1.0261-01	15 27	4.5215-02	15 28	1.7891-02	15 29	6.2917-03	15 30	6.4150-04
16 1	6.5793-03	16 2	3.3097-03	16 3	1.4063-02	16 4	3.4867-02	16 5	6.4871-02
16 6	1.0208-01	16 7	1.4354-01	16 8	1.8541-01	16 9	2.2364-01	16 10	2.5762-01
16 11	2.6411-01	16 12	3.6115-01	16 13	3.0722-01	16 14	3.0324-01	16 15	2.8870-01
16 16	2.6318-01	16 17	2.2847-01	16 18	1.8957-01	16 19	1.5306-01	16 20	1.2201-01
16 21	9.6212-02	16 22	7.5823-02	16 23	6.5192-02	16 24	6.2729-02	16 25	7.6227-02
16 26	7.6943-02	16 27	5.7670-02	16 28	1.3789-02	16 29	6.3633-03	16 30	4.6335-04
17 1	4.7450-06	17 2	2.3443-03	17 3	1.0126-02	17 4	2.5450-02	17 5	4.7846-02
17 6	7.5850-02	17 7	1.0721-01	17 8	1.3904-01	17 9	1.6838-01	17 10	1.6420-01
17 11	2.1442-01	17 12	2.2747-01	17 13	2.3226-01	17 14	2.2940-01	17 15	2.1859-01
17 16	1.9946-01	17 17	1.7333-01	17 18	1.4410-01	17 19	1.1598-01	17 20	9.2336-02
17 21	7.4195-02	17 22	5.7277-02	17 23	4.8933-02	17 24	4.6846-02	17 25	5.8687-02
17 26	5.5189-02	17 27	2.7313-02	17 28	1.0148-02	17 29	4.6737-03	17 30	3.6367-04
18 1	3.2037-05	18 2	1.5558-03	18 3	6.8036-03	18 4	1.7259-02	18 5	3.2687-02
18 6	5.2101-02	18 7	7.3930-02	18 8	9.6154-02	18 9	1.1672-01	18 10	1.3482-01
18 11	1.4899-01	18 12	1.8817-01	18 13	1.6155-01	18 14	1.5968-01	18 15	1.5222-01
18 16	1.3904-01	18 17	1.2088-01	18 18	1.0049-01	18 19	5.0820-02	18 20	6.4276-02
18 21	5.1579-02	18 22	3.9740-02	18 23	3.3913-02	18 24	3.2282-02	18 25	4.0201-02
18 26	3.9702-02	18 27	1.3631-02	18 28	6.9197-03	18 29	3.1853-03	18 30	2.4788-04
19 1	1.6428-05	19 2	8.5781-04	19 3	3.8977-03	19 4	9.9450-03	19 5	1.8929-02
19 6	3.6275-02	19 7	4.3872-02	19 8	5.6129-02	19 9	6.8238-02	19 10	7.8903-02
19 11	5.7259-02	19 12	9.2586-02	19 13	9.4732-02	19 14	9.3636-02	19 15	8.9290-02
19 16	6.1601-02	19 17	7.8963-02	19 18	5.8994-02	19 19	4.7427-02	19 20	3.7694-02
19 21	3.0223-02	19 22	2.3256-02	19 23	1.9821-02	19 24	1.8809-02	19 25	2.7326-02
19 26	2.2983-02	19 27	1.6784-02	19 28	4.0083-03	19 29	1.8439-03	19 30	1.4363-04
20 1	0.0000	20 2	0.0000	20 3	0.0000	20 4	0.0000	20 5	0.0000
20 6	0.0000	20 7	0.0000	20 8	0.0000	20 9	0.0000	20 10	0.0000
20 11	0.0000	20 12	0.0000	20 13	0.0000	20 14	0.0000	20 15	0.0000
20 16	0.0000	20 17	0.0000	20 18	0.0000	20 19	0.0000	20 20	0.0000
20 21	0.0000	20 22	0.0000	20 23	0.0000	20 24	0.0000	20 25	0.0000
20 26	0.0000	20 27	0.0000	20 28	0.0000	20 29	0.0000	20 30	0.0000

A-13

BNWL-516

THERMOS CASE NO. 1 PAGE 12
 AVERAGES FOR I= 1 TO I=30 X= 1.58100-01 TO Y= 5.14579+00
 Z= 5.78809-04 TO L= 5.28005-21

MATERIALS USED IN CELL

MICROSCOPIC CONSTANTS FOR TOSTOP: 1 1/0.332 TEL NUMBER 1001. 1029.

REG	WIX	DENSITY	PARTIAL DENSITY	SIGMA A	SIGMA S	NO*SIGMA F	SIGMA TP	SIGMA S1	D
1	1	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	2	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	3	0.0000-02	0.0000-02	2.0301-01	4.0633+01	0.0000	2.9633+01	9.9907+00	1.1247-02
REG. SKEW VALUES			4.7474-02	2.0301-01	4.0633+01	0.0000	2.9633+01	9.9907+00	1.1247-02
CELL SKEW VALUES			4.8001-02	2.0375-01	4.2597+01	0.0000	1.3611+01	4.5480+00	2.4491-02
		*****	*****	*****	*****	*****	*****	*****	

MICROSCOPIC CONSTANTS FOR TOSTOP: 1 1/0.332 TEL NUMBER 1001. 1029.

REG	WIX	DENSITY	PARTIAL DENSITY	SIGMA A	SIGMA S	NO*SIGMA F	SIGMA TP	SIGMA S1	D
1	1	2.0091-02	5.2205-03	2.0327+00	8.3123+00	0.0000	1.0474+01	2.3289-02	3.1824-02
2	2	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	3	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
REG. SKEW VALUES			4.8492-03	2.0327+00	8.3123+00	0.0000	1.0474+01	2.3289-02	3.1824-02
CELL SKEW VALUES			5.2205-03	1.7652+00	7.2307+00	0.0000	1.4713+01	3.2714-02	2.2655-02
		*****	*****	*****	*****	*****	*****	*****	

A-14

BNWL-516

THERMOS CASE NO. 1 PAGE 23
 AVERAGES FOR I= 1 TO I=30 V= 1.50100-01 TO V= 5.19579+00
 E= 5.70009-04 TO E= 6.15008-01

MATERIALS USED IN CELL

MICROSCOPIC CONSTANTS FOR ISOTOPE PU40L126 DSJ NUMBER 94240. 11029.

REG MIX	DENSITY	PARTIAL DENSITY	SIGMA A	SIGMA S	NU*SIGMA F	SIGMA TR	SIGMA S1	D
1 1	2.4959-05	5.2183-06	2.3341+02	9.6137+00	1.1501-01	2.5244+02	2.6712-02	1.3205-03
2 2	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3 3	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
REG. SKEAR VALUES		5.4118-06	2.3341+02	9.6137+00	1.1501-01	2.5244+02	2.6712-02	1.3205-03
CELL SKEAR VALUES		5.2183-06	2.0319+02	8.3690+00	1.0012-01	3.5460+02	3.7522-02	9.4003-04
*****	*****	*****	*****	*****	*****	*****	*****	

MICROSCOPIC CONSTANTS FOR ISOTOPE PU40L126 DSJ NUMBER 94241. 31029.

REG MIX	DENSITY	PARTIAL DENSITY	SIGMA A	SIGMA S	NU*SIGMA F	SIGMA TR	SIGMA S1	D
1 1	2.3279-06	5.7956-07	1.1245+03	9.6137+00	2.4613+03	1.2533+03	2.6600-02	2.6597-04
2 2	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3 3	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
REG. SKEAR VALUES		5.0450-07	1.1245+03	9.6137+00	2.4613+03	1.2533+03	2.6600-02	2.6597-04
CELL SKEAR VALUES		5.7956-07	9.7887+02	8.3690+00	2.1426+03	1.7605+03	3.7366-02	1.8934-04
*****	*****	*****	*****	*****	*****	*****	*****	

A-15

BNWL-516

THERMOS CASE NO. 1 PAGE 24
 AVERAGES FOR I= 1 TO IEND= 1.0000-01 TO V= 5.19579+00
 L= 5.7009-04 TO E= 5.0000-01

MATERIALS USED IN CELL

MICROSCOPIC CONSTANTS FOR ISOTOPE 016 1/V1.6-N ISU NUMBER 5000. 1029.

=====									
REG	PIX	DENSITY	PARTIAL DENSITY	SIGMA A	SIGMA S	RU*SIGMA F	SIGMA TR	SIGMA S1	D
---	---	-----	-----	-----	-----	-----	-----	-----	-----
1	1	4.2090-02	1.0000-02	1.3242-04	3.2518+00	0.0000	3.6963+00	1.6071-01	9.0179-02
2	2	-0.0000	0.0000	1.3000	3.0000	0.0000	0.0000	0.0000	0.0000
3	3	3.5430-02	2.0000-02	2.3716-04	3.2499+00	0.0000	3.6833+00	1.6014-01	9.0499-02
REG. SLEAK VALUES			3.0000-02	1.3500-04	3.5478+00	0.0000	3.6910+00	1.6048-01	9.0310-02
CELL SLEAK VALUES			2.0000-02	1.3523-04	3.0299+00	0.0000	2.8140+00	1.2235-01	1.1845-01

MICROSCOPIC CONSTANTS FOR ISOTOPE 28 THE ISU NUMBER 40000. 1029.

=====									
REG	PIX	DENSITY	PARTIAL DENSITY	SIGMA A	SIGMA S	RU*SIGMA F	SIGMA TR	SIGMA S1	D
---	---	-----	-----	-----	-----	-----	-----	-----	-----
1	1	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	2	4.2260-02	3.2701-02	1.3300-01	8.0313+00	0.0000	8.1360+00	5.8781-02	4.0970-02
3	3	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
REG. SLEAK VALUES			3.0000-02	1.3300-01	8.0313+00	0.0000	8.1360+00	5.8781-02	4.0970-02
CELL SLEAK VALUES			2.2701-02	1.2804-01	7.5788+00	0.0000	3.5787+01	2.5855-01	9.3145-03

A-16

BNWL-516

THERMOS CASE NO. 1 PAGE 15
 AVERAGES FOR I= 1 TO I=30 V= 1.50100-01 TO V= 5.19579+00
 E= 5.70009-04 TO E= 6.83005-01

MATERIALS USED IN CELL

MICROSCOPIC CONSTANTS FOR ISOTOPE U235+TAB ESU NUMBER 92235, 31029.

REG MIX	DENSITY	PARTIAL DENSITY	SIGMA A	SIGMA S	NU*SIGMA F	SIGMA TR	SIGMA S1	D
1 1	3.4893-05	8.6372-06	4.8458+02	1.0015+01	1.0033+03	5.4061+02	2.8418-02	6.1659-04
2 2	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3 3	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
REG. SHEAR VALUES		7.5109-06	4.8458+02	1.0015+01	1.0033+03	5.4061+02	2.8418-02	6.1659-04
CELL SHEAR VALUES		8.6372-06	4.2162+02	8.7180+00	8.7340+02	7.5940+02	3.9918-02	4.3894-04

MICROSCOPIC CONSTANTS FOR ISOTOPE PU39+TAB ESU NUMBER 94239, 31029.

REG MIX	DENSITY	PARTIAL DENSITY	SIGMA A	SIGMA S	NU*SIGMA F	SIGMA TR	SIGMA S1	D
1 1	2.9150-04	7.2572-05	9.8028+02	9.6135+00	1.9456+03	1.1404+03	2.6823-02	2.9229-04
2 2	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3 3	-0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
REG. SHEAR VALUES		8.3176-05	9.8028+02	9.6135+00	1.9456+03	1.1404+03	2.6823-02	2.9229-04
CELL SHEAR VALUES		7.2572-05	8.6335+02	8.3591+00	1.6932+03	1.6019+03	3.7679-02	2.0808-04

A-17

BNWL-516

THERMOS CASE NO. 1 PAGE 16
 AVERAGES FOR I= 1 TO I=30 V= 1.56100-01 TO V= 5.19579+00
 E= 5.70009-04 TO E= 6.63005-01

MACROSCOPIC CELL VALUES
 =====

REG	WIA	RADIUS	VOLUME FRACTION	FLUX DEPRESSION	CURRENT DEPRESSION	INVERSE VELOCITY	SIGMA A	SIGMA S	NU*SIGMA F	SIGMA S1	D
---	---	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1	1	4.7245-01	2.4898-01	8.7053-01	1.4047+00	7.3567-01	3.5368-01	3.4189-01	6.0750-01	7.3591-03	4.5163-01
2	2	5.4103-01	7.7523-02	9.4380-01	4.3985+00	7.4370-01	5.6571-03	3.3940-01	0.0000	2.4841-03	9.6948-01
3	3	9.4687-01	6.7352-01	1.0543+00	4.5923-01	7.6209-01	1.6921-02	2.8488+00	0.0000	6.7333-01	1.5837-01
CELL SPHER VALUES			1.0000+00	1.0000+00	1.0000+00	7.5502-01	8.9082-02	2.1219+00	1.3166-01	2.1168-01	3.2478-01

THERMOS CASE NO. 1 PAGE 17
 AVERAGES FOR I= 1 TO I=50 VE= 1.58100-01 TO VE= 5.19579+00
 EE= 5.70009-04 TO EE= 5.13615-01

MATERIALS USED IN 2011

ISOTOPE			1001.	1025.							
=====			=====		1.0000+00	=====		=====		=====	
CONCENTRATION											
POINT	REG	MIX	SIG A	REL ACT		SIGMA A	REL ACT	SIGMA A	REL ACT	SIGMA A	REL ACT
-----	----	----	-----	-----		-----	-----	-----	-----	-----	-----
1	1	1	2.4175-01	1.0500+00							
2	1	1	2.4182-01	1.0555+00							
3	1	1	2.4242-01	1.0225+00							
4	1	1	2.4306-01	1.0446+00							
5	1	1	2.4302-01	1.0716+00							
6	1	1	2.4569-01	1.1017+00							
7	1	1	2.4580-01	1.1367+00							
AVE	1	1	2.4428-01	1.0650+00							
8	2	2	2.4678-01	1.1791+00							
9	2	2	2.4632-01	1.1892+00							
10	2	2	2.4710-01	1.1885+00							
AVE	2	2	2.4651-01	1.1692+00							
11	3	3	2.4826-01	1.2303+00							
12	3	3	2.5002-01	1.2730+00							
13	3	3	2.5105-01	1.3056+00							
14	3	3	2.5265-01	1.3279+00							
15	3	3	2.5312-01	1.3611+00							
16	3	3	2.5370-01	1.3858+00							
17	3	3	2.5416-01	1.3954+00							
18	3	3	2.5462-01	1.4159+00							
19	3	3	2.5451-01	1.4127+00							
20	3	3	2.5476-01	1.4161+00							
AVE	3	3	2.5361-01	1.3610+00							

THERMOS CALCULATION COMPLETED

A-19

BNWL-516

•

•

•

•

•

•

•

•

•

•

•

•

BNWL-516

APPENDIX B
PROGRAM LISTING

W LIT THERM,1,670118, 31052

000001 THERM SEG THERMO-XPREP-*(GEOM,GEOR1,GEOX1,GEOX,ITER-EDIT,SMR)

B-1

BNWL-516

W ELY THERMO,1,621009, 41556

```
000001      DIMENSION FTBX(7),NTIM(6)
000002      10 CALL SLTDR(11,1353200,9000,FTBX)
000003          NN3=3
000004          NN4=4
000005          NN5=5
000006          NN6=6
000007      500 CALL XPRER(NTIM(NN3),NTIM(NN4),NTIM(NN5),NTIM(NN6))
000008      END
```

2. LIST XPRER

@ ELT XPREP,1,661009, 41602

```

000001      SUBROUTINE XPREP(NQ1,NQ2,NQ3,NQ4)
000002      DIMENSION T(10,30,30),F(30,30),H(30,30),R(30,30),P(30,30,6),VOL(30)
000003      1,RAL(30),DV(30),V(30),MTBL(30),Q(30,30),XTM(30,30),XAM(30,30),IXPT
000004      2(6),NRTBL(30),ISTBA(30),ISTBB(30),ISTBE(30),ISTBG(30),CONCTA(30,6)
000005      3,CONCTE(30),XAT(30,30),XST(30,30),XATE(30,30),S(30,30),
000006      4XA(30),PP(30,30),SQ(30),SP(30)
000007      DIMENSION AT(10),AKT(10)
000008      COMMON T
000009      COMMON F      , H      , R      , P      , VOL      , RAD
000010      COMMON DV      , V      , MTBL      , Q      , XTM      , XAM
000011      COMMON IXPT      , NRTBL      , ISTBA      , ISTBB      , ISTBE      , ISTBG
000012      COMMON CONCTA      , CONCTE      , XAT      , XST      , XATE      , S
000013      COMMON IX      , NX      , IXPC      , ISOX      , ISOXE      , LEAKT
000014      COMMON NPAGE      , IDENT      , MX      , NTIN      , NTOUT      , NTLIB
000015      COMMON NTPUN,NTEMP,IBY,NXA
000016      DIMENSION PP1(30,30)
000017      EQUIVALENCE(PP,T),(PP1,T(901))
000018      COMMON/LIFUSE/ISOT ,HOLID(3,30),NKERNT(30),AMAS(30),RI(30),RO(30)
000019      DIMENSION VNUT(30),XFT(30,30),XS(30),XF(30),HOLC(3),HOLT(3)
000020      DIMENSION WSTBA(30),WSTBB(30)
000021      EQUIVALENCE (VNUT,CONCTE),(XATE,XFT),(ISTBA,WSTBA),(ISTBB,WSTBB)
000022      NTIN=5
000023      NTOUT=6
000024      NTEMP=4
000025      100 READ (NTIN,110)
000026      110 FORMAT(72H
000027      1
000028      WRITE (NTOUT,110)
000029      120 FORMAT(915)
000030      READ (NTIN,120)IDENTA,IBY,NTLIB
000031      IF (IDENTA)121,121,123
000032      121 RETURN
000033      123 WRITE (NTOUT,3000)
000034      3000 FORMAT(///54X22H*****54X22H* THERMOS / BATTELLE
000035      1*/54X22H*****54X22H*)
000036      IF (IBY) 122,127,122
000037      122 WRITE (NTOUT,125) IDENTA,IDENT
000038      125 FORMAT(6H01CENT16,15H SAME XSECT AS16)
000039      IDENT=IDENTA
000040      IF (IBY)890,890,890
000041      127 LMX=1ACS(LOC(T)-LOC(IX))+1
000042      IXOF=0
000043      DO128 I=1,LMX
000044      128 T(1,1,1)=0.

```

*NEW
*NEW
*NEW
*NEW
**=5

*NEW
**=1

B-3

BNWL-516

```

000045      ISOT=IDENTA
000046      140  FOR AT(7E10,5)
000047          READ(NTIN,120) NX,IX,IX,ISOX,ISOXE,ICX,ICXE,NANI
000048          WRITE(NTOUT,130)IDENT,NX,IX,IX,ISOX,ISOXE,ICX,ICXE
000049      130  FOR AT(6H01,ENT16/14H0SPACE POINTS=13/8H GROUPS=13/10H MIXTURES=13
000050          1/26H LIBRARY ISOTOPES IN CELL=13/26H LIBRARY ISOTOPES IN EDIT=13/2
000051          24H ADDED ISOTOPES IN CELL=13/24H ADDED ISOTOPES IN EDIT=13)
000052          IF (ISOX+ISOXE+ICX+ICXE)135,135,137
000053      135  CALL STOP(100)
000054          137  ISOXI=ISOX+ICX
000055          ISOXEI=ISOXE+ICXE
000056          ISOI=ISOXI+ISOXEI
000057          IF (ISOI,3E,30) CALL STOP(103)
000058      160  READ (NTIN,170) (NTEL(N),N=1,NX)
000059      170  FOR AT(5011)
000060          READ(NTIN,180) (NSTEA(J),NSTEB(J),(CONCTA(J,M),M=1,5),AMAS(J),
000061          10=1,ISOX)
000062          100  FOR AT(0P2F5,0,6E10,5)
000063              IF (ISOXI)195,195,195
000064          125  JTOP=ISOXI+1
000065              JTOP=ISOXI+ISOXE
000066              READ(NTIN,190) (NSTEA(J),NSTEB(J),CONCTA(J,1),J=JPOT,JTOP)
000067          190  FOR AT(0P2F5,0,1E10,5)
000068              195  JPAGE=1
000069                  IF (ISOX+ISOXE)200,197,200
000070          197  READ (NTIN,140) (V(I),I=1,IX)
000071              READ (NTIN,140) (DV(I),I=1,IX)
000072              GO TO 200
000073          200  REMIND NTL1B
000074              READ(NTL1B) IXA,HOLT,V,DV
000075              IF (IX-IXA)210,220,210
000076          210  REMIND NTL1B
000077              CALL STOP(104)
000078          220  WRITE(NTOUT,225) HOLT
000079          225  FOR AT(22H LIBRARY TAPE LABEL= 3A6)
000080              ISOC=0
000081              DO 290 I=1,ISOT
000082          290  IF (.STEA(I),EW,0,0) ISOC =ISOC+1
000083          300  READ (NTL1B)XA,XS,HOLC,OKERN,VNU,XA,XS,XF,SP
000084              IF (IX) 305,305,309
000085          305  REMIND NTL1B
000086              CALL STOP(101)
000087              GO TO 300
000088          309  JTOP=1
000089          310  DO 320 J=JTOP,ISOT
000090              L=J
000091              IF (.STEA(J)-XA) 320,315,320
000092          315  IF (.STEB(J)-XS) 320,330,320
000093          320  CONTINUE

```

```

000094      IF (RKERN.LE.0.OR.URGT.NE.1) GO TO 300
000095      325 DO 326 J=1,NKERN
000096      328 READ (NTLIB)
000097      GO TO 300
000098      330 ISOC=ISOC+1
000099      DO 340 J=1,3
000100      340 HCLID(J,L) = HCLC(J)
000101      VROT(L)=VAV
000102      RKERN(L) = RKERN
000103      DO 360 I=1,IX
000104      XAT(L,I) = XA(I)
000105      XSI(L,I) = XS(I)
000106      360 XFI(L,I) = XF(I)
000107      IF (L-ISOX) 370,370,365
000108      365 IF (RKERN.LE.0.OR.URGT.NE.1) GO TO 490
000109      366 DO 368 J=1,NKERN
000110      368 READ (NTLIB)
000111      GO TO 490
000112      370 IF (RKERN) 375,375,369
000113      375 DO 379 M=1,NX
000114      IF (CONCTA(L,M)) 376,379,376
000115      376 DO 378 J=1,IX
000116      378 P(J,J,M) = P(J,J,M)+CONCTA(L,M)*XS(J)
000117      379 CONTINUE
000118      GO TO 460
000119      380 IF (URGT.NE.1) GO TO 381
000120      READ (NTLIB) PP
000121      381 DO 390 I=1,NX
000122      IF (CONCTA(L,I)) 383,390,383
000123      383 DO 385 J=1,IX
000124      DO 385 I=1,IX
000125      385 P(I,J,I)=P(I,J,M) + CONCTA(L,I)*PP(I,J)/V(I)
000126      390 CONTINUE
000127      IF (RKERN=1) 460,460,400
000128      400 IF (URGT.NE.1) GO TO 401
000129      READ (NTLIB) PP1
000130      401 IF (MANI.NE.1) GO TO 450
000131      DO 420 J=1,IX
000132      XS(J)=0.
000133      DO 410 I=1,IX
000134      410 XS(J) = XS(J) + PP1(I,J) * DV(I)
000135      420 XS(J)=XS(J)/(V(J)*DV(J))
000136      421 DO 430 M=1,NX
000137      IF (CONCTA(L,M)) 423,430,423
000138      423 DO 425 J=1,IX
000139      425 P(J,J,M) = P(J,J,M) - CONCTA(L,M)*XS(J)
000140      430 CONTINUE
000141      DO 440 N=1,NX
000142      M = NTEL(N)

```

```

000143      IF(CONCTA(L,M)) 435,440,435
000144      DO 437 J=1,IX
000145      437 XTH(N,J)= XTH(N,J) - CONCTA(L,M)*XS(J)
000146      440 CONTINUE
000147      IF(LXKERN=1) 480,480,450
000148      450 NKUP=NKUP+1
000149      IF(NKUP.GT.9) GO TO 457
000150      NKERN(L) = NKUP*1000 + NKERN
000151      WRITE(11) PP1
000152      GO TO 480
000153      457 NKERN(L) = 1
000154      GO TO 480
000155      C          NO FIRST MOMENT KERNELS
000156      480 IF(LAMP.EQ.1) GO TO 480
000157      DO 485 I=1,IX
000158      485 XS(J) = 2./3./AMAS(L)*XS(J)
000159      GO TO 481
000160      480 DO 480 I=1,NX
000161      I=3-L(N)
000162      IF(CONCTA(L,M)) 482,485,482
000163      482 DO 484 I=1,IX
000164      XAH(N,I) = XAH(N,I) + CONCTA(L,M)*XA(I)
000165      XTH(N,I) = XTH(N,I) + CONCTA(L,M)*(XA(I)+XST(L,I))
000166      S(N,I) = S(N,I) + CONCTA(L,M)*SF(I)/V(I)
000167      484 CONTINUE
000168      485 CONTINUE
000169      490 IF(1500.GE.1501) GO TO 500
000170      IF(LXKERN.LE.2.OR.JPOT.EQ.1) GO TO 495
000171      DO 498 J=3,NKERN
000172      498 READ(NTL13)
000173      495 IF(L.GE.1501) GO TO 300
000174      JCVI=L+1
000175      GO TO 310
000176      500 READ(NTL13)
000177      1000 IF(10X)1100,1100,1010
000178      1010 DO1000L=1,10X
000179      LP=L+150X
000180      READ(NT11,180) *STBA(LP),*STBB(LP),*(CONCTA(LP,M),M=1,5),AMAS(LP)
000181      READ(NT11,1015),NXAT,NKERT,TF
000182      1015 FOR A1(215,6E10.5)
000183      IF(NXAT)1020,1030,1020
000184      1020 READ(NT11,140) VALXA,VALXF,VNU,VALXS
000185      DO1025I=1,IX
000186      XA(I)=VALXA/V(I)
000187      XF(I)=VALXF/V(I)
000188      1025 XS(I)=VALXS
000189      GO TO 1035
000190      1030 READ(NT11,140) XA
000191      READ(NT11,140) XF

```

```

000192      READ(NTIN,140) VNU
000193      IF(NKERT) 1031,1032,1035
000194      1031 READ(NTIN,140) PP
000195      1032 READ(NTIN,140) XS
000196      1035 WRITE(NTOUT,1040) *STBA(LP),*STBL(LP),TP
000197      1040 FORMAT(15HOADDED ISOTOPE 0PF6.0,1H-,0PF6.0,12H IN CELL, T=1PE12.5)
000198      IF(NKERT) 1058,1060,1050
000199      1050 READ(NTIN,1055)(AT(I),AMT(I),AKT(I),I=1,NKERT)
000200      1055 FORMAT(3E10.5)
000201      WRITE(NTOUT,1056)(AT(I),AMT(I),AKT(I),I=1,NKERT)
000202      1056 FORMAT(6H XS=1PE12.5,6H M=E12.5,10H KAPPA=E12.5)
000203      DO 1057 I=1,IX
000204      1057 XS(I)=0.
000205      CALL BASK(PP,V,DV,XS,AT,AKT,AMT,TP,IX,NKERT)
000206      1060 NKERT=IABS(NKERT)
000207      DO1070 I=1,IX
000208      IF(CONCTA(LP,I))1060,1070,1060
000209      DO1065J=1,IX
000210      DO1065I=1,IX
000211      1065 F(I,J,I)=P(I,J,I)+CONCTA(LP,I)*PP(I,J)/V(I)
000212      1070 CONTINUE
000213      DO1077I=1,IX
000214      XAT(LP,I) = XA(I)
000215      XFI(LP,I) = XF(I)
000216      1077 XST(LP,I) = XS(I)
000217      VNUOT(LP) = VNU
000218      NKERTNT(LP) = NKERT
000219      DO 1079 N=1,IX
000220      * = NTEL(N)
000221      DO 1079 I=1,IX
000222      XAN(N,I)=XAN(N,I) + CONCTA(LP,I)*XA(I)
000223      1079 XTN(N,I)=XTN(N,I) + CONCTA(LP,I)*(XA(I)+XS(I))
000224      1080 CONTINUE
000225      1100 IF(1CXZ)1100,1160,1110
000226      1110 DO1100L=1,1CXZ
000227      LP=L+150AT+ 150XE
000228      READ(NTIN,120) *STBA(LP),*STBL(LP),CONCTA(LP,I)
000229      READ(NTIN,120) *XAT
000230      IF(*XAT)1120,1130,1120
000231      1120 READ(NTIN,140) VALXA,VALXF,VNU,VALXS
000232      DO1125I=1,IX
000233      XAT(LP,I) = VALXA/V(I)
000234      XFI(LP,I) = VALXF/V(I)
000235      1125 XST(LP,I) = VALXS
000236      VNUOT(LP) = VNU
000237      GO1135
000238      1130 READ(NTIN,140) (XAT(LP,I),I=1,IX)
000239      READ(NTIN,140) (XFI(LP,I),I=1,IX)
000240      READ(NTIN,140) VNUOT(LP)

```



```

000241      READ (N710,140) (XST(LP,I),I=1,IX)
000242      KXNDAT(LP)=0
000243      WRITE (N700T,1140) NSIPA(LP),,STRE(LP)
000244      1140  FORMAT(10HUNDOED ISOTOPE UPF6.0,1H-,UPF6.0,9H IN EDIT )
000245      1150  CONTINUE
000246      1160  ISX=ISOX+1CX
000247      ISXAL=ISOXAL+1CXE
000248      2010  NPAGE=PAGE+1
000249      WRITE (N700T,2010) IDENT,NPAGE
000250      2010  FORN AT(17HOTHERS CASE NO.15,6H  PAGEI3)
000251      WRITE (N700T,2020)
000252      2020  FORN AT(74H  ISOTOPE      CONC MIX 1  CONC MIX 2  CONC MIX 3  CONC M
000253      1X 4  CONC MIX 5)
000254      WRITE (N700T,2030)
000255      2030  FORN AT(74H  -----  -----  -----  -----  -----
000256      1X 4  -----)
000257      WRITE (N700T,2040)
000258      2040  FORN AT(10H USED IN CELL)
000259      WRITE (N700T,2050) ( STLA(I),,STRE(I),(CONCTA(I,"),N=1,5),I=1,ISCX)
000260      2050  FORN AT(10H ,UPF6.0,1P5E12.5)
000261      WRITE (N700T,2060)
000262      2060  FORN AT(10H USED IN EDIT)
000263      2060  ISX=ISOX+1
000264      WRITE (N700T,2070) ( STLA(I),,STRE(I),CONCTA(I,1),I=JLOT,ISOT)
000265      2070  FORN AT(10H ,UPF6.0,1P12.5)
000266      WRITE (N700T,2080) (N,N=1,IX)
000267      2080  FORN AT(11HUPF610N 10 2013)
000268      WRITE (N700T,2090) (NTEL(N),N=1,IX)
000269      2090  FORN AT(11H 1XTURE N2013)
000270      3001  WRITE (N700T,310)
000271      610  FORN AT(12HNSOURCE LXTA)
000272      700  READ (N710,120) NSC,NST,NPRINT,NCAL
000273      WRITE (N700T,705) NSC
000274      705  FORN AT(14H6.0. OF CARUS=13)
000275      IF (.ST) 710,710,730
000276      710  20720=1,IX
000277      720  SU(1)=1.
000278      2010740
000279      READ (N710,140) (SD(N),N=1,IX)
000280      740  S=(S(IX)+0.5*SV(IX))**2
000281      S2A=(S(IX)-0.5*SV(IX))**2
000282      WRITE (N700T,742) (SD(N),N=1,IX)
000283      742  FORN AT(11HNSPACE LIST/(1P5E12.5))
000284      IF (.SC.EQ.0) GO TO 660
000285      WRITE (N700T,743)
000286      743  FORN AT(17HNSOURCE CONSTANTS)
000287      2008005=1,NSC
000288      READ (N710,570) N,AF,NAS,NCON,TF
000289      WRITE (N700T,745) N,AF,NXS,NCON,TF

```

B-8

BNWL-516

** -1

```

000290      740  FCN AT(4H 1X12,8H  MASS=1PE12.5,6H  XS=1PE12.5,7H  CON=1PE12.5
000291      1,5H  1PE=1PE12.5)
000292      ALPH=((AM-1.)/(AM+1.))*2
000293      DO 750 I=1,IX
000294      750  SP(I)=0.
000295      IF (2A-ALPH*EA) 760,760,770
000296      760  SP(I)=PCOQ*HXS/(LV(IX)*(AM+0.667))
000297      GO TO 820
000298      770  DO 780 I=1,IX
000299      A=V(I)*(1./EA-ALPH/(V(I)*V(I)))
000300      IF (A) 790,790,780
000301      780  SP(I)=PCON*HXS*A/(1.-ALPH)
000302      790  CONTINUE
000303      IF (TP) 820,820,800
000304      800  DO 810 I=1,IX
000305      A=V(I)*V(I)/TP
000306      A=1.+A*(.278293+A*(.230559+A*(.000972+A*(.078108))))
000307      IF (A-1.E+5) 805,805,803
000308      803  A=1.
000309      GO TO 810
000310      805  A=1.-1./(A**4)
000311      810  SP(I)=A*SP(I)
000312      820  DO 830 N=1,NX
000313      HP=HTBL(N)
000314      IF (A-HP) 830,830,850
000315      830  DO 840 I=1,IX
000316      840  S(N,I) = S(N,I) + SP(I) / V(I)
000317      850  CONTINUE
000318      860  CONTINUE
000319      IF (NPRNT.EQ.0) GO TO 866
000320      DO 869 I=1,IX
000321      869  WRITE(NTOUT,872) I,(S(I,N),N=1,IX)
000322      DO 868 I=1,IX
000323      DO 868 N=1,NX
000324      868  S(N,I)=S(N,I)*SD(N)
000325      871  FORMAT(140,2E10.5,2I5)
000326      874  FORMAT(27H SOURCE CALCULATED FROM HRG/43H HRG IDENT  MASS  DEN
000327      1S11T MIXTURE )
000328      875  FORMAT(16,3X,1PE9.4,1PE11.5,2I5)
000329      872  FORMAT(23H SOURCE FOR SPACE POINT I3/(1P7E13.5))
000330      IF (NPRAT.EQ.0) GO TO 880
000331      DO 1861 I=1,NX
000332      1861  WRITE(NTOUT,872) I,(S(I,N),N=1,IX)
000333      870  FORMAT(15,5E10.5)
000334      880  CALL ETJMEI(NQ1)
000335      READ(NTIN,120) LEAKT,NXA,NGEOM,NSMR
000336      ISANE=LEAKT
000337      CALL CLEAR(1,12000)
000338      C  NGEOM=1 REGULAR CYLINDRICAL GEOMETRY WITH ARGONNE CORRECTIONS

```

B-9

*-17

BNWL-516

```

000339      C      RGEOM=2 FAST COSINE CURRENTS CYLINDRICAL GEOMETRY FROM SRL
000340      C      RGEOM=3 REGULAR SLAB GEOMETRY WITH ADDITIVE CORRECTIONS
000341      C      RGEOM=4 FAST COSINE CURRENTS SLAB GEOMETRY FROM SRL
000342      GO TO (RGEOM,881,882,883,884),75801
000343      881 CALL GEO1
000344      GO TO 885
000345      882 CALL GEOR1
000346      GO TO 885
000347      883 CALL GEOX
000348      GO TO 885
000349      884 CALL GEOR1
000350      885 CALL ETIME1(RW2)
000351      LEAVE ISAME
000352      CALL ITR
000353      CALL ETIME1(RW3)
000354      690 CALL EXIT
000355      IF (ISAME.EQ.0) CALL SMR
000356      CALL ETIME1(RW4)
000357      GO TO 100
000358      END

```

5. LIST SMR

@ ELT SMK,1,661009, 41650

```

000001      SUBROUTINE SMK
000002      DIMENSIONT(30,30,30),F(30,30),H(30,30),R(30,30),P(30,30,6),VOL(30)
000003      1,RAD(30),DV(30),V(30),MTBL(30),Q(30,30),XTM(30,30),XAM(30,30),IXPT
000004      2(6),NRTBL(30),ISTBA(30),ISTBB(30),ISTBE(30),ISTBG(30),CONCTA(30,6)
000005      3,CONCTE(30),XAT(30,30),XST(30,30),XATE(30,30),S(30,30)
000006      COMMON T      , F      , H      , R      , P      , VOL
000007      COMMON RAD      , DV      , V      , MTBL      , Q      , XTM
000008      COMMON XAM      , IXPT      , NRTBL      , ISTBA      , ISTBB      , ISTBE
000009      COMMON ISTBG      , CONCTA      , CONCTE      , XAT      , XST      , XATE
000010      COMMON S      , IX      , NX      , IXPCM      , ISOX      , ISOXE
000011      COMMON LEAKT      , NPAGE      , IDENT      , MX      , NTIN      , NTOUT
000012      COMMON NTLIB      , NTPUN      , NTEMP
000013      DIMENSION PS(30,30),XSS(30),XAS(30),PHITOT(30)
000014      EQUIVALENCE (PS,T),(XSS,T(901)),(XAS,T(931)),(PHITOT,T(961)),
000015      1(VOLTOT,T(962))
000016      DO 100 I=1,30
000017      XSS(I)=0.
000018      XAS(I)=0.
000019      DO 100 J=1,30
000020      100 PS(I,J)=0.
000021      DO 200 I=1,IX
000022      DO 200 J=1,NX
000023      200 PHITOT(I)=PHITOT(I)+F(J,I)
000024      DO 500 I=1,IX
000025      DO 500 N=1,NX
000026      XAS(I)=XAS(I)+XAM(N,I)*F(N,I)/PHITOT(I)
000027      XSS(I)=XSS(I)+(XTM(N,I)-XAM(N,I))*F(N,I)/PHITOT(I)
000028      M=MTBL(N)
000029      DO 500 II=1,IX
000030      500 PS(II,I)=PS(II,I)+P(II,I,M)*F(N,I)/PHITOT(I)
000031      600 FORMAT(1H1,42X,36HCELL AVERAGED MACROSCOPIC ABSORPTION //(1P8E15.
000032      17))
000033      WRITE(NTOUT,600)(XAS(I),I=1,IX)
000034      610 FORMAT(//41X,36HCELL AVERAGED MACROSCOPIC SCATTER //(1P8E15.7))
000035      WRITE(NTOUT,610)(XSS(I),I=1,IX)
000036      620 FORMAT(1H1,36X,48HCELL AVERAGED MACROSCOPIC ENERGY TRANSFER MATRIX
000037      1 //)
000038      WRITE(NTOUT,620)
000039      630 FORMAT(17,7115)
000040      640 FORMAT(13,1P8E12.6,1P7E15.6)
000041      II=1
000042      IU=6
000043      650 WRITE(NTOUT,630)(I,I=II,IU)
000044      DO 660 J=1,IX

```

*NEW
*NEW
*NEW
*NEW
**-4

B-11

BNWL-516

```

000045      600 WRITE(NTOUT,640)J,(PS(K,J),K=II,IJ)
000046      IF(IJ.EQ.IX) GO TO 700
000047      II=II+6
000048      IJ=MIN0(IJ+6,IX)
000049      GO TO 650
000050      800 FORMAT(7E10.5)
000051      700 PUNCH 800,(XAS(I),I=1,30)
000052      PUNCH 800,(XSS(I),I=1,30)
000053      PUNCH 800,((PS(I,J),I=1,30),J=1,30)
000054      RETURN
000055      END

```

4. LIST ED11

@ ELT EDIT,1,661009, 41579

```

000001      SUBROUTINE EDIT
000002      DIMENSION T(30,30,30),F(30,30),H(30,30),R(30,30),P(30,30,6),VOL(30)
000003      1,RAD(30),DV(30),V(30),MTBL(30),Q(30,30),XTM(30,30),XAM(30,30),IXPT
000004      2(6),NRTBL(30),ISTBA(30),ISTBB(30),ISTBE(30),ISTBG(30),CONCTA(30,6)
000005      3,CONCTE(30),XAT(30,30),XST(30,30),XATE(30,30),S(30,30),
000006      4REGR(30),PARTL(4),XSEC(2,6),NS(30),VOLF(30),FLUX(30,2),PHI(30,30,
000007      52),XTR(30,30),CELLX(30,6),SFLUX(2),VINV(2),NLOW(6),ACT(3,4),
000008      6XS1(30,30),F1(30,30)
000009      EQUIVALENCE(PHI,H),(REGR,T(6101)),(PARTL,T(8131)),(XSEC,T(8135)),
000010      1(NS,T(8147)),(VOLF,T(8177)),(FLUX,T(8207)),(XTR,T(8267)),
000011      2(CELLX,T(9167)),(SFLUX,T(9347)),(VINV,T(9349)),
000012      3(ACT,T(9351)),(XS1,T(9363)),(F1,T(10982))
000013      C      10761-10980 USED IN SUBROUTINE S
000014      COMMON/RI/KRAP(37),NNHN
000015      COMMON/NS/NPROS,NNHN,KARD
000016      COMMON T , F , H , R , P , VOL
000017      COMMON RAD , DV , V , MTBL , Q , XTM
000018      COMMON XAM , IXPT , NRTBL , ISTBA , ISTBB , ISTBE
000019      COMMON ISTBG , CONCTA , CONCTE , XAT , XST , XATE
000020      COMMON S , IX , NX , IXPCM , ISOX , ISOXE
000021      COMMON LEAKT , NPAGE , IDENT , MX , NTIN , NTOUT
000022      COMMON NTLIB , NTPUN , NTEMP , IBY
000023      COMMON/DIFUSE/ISOT ,HOLID(3,30),NKERNT(30),AMAS(30),RI(30),RO(30)
000024      DIMENSION XFT(30,30),VNUT(30)
000025      DIMENSION WSTBA(30),WSTBB(30)
000026      EQUIVALENCE (VNUT,CONCTE),(XATE,XFT),(ISTBA,WSTBA),(ISTBB,WSTBB)
000027      DIMENSION PP1(30,30,9)
000028      EQUIVALENCE(PP1,T)
000029      REWIND 11
000030      NKERN=0
000031      DO 900 I=1,ISOX
000032      900 IF(NKERNT(I).GT.2) NKERN=NKERN+1
000033      IF(NKERN.EQ.0) GO TO 950
000034      READ(11)((PP1(I,K,J),I=1,30),K=1,30),J=1,NKERN)
000035      950 IF(IBY) 1056,1050,1050
000036      1050 DO1055I=1,NX
000037      DO1055I=1,IX
000038      1055 F(N,I) = F(N,I)*V(I)*DV(I)*VOL(N)
000039      C      MAKE UP A TRANSPORT AND FIRST MOMENT CROSS SECTION
000040      DO 1120 I=1,ISOX
000041      IF(NKERNT(I)-1) 1080,1080,1090
000042      1080 DO 1085 J=1,IX
000043      1085 XS1(I,J) = 2. * XST(I,J) / (3. * AMAS(I))
000044      GO TO 1100

```

B-13

BNWL-516

```

000045      1090 IP=MKERNT(I)/1000
000046          DO 1097 J=1,IX
000047              XS1(I,J)=0.
000048          DO 1095 JJ=1,IX
000049      1095 XS1(I,J) = XS1(I,J) + PP1(JJ,J,IP) * DV(JJ)
000050      1097 XS1(I,J) = XS1(I,J) / (V(J) * DV(J))
000051      1100 DO 1120 J=1,IX
000052      1120 XTR(I,J) = XAT(I,J) + XST(I,J) - XS1(I,J)
000053      1056 READ (NTIN,1057)IXPCM,(NLOW(J),IXPT(J),J=1,IXPCM)
000054      1057 FORMAT(11I5)
000055          READ (NTIN,1058)(NRTBL(N),N=1,NX)
000056      1058 FORMAT(50I1)
000057          NT=NX-1
000058          DO 1101 N=2,NT
000059              M=MTBL(N)
000060          DO 1101 I=1,IX
000061              SX2=0.
000062              SXY=0.
000063              SX=0.
000064              SY=0.
000065      C          CURRENT LOOP FOR LOG-LSQS DERIVATIVES
000066          KB=N-1
000067          KT=N+1
000068          DO 1060 K=KB,KT
000069              Y=A*LOG(F(K,I)/DV(I)/VOL(K))
000070              SY=SY+Y
000071              SX=SX+RAD(K)
000072              SXY=SXY+RAD(K)*Y
000073      1060 SX2=SX2+RAD(K)**2
000074              XR=0.
000075          DO 1070 K=1,ISCX
000076      1070 XR=XR+XTR(K,I)*CONCTA(K,M)
000077              A=(3.*SXY-SX*SY)/(3.*SX2-SX**2)
000078              B=(SX2*SY-SX*SXY)/(3.*SX2-SX**2)
000079              F1(N,I)=A*EXP(A*RAD(N)+B)/XR
000080      1101 CONTINUE
000081          DO 1113 I=1,IX
000082              IF(LEAKT) 1105,1103,1103
000083      1103 F1(1,I)=0.
000084              GO TO 1106
000085      1105 F1(1,I)=F1(2,I)
000086      1106 IF(LEAKT-1) 1110,1107,1110
000087      1107 F1(NX,I) = 0.
000088              GO TO 1113
000089      1110 F1(NX,I)=F1(NT,I)
000090      1113 CONTINUE
000091              NC=1
000092              ND=7
000093      1115 IF(ND.GT.NX) ND=NX

```

```

000094      NPAGE=NPAGE+1
000095      WRITE(NTOUT,2000) IDENT,NPAGE
000096      WRITE(NTOUT,2031) ((N,I,F1(N,I),I=1,IX),N=NC,ND)
000097      IF(NX-ND) 1119,1119,1117
000098      1117 NC=NC+7
000099      ND=ND+7
000100      GO TO 1115
000101      1119 CONTINUE
000102      C      MAKE UP REGION FLUXES,CURRENTS,VOLUME FRACTIONS,
000103      C      REGION MIXTURE TABLE
000104      DO 1125 I=1,2
000105      1125 SFLUX(I) = 0.
000106      VOLTOT=0.
000107      NREG=1
000108      DO 1200 N=1,NX
000109      IF(N.EQ.1) GO TO 1130
000110      IF(NRTBL(N-1).EQ.NRTBL(N))      GO TO 1150
000111      NREG=NREG+1
000112      REGR(NREG-1) = RI(N)
000113      1130 NS(NREG)=MTBL(N)
000114      M=MTBL(N)
000115      VOLF(NREG)=0.
000116      DO 1140 I=1,IX
000117      DO 1140 J=1,2
000118      1140 PHI(NREG,I,J)=0.
000119      DO 1146 J=1,2
000120      1146 FLUX(NREG,J) = 0.
000121      1150 DO 1180 I=1,IX
000122      PHI(NREG,I,1) = PHI(NREG,I,1) + F(N,I)
000123      FLUX(NREG,1) = FLUX(NREG,1) + F(N,I)
000124      SFLUX(1) = SFLUX(1) + F(N,I)
000125      F1(N,I)=ABS(F1(N,I))*DV(I)*VOL(N)
000126      PHI(NREG,I,2) = PHI(NREG,I,2) + F1(N,I)
000127      FLUX(NREG,2) = FLUX(NREG,2) + F1(N,I)
000128      SFLUX(2) = SFLUX(2) + F1(N,I)
000129      1180 CONTINUE
000130      VOLF(NREG) = VOLF(NREG) + VOL(N)
000131      1200 VOLTOT = VOLTOT + VOL(N)
000132      C      VOLUME FRACTIONS
000133      DO 1210 N=1,NREG
000134      1210 VOLF(N) = VOLF(N)/VOLTOT
000135      REGR(NREG)=RO(NX)
000136      DO 1999 IXPC=1,IXPCW
000137      IF(NLOW(IXPC))1002,1002,1001
000138      1001 MAX=NLOW(IXPC)
000139      LXP=MAX+1
000140      Z=v(MXP)+0.5*DV(MXP)
000141      W=0.0253*Z*Z
000142      GO TO 1003

```

*NEW
*NEW
**-2

B-15

BNWL-516


```

000143      1002 LXP=1
000144          MXP=0
000145          Z=0.0
000146          W=0.0
000147      1003 IXP=IXFT(IXPC)
000148          A=V(IXP)+0.5*EV(IXP)
000149          B=0.0253*A*A
000150
000151      C          MAIN CELL EDITING LOOPS
000152
000153          DO 1250 IYP=1,5
000154          DO 1250 N=1,MREG
000155      1250  CELLA(N,IYP)=0.
000156          LINE=48
000157          DO 1500 I=1,ISOX
000158          LINE = LINE+MREG+15
000159          IF(LINE.GT.48) GO TO 1260
000160          LINE=LINE+20
000161          NPAGE=NPAGE+1
000162          WRITE(1,OUT,2000) IDENT,NPAGE
000163          WRITE(1,OUT,2100) MXP,IXP,Z,A,W,B
000164          WRITE(1,OUT,2240)
000165      1260  WRITE(1,OUT,2200) (HOLID(K,I),K=1,3),#STBA(I),#STBB(I)
000166          DO 1270 IYP=1,4
000167          PARTL(IYP)=0.
000168      1270  XSEC(2,IYP)=0.
000169          XSEC(2,5)=0.
000170          DO 1400 K=1,MREG
000171          DO 1300 IYP=1,5
000172      1300  XSEC(1,IYP)=0.
000173          K=KS(K)
000174          IF(CONCTA(I,K))1360,1360,1310
000175      1310  PARTL(1)=CONCTA(I,K)*VOLF(N)
000176          PARTL(2)=PARTL(2) + CONCTA(I,M)*FLUX(N,1)
000177          PARTL(3)=PARTL(3) + PARTL(1)
000178          PARTL(4)=PARTL(4) + CONCTA(I,M)*FLUX(N,2)
000179          DO 1320 L=LXP,IXP
000180          XSEC(1,1) = XSEC(1,1) + XAT(I,L)*PHI(N,L,1)
000181          XSEC(1,2) = XSEC(1,2) + XST(I,L)*PHI(N,L,1)
000182          XSEC(1,3) = XSEC(1,3) + XFT(I,L)*PHI(N,L,1)*WOUT(1)
000183          XSEC(1,4) = XSEC(1,4) + XIR(I,L)*PHI(N,L,2)
000184      1320  XSEC(1,5) = XSEC(1,5) + XS1(I,L)*PHI(N,L,2)
000185          KIND=1
000186          DO 1350 K=1,5
000187          XSEC(2,K) = XSEC(2,K) + XSEC(1,K)*CONCTA(I,M)
000188          CELLA(N,K)=CELLX(N,K) + XSEC(1,K)*CONCTA(I,M)
000189          IF(K.EQ.4) KIND=2
000190      1350  XSEC(1,K) = XSEC(1,K)/FLUA(I,KIND)
000191          D=1./(3.*XSEC(1,4))

```

**=2

B-16

BNWL-516

```

000192      GO TO 1370
000193      1360 D=0
000194      PARTL(1)=0.
000195      C          PRINT REGION NUMBERS
000196      1370 WRITE(NTOUT,2250) C,I,CONCTA(I,K),PARTL(1),(XSEC(1,K),K=1,5),D
000197      1400 CONTINUE
000198      C          REGION SMEAR
000199      KIND=2
000200      DO 1410 K=1,5
000201      IF(K.EQ.4) KIND=4
000202      1410 XSEC(2,K) = XSEC(2,K)/PARTL(KIND)
000203      PARTL(2) = PARTL(2)/SFLUX(1)
000204      PARTL(4) = PARTL(4)/SFLUX(2)
000205      D = 1./(3.*XSEC(2,4))
000206      C          PRINT REGION SMEAR NUMBERS
000207      WRITE(NTOUT,2260)PARTL(2),(XSEC(2,K),K=1,5),D
000208      C          CELL SMEAR
000209      KIND=2
000210      DO 1450 K=1,5
000211      IF(K.EQ.4) KIND=4
000212      1450 XSEC(2,K) = XSEC(2,K)*PARTL(KIND)/PARTL(3)
000213      D=1./(3.*XSEC(2,4))
000214      C          PRINT CELL SMEAR NUMBERS
000215      WRITE(NTOUT,2270)PARTL(3),(XSEC(2,K),K=1,5),D
000216      WRITE(6,2280)
000217      1500 CONTINUE
000218
000219      C          MACROSCOPIC CELL SMEAR
000220
000221      NPAGE=NPAGE+1
000222      WRITE(NTOUT,2000) IDENT,NPAGE
000223      WRITE(NTOUT,2100) NXP,IXP,Z,A,W,B
000224      WRITE(NTOUT,2300)
000225      DO 1510 K=1,5
000226      1510 XSEC(2,K)=0.
000227      VINV(2)=0.
000228      DO 1600 N=1,NREG
000229      KIND=1
000230      DO 1530 K=1,5
000231      XSEC(2,K) = XSEC(2,K) + CELLX(N,K)
000232      IF(K.EQ.4) KIND = 2
000233      1530 CELLX(N,K) = CELLX(N,K)/FLUX(N,KIND)
000234      VINV(1) = 0.
000235      DO 1540 L=LXP,IXP
000236      1540 VINV(1) = VINV(1) + PHI(N,L,1)/V(L)
000237      VINV(2) = VINV(2) + VINV(1)
000238      VINV(1) = VINV(1)/FLUX(N,1)
000239      D = 1./(3.*CELLX(N,4))
000240      DO 1550 K=1,2

```

**-2

**-2

B-17

BNWL-516

```

000241      FLUX(I,K) = FLUX(N,K)/SFLUX(K)/VOL(N)
000242      WRITE(1001,2250)N,NS(I),KEGK(N),VOL(N),(FLUX(N,K),K=1,2),VINV(1)
000243      A=(CELLX(N,3),K=1,3),CELLX(N,5),S
000244 1600 CONTINUE
000245      VINV(2) = VINV(2)/SFLUX(1)
000246      K1ND=1
000247      DO 1610 K=1,5
000248      IF(N.EQ.4) K1ND=2
000249 1610 XSEC(2,K) = XSEC(2,K)/SFLUX(K1ND)
000250      S=1/(S.*XSEC(2,4))
000251 C          REGION SHEAR PRINT
000252      X=1.
000253      WRITE(1001,2270) X,X,X,VINV(2),(XSEC(2,K),K=1,3),XSEC(2,5),S
000254
000255 C          EDIT SECTION OF EDIT
000256
000257      IF(.NOT.ISOT) 1620,1999,1999
000258 1620 1601=1999+1
000259      DO 1600 I=1,ISOT,4
000260 C          PAGE HEADER
000261      ITOP=1+3
000262      IF(ITOP.GT.ISOT) ITOP=ISOT
000263      IOTOP=ITOP-1+1
000264      NPAGE=NPAGE+1
000265      WRITE(1001,2000) IOTOP,APAGE
000266      WRITE(1001,2100) X,IAP,2,A,S,P
000267      WRITE(1001,2400) (ASTRA(L),XSTBR(L),L=I,ITOP)
000268      WRITE(1001,2405)
000269      WRITE(1001,2410) (CORCTA(L,1),L=I,ITOP)
000270      WRITE(1001,2415)
000271      DO 1630 L=1,4
000272 1630 XSEC(2,L)=S.
000273      K1ND=1
000274      DO 1640 K=1,2X
000275      DO 1640 K=1,16TOP
000276 1640 XSEC(1,K)=S.
000277      ACT(2,K)=0.
000278      PHIPT=0.
000279      DO 1710 L=LXP,1XP
000280      DO 1700 ISL=1,16TOP
000281      ISL=ISL-1+1
000282 1700 XSEC(1,ISL)=XSEC(1,ISL)+F(N,L)*XAT(ISL,L)*CORCTA(ISL,1)
000283 1710 PHIPT=PHIPT+F(N,L)
000284      DO 1730 L=1,16TOP
000285      IF(L.EQ.1) GO TO 1725
000286      ACT(1,L)=XSEC(1,L)/VOL(N)
000287 1725 ACT(2,L)=XSEC(1,L)/VOL(N)/ACT(1,L)
000288      XSEC(2,L)=XSEC(2,L)+XSEC(1,L)
000289 1730 XSEC(1,L)=XSEC(1,L)/PHIPT

```

**-1

```

000290      WRITE(NTOUT,2450)N,KREG,NRTBL(N),(XSEC(1,L),ACT(2,L),L=1,IBTOP)
000291      IF(NRTBL(N).EQ.NRTBL(N+1).AND.N.NE.NX) GO TO 1800
000292      DO 1750 L=1,IBTOP
000293      ACT(3,L)=XSEC(2,L)/VOLF(KREG)/VOLTOT/ACT(1,L)
000294 1750 XSEC(2,L)=XSEC(2,L)/(FLUX(KREG,1)*SFLUX(1)*VOLF(KREG))
000295      WRITE(NTOUT,2460) KREG,NRTBL(N),(XSEC(2,L),ACT(3,L),L=1,IBTOP)
000296      WRITE(NTOUT,2470)
000297      KREG=KREG+1
000298      DO 1770 L=1,4
000299 1770 XSEC(2,L)=0.
000300 1800 CONTINUE
000301 1999 CONTINUE
000302 2000 FORMAT(17H1THERMOS CASE NO.15,6H PAGE13)
000303 2031 FORMAT(17HOK,I,CURRENT(K,1)/(5(2I3,1PE12.4)))
000304 2100 FORMAT(16H AVERAGES FOR I=12,6H TO I=12,4H V=1PE12.5,6H TO V=1PE1
000305 12.5/4H E=1PE12.5,6H TO E=1PE12.5)
000306 2200 FORMAT(35H0MICROSCOPIC CONSTANTS FOR ISOTOPE ,3A6, 8H NUMBER,
000307 10P2F8.0,/1H ,77(1H=),/25X7HPARTIAL/1X7HREG MIX,2(5X7HDENSITY),5X
000308 27HSIGMA A,5X7HSIGMA S,3X10HNU*SIGMA F,3X8HSIGMA TR,4X8HSIGMA S1,7X
000309 31H0,/9H --- --- ,8(2X10H-----))
000310 2240 FORMAT(23H0MATERIALS USED IN CELL)
000311 2250 FORMAT(1H I2,I4,2X,1P10E12.4)
000312 2260 FORMAT(18H0REG. SMEAR VALUES 3X1P8E12.4)
000313 2270 FORMAT(18H0CELL SMEAR VALUES 3X1P9E12.4)
000314 2280 FORMAT( 1H0,6(10X5H*****))
000315 2300 FORMAT(24H0MACROSCOPIC CELL VALUES /1H 23(1H=)/25X6HVOLUME7X4HFLUX
000316 17X7HCURRENT
000317 24X7H INVERSE/9H REG MIX5X6HRADIUS5X8HFRACTION3X10HDEPRESSION2X10HDE
000318 3PRESSION,3X, 8HVEL
000319 40CITY5X7HSIGMA A5X7HSIGMA S3X10HNU*SIGMA F3X9HSIGMA S18X1H0 /
000320 S10H --- --- ,10(12H ----- ))
000321 2400 FORMAT(23H0MATERIALS USED IN EDIT/ 6H0ISOTOPE3X,4(8X0P2F8.0))
000322 2405 FORMAT(8H =====,7X,4(4X20H===== ))
000323 2410 FORMAT(14H CONCENTRATION 2X,4(5X1PE12.4 ,7X))
000324 2415 FORMAT( 14H POINT REG MIX ,
000325 14(5X7HSIGMA A5X7HREL ACT)/15H ----- --- --- ,8(3V9H-----))
000326 2450 FORMAT(14,I5,14,2X1PE12.4)
000327 2460 FORMAT(4H0AVE,I5,I4,2X1P8E12.4)
000328 2470 FORMAT(1H )
000329      RETURN
000330      END

```

5. LIST ITER

B-19

BNWL-516

ELT ITER,1,661009, 41672

```

000001      C      ITERATION PROGRAM          -THERMOS-      HONECK, BNL
000002      SUBROUTINE ITER
000003      DIMENSION(30,30,30),F(30,30),H(30,30),R(30,30),P(30,30,6),VOL(30)
000004      1,RAD(30),DV(30),V(30),NTBL(30),G(30,30),XTM(30,30),XAM(30,30),IXPT
000005      2(6),NRTBL(30),ISTBA(30),ISTBB(30),ISTBE(30),ISTBG(30),CONCTA(30,6)
000006      3,CONCTE(30),XAT(30,30),XST(30,30),XATE(30,30),S(30,30)
000007      COMMON 1      , F      , H      , R      , P      , VOL
000008      COMMON  RAD      , DV      , V      , NTBL      , G      , XTM
000009      COMMON  XAM      , IXPT      , NRTBL      , ISTBA      , ISTBB      , ISTBE
000010      COMMON  ISTBG      , CONCTA      , CONCTE      , XAT      , XST      , XATE
000011      COMMON  S      , IX      , NX      , IXPCM      , ISOX      , ISOXE
000012      COMMON  LEAKT      , NPAGE      , ILENT      , MX      , NTIN      , NTOUT
000013      COMMON  ILLIB      , NTPUR      , NTEMP
000014      ITCNT=-1
000015      NPAGE=NPAGE+1
000016      WRITE (NTOUT,2000) ILENT, NPAGE
000017      CALL SELMA(ITCNT,RTLES,OVER,EPS,ITMAX,RENORM)
000018      30  FOR N1(1415)
000019      40  FOR AT(7E10,5)
000020      100 IF(LEAKT)100,140,110
000021      110 DO150I=1,IX
000022      DO150K=1,NX
000023      F(K,I)=0
000024      DO120J=1,NZ
000025      120 F(K,I)=F(K,I)+XTM(K,I)*T(N,K,I)*VOL(J)/VOL(K)
000026      130 F(K,I)=F(K,I)*V(I)
000027      GOT(15)
000028      140 DO150I=1,IX
000029      DO150K=1,NX
000030      150 F(K,I)=V(1)
000031      160 A=0.
000032      DO170J=1,IX
000033      DO170H=1,NX
000034      170 A=A+F(N,I)*S(H,I)*VOL(H)*DV(I)
000035      IF(A)175,185,175
000036      175 A=1./A
000037      DO190I=1,IX
000038      DO190N=1,NX
000039      180 S(N,I)=S(N,I)*A
000040      FVSTR=A/(V(IX)+0.5*LV(IX))**2
000041      185 IF(LEAKT)220,220,190
000042      190 DO200I=1,IX
000043      DO200N=1,NX
000044      G(N,I)=0.

```

*NEW
*NEW
*NEW
*NEW
**-4

**=8

B-20

BNWL-516

```

000045      M=RTBL(N)
000046      D0200I=1,IX
000047      200  G(N,I)=G(N,I)+F(N,J)*P(J,I,M)*EV(J)
000048      D0210I=1,IX
000049      D0210N=1,NX
000050      210  G(N,I)=(V(I)*XTM(N,I)*DV(I)-G(N,I))*VOL(N)
000051      GOT0240
000052      220  D0230I=1,IX
000053      D0230N=1,NX
000054      230  G(N,I)=V(I)*XAN(N,I)*DV(I)*VOL(N)
000055      240  A=0.
000056      D0250I=1,IX
000057      B=V(I)*V(I)
000058      B=B*EXP(-B)
000059      D0250N=1,NX
000060      F(N,I)=B
000061      250  A=A+B*G(N,I)
000062      A=1./A
000063      D0260I=1,IX
000064      D0260N=1,NX
000065      260  F(N,I)=A*F(N,I)
000066      EPSA=EPS*F(1,10)
000067      QBAR=0
000068      D0270I=1,IX
000069      D0270N=1,NX
000070      270  QBAR=QBAR+G(N,I)**2
000071      RNL=0.
000072      ITCNT=0
000073      CALL RELAX(ITCNT,RNEW,OVER,EPS,ITMAX,RENORM)
000074      280  IF(ITCNT-ITMAX)300,360,360
000075      300  D0310I=1,IX
000076      D0310K=1,NX
000077      M=RTBL(K)
000078      H(K,I)=S(K,I)
000079      D0310J=1,IX
000080      310  H(K,I)=H(K,I)+P(I,J,M)*F(K,J)
000081      A=0.
000082      D0330I=1,IX
000083      D0330N=1,NX
000084      R(N,I)=0.
000085      D0320K=1,NX
000086      320  R(N,I)=R(N,I)+H(K,I)*T(N,K,I)
000087      330  A=A+R(N,I)*G(N,I)
000088      RENORM=1./A
000089      D0340I=1,IX
000090      D0340N=1,NX
000091      340  R(N,I)=RENORM*R(N,I)-F(N,I)
000092      ITCNT=ITCNT+1
000093      RNL=RNL+1

```

```

000094      DOO45I=1,IX
000095      DOO45K=1,NX
000096      345  KREL=NEPS*(R(N,I)*E(N,I))**2
000097      KREL=SQRT(RREL/ODAR)
000098      CALL RELAX(ITCNT,RNEP,OVER,EPS,I1MAX,RENDRY)
000099      3110 DOO120I=1,IX
000100      DOO120K=1,NX
000101      3120 F(N,I)=F(N,I)+OVER*K(N,I)
000102      DOO20I=1,IX
000103      DOO20K=1,NX
000104      IF (ABS(R(N,I))-EPSA)350,350,290
000105      350  CONTINUE
000106      360  CONTINUE
000107      ROL=0.
000108      DOO10I=1,IX
000109      DOO10K=1,NX
000110      IF (ABS(R(N,I))-ROL)410,410,400
000111      400  ROL=ABS(R(N,I))
000112      410  CONTINUE
000113      1000 NC=1
000114      ND=1
000115      1010 IF (IX=1)1020,1030,1030
000116      1020 GO=1
000117      1030 IF AGE=1PAGE+1
000118      WRITE (NTOUT,2000)IDENT,KPAGE
000119      2000 FOR AT(17H1PELKHOS CASE NO.15,6H PAGE13)
000120      WRITE (NTOUT,2020)ITCNT,RENDRM,EPSA
000121      2020 FOR AT(7H01ICNT=15,2H REENDRM=1PE12.5,5H EPS=1PE12.5)
000122      WRITE (NTOUT,1035)ROL,RNEP,FVSTR
000123      1035 FOR AT(13H LARGEST RES=1PE12.5,13H MEAN RES=1PE12.5,9H R(V*)=
000124      1PE12.5)
000125      WRITE (NTOUT,2030)((R,I,F(N,I),I=1,IX),K=NC,ND)
000126      2030 FOR AT(11HOK,I,N(K,I)/(S(213,1PE12.4)))
000127      IF (IX=1)1050,1050,1040
000128      1040 NC=NC+7
000129      AL=AL+7
000130      GOTO1010
000131      1050 RETURN
000132      END

```

0. LIST RELAX

Q ELT RELAX,1,661009, 41661

```

000001      SUBROUTINE RELAX(ITCNT,RNEW,OVER,EPS,ITMAX,RENORM)
000002      DIMENSION RBS(30)
000003      NTIN=5
000004      NTOUT=6
000005      10  IF(ITCNT)20,100,2900
000006      20  READ (NTIN,30)EPS,RELC,EPSG,OVERX,FACTOR,ITBG,LCMX,ITDM,ITMAX,IPT
000007      30  FORMAT(5E10.5,4I5,12)
000008      IF(ITMAX)35,35,40
000009      35  EPS=1.E-9
000010      RELC=1.2
000011      EPSG=.05
000012      OVERX=100.
000013      FACTOR=1.
000014      ITBG=5
000015      LCMX=5
000016      ITDM=5
000017      ITMAX=100
000018      IPT=-1
000019      40  CONTINUE
000020      RELCA=RELC
000021      WRITE (NTOUT,50)ITBG,LCMX,ITDM,ITMAX,EPS,RELC, EPSG,OVERX,FACTOR
000022      50  FORMAT(17H01EARLIEST EXTRAP=13/12H NO. TESTED=13/11H INCREMENT=13/9
000023      1H MAX ITS=13/11H CONV CRIT=1PE12.5/16H OVERRELAXATION=1PE12.5/13H
000024      2EXTRAP CRIT=1PE12.5/12H MAX EXTRAP=1PE12.5/8H FACTOR=1PE12.5)
000025      IF(IPT)3110,3110,60
000026      60  WRITE (NTOUT,70)
000027      70  FORMAT(37H      IT      RENORM      RMS RES      RATIO)
000028      GOTO3110
000029      100  LCNT=0
000030      RELC=RELCA
000031      GOTO3110
000032      2900  RATIO=RNEW/ROLD
000033      ROLD=RNEW
000034      IF(IPT)2990,2990,2910
000035      2910  WRITE (NTOUT,2920)ITCNT,RENORM,RNEW,RATIO
000036      2920  FORMAT(16,F10.5,1PE13.4,0PF9.4)
000037      2990  IF(ITCNT-ITBG)3100,3000,3000
000038      3000  LCNT=LCNT+1
000039      RBS(LCNT)=1./(1.-RATIO)
000040      CALL OVERFL(N000FX)
000041      GO TO(5000,5000),N000FX
000042      5000  IF(RBS(LCNT))3050,5010,5010
000043      5010  IF(LCNT-LCMX)3100,3020,3020
000044      3020  LCMX=LCMX

```

*NEW
***-2

B-23

BNWL-516


```

000045      GO2040M=1,LC=XP
000046      IF (ABS(RBS(1)-RBS(LC*XP))/RBS(LC*XP)-EPS6) 3040,3040,3050
000047      3040 CONTINUE
000048      GO103066
000049      3050 LC=1
000050      RELO=1.
000051      GO103100
000052      3060 OVER=FACTOR*RBS(LC*XP)
000053      IF (OVER-OVERX) 3080,3080,3070
000054      3070 OVER=OVERX
000055      3080 ALAM=(RATIO+RELO-1.)/RELO
000056      RELO=2./(2.-ALAM)
000057      IF (RELO=2.) 3082,3083,3083
000058      3082 RELO=RELO
000059      3083 WRITE (17001,3085) ITCNT,OVER,RATIO,ALAM,RELO
000060      3085 FORMAT(17HLEASTRAPOLATION AT14,4H BYF8.4/6H 10=F8.5,7H LAM=FP.
000061      15,9, 0HE6A=F8.5)
000062      ITCO=ITCNT+1ITB+1
000063      LC=1
000064      GO103110
000065      3100 OVER=RELO
000066      3110 RETURN
000067      END

```

7. LIST CLEAR

0 ELY CLEAR,1,631104, 81924

000001		SUBROUTINE CLEAR(N,K)	
000002	C	CLEARNS A BLOCK OF MEMORY K LONG	
000003		DIMENSION N(2)	01305
000004		DO 10 I=1,K	01505
000005	10	N(I) = 0.0	
000006		RETURN	01805
000007		END	-
8. LIST	BASK		

ELT BASN,1,651012, 70520

```

000001      SUBROUTINE ELTASK(P,V,DV,AS,AT,AKT,ANT,T,IX,NISQ)
000002      DIMENSION P(30,30),V(30),DV(30),AS(30),X(30),E(30),AT(10),AKT(10),A
000003      KT(10)
000004      C 01 65101P(30,30),V(30),DV(30),AS(30),X(30),E(30),AT(10),AKT(10),A
000005      C 10 KT(10)
000006      10 20181=1,IX
000007      AS(1)=0.
000008      20181=1,IX
000009      15 P(1,0)=0.
000010      100 20181=1,NISQ
000011      IF(A(1))110,500,110
000012      110 AKT(1)=1
000013      20181=1,IX
000014      20181=1,IX
000015      X(1)=AT*V(1)
000016      120 E(1)=X(1)*X(1)
000017      TAU=20181/(20181+AKT(1))
000018      TAU=20181/(TAU)
000019      ALP=AKT(1)*TAU/20181
000020      THETA=(A+1.)/(2.*A*TAU)
000021      ZETA=TAU-THETA
000022      00181=TAU*(20181+(A+1.)*AKT(1))/20181
000023      CONST=(AKT(1)*TAU*TAU*(A+1.)*(A+1.))/(4.*A*OMEGA)
000024      201 20181=1,IX
000025      20181=1,IX
000026      CALL OVERFL(K000FX)
000027      GO TO(250,260),K000FX
000028      250 EX=ERF((THETA*X(1))+(ZETA*X(1)))+ERF((THETA*X(1))-(ZETA*X(1)))
000029      EB=ERF((THETA*X(1))-(ZETA*X(1)))-ERF((ZETA*X(1))+(THETA*X(1)))
000030      AX=ALPHA*A*(1)
000031      IF(A=0.)250,251,251
000032      251 AX=1.
000033      251 251
000034      251 251
000035      251 251
000036      251 251
000037      251 251
000038      251 251
000039      251 251
000040      251 251
000041      251 251
000042      251 251
000043      251 251
000044      251 251

```

B-26

BNWL-516

```

000045      IF (EA-50.) 352,351,351
000046      351  WA=0.
000047      GO TO 353
000048      352  WA=EXP(-WA)
000049      353  EB=WA*ERF(EA)*(EA+(0.5/EA))
000050      IF (E(1)-50.) 355,354,354
000051      354  WB=0.
000052      GO TO 356
000053      355  WB=EXP(-E(1))
000054      356  XS(1)=XS(1)+(AT(N)*TAUS*TAUS/BET)*(EB+0.5641896*WB)
000055      400  CONTINUE
000056      500  CONTINUE
000057      600  D06101=1,IX
000058      610  E(1)=(V(1)*V(1))*EXP(-(V(1)*V(1))/T)
000059      D06201=1,IX
000060      D06200=1,IX
000061      620  P(J,1)=P(I,J)*E(J)/E(1)
000062      D06500=1,IX
000063      TEM=0.
000064      D06401=1,IX
000065      640  TEM=TEM+P(1,J)*DV(I)
000066      650  P(J,J)=((XS(J)-TEM)/DV(J))+P(J,J)
000067      D06801=1,IX
000068      XS(1)=XS(1)/V(1)
000069      D06800=1,IX
000070      680  P(1,J)=P(1,J)*DV(J)
000071      RETURN
000072      END

```

9. LIST ERF

3 ELF ERF,1,651012, 70028

```

000001      FUNCTION ERF(X)
000002      10  IF (ABS(X)-3.7)30,20,20
000003      20  ERF=1.
000004      30  GO TO 55
000005      30  XX=ABS(X)
000006      40  IF (XX-1.5-5)50,40,50
000007      40  ERF=1.12838*XX
000008      50  GO TO 55
000009      50  ERF=1.-1./(1.+XX*(.14112821+XX*(.08664027+XX*(.02743349+XX*
000010      1(-.00439446+XX*.00328975))))))**8
000011      55  IF (X)60,70,70
000012      60  ERF=-ERF
000013      70  RETURN
000014      END

```

10. LIST STOP

@ EL7 STOP,1,651202, 38094

```
000001      C      SUBROUTINE TO PRINT ERROR STOP NUMBERS
000002      SUBROUTINE STOP(K)
000003      1      FORMAT(19H0PROGRAM ERROR STOP I6)
000004      NTOUT = 6
000005      WRITE (NTOUT,1)K
000006      CALL ERREX(XPREP,2)
000007      END
```

*NEW
**-1

11. LIST ERREX

% ELT ERREX,1,651202, 36091

```

000001      SUBROUTINE ERREX(NAME,I)
000002      C          ERROR EXIT ROUTINE
000003      900 FORMAT(37H0 UNRECOVERABLE ERROR IN SUBROUTINE ,A6)
000004      CALL TIME
000005      400 FORMAT(      ////
000006      120X,50H      B B      B B      /      *NEW
000007      120X,50H      B B      B B      /      *NEW
000008      120X,50H      B B      B B      /      *NEW
000009      120X,50H      B B      B B      /      *NEW
000010      120X,50H      B BBBBB B      B      /      *NEW
000011      120X,50H      BBB BBB      B      /      *NEW
000012      120X,50H      BB * BB BBB B      /      *NEW
000013      120X,50H      BB * CSC * BB BB BB      /      *NEW
000014      120X,50H      BB      BB      B      )      *NEW
000015      401 FORMAT(120X,51H      B      B      /      *NEW
000016      120X,50H      B *** BUG *** BBB BB      /      *NEW
000017      120X,50H      BB      BB BBB B      /      *NEW
000018      120X,50H      BB *CSC * BB      B      /      *NEW
000019      120X,50H      BB * BB      B      /      *NEW
000020      120X,50H      BBB BBB      B      /      *NEW
000021      120X,50H      B BBBBBB B      B      /      *NEW
000022      120X,50H      B B      B B      B      /      *NEW
000023      120X,50H      B B      B B      /      *NEW
000024      120X,50H      B B      B B      )      *NEW
000025      402 FORMAT(      B B      S B      )      *NEW
000026      120X,50H      B B      S B      )      *NEW
000027      WRITE(6,400)
000028      WRITE(6,401)
000029      WRITE(6,402)
000030      IF(1.00,1) GO TO 10
000031      WRITE(6,900) NAME
000032      10 CALL AFRAM(9,11)
000033      CALL EXIF
000034      END

```

12. LIST GEOM

B-30

BNWL-516

Q ELY GEOG, 1,661,009, 41635

```

000001      SOLKROUTINE GEOM
000002      DIMENSION FNA1(100),FNB1(100)
000003      EQUIVALENCE (FNA1,F),(FNB1,F(101))
000004      DIMENSION(30,30,30),F(30,30),H(30,30),R(30,30),P(30,30,6),VOL(30)
000005      1,RAD(30),DV(30),V(30),MTBL(30),S(30,30),XTM(30,30),XAM(30,30),IXPT
000006      2(6),NRTBL(30),ISTBA(30),ISTER(30),ISTBE(30),ISTBG(30),CONCTA(30,6)
000007      3,CONCTE(30),XAT(30,30),XST(30,30),XATE(30,30),S(30,30),
000008      4RI(30),RO(30),RN(30),BETA(21),DX(30),DL(30),FNA(100),FNB(100)
000009      COMMON T , F , H , R , P , VOL
000010      COMMON RAD , DV , V , MTBL , S , XTM
000011      COMMON XAM , IXPT , NRTBL , ISTBA , ISTBE , ISTBE
000012      COMMON ISTBG , CONCTA , CONCTE , XAT , XST , XATE
000013      COMMON S , IX , NX , IXPCM , ISOX , ISOXE
000014      COMMON LEAKT , NPAGE , ICENT , MX , NTIN , NTOUT
000015      COMMON NTLIE , NTFUN , NTEMP,IEY,NRX,DELTAU
000016      COMMON/DIFUSE/ISOXY,KOLID(3,30),MKERN(30),AMAS(30),RI,RO
000017      100  FORMAT(9I5)
000018      NPAGE=, PAGE+1
000019      WRITEOUTPUTTAPENTOUT,2000,ILENT,NPAGE
000020      IF(LEAKT)120,120,110
000021      110  WRITEOUTPUTTAPENTOUT,2010
000022      LEAKT=-1
000023      GOTO150
000024      120  WRITEOUTPUTTAPENTOUT,2020
000025      LEAKT=1
000026      150  WRITEOUTPUTTAPENTOUT,2030
000027      WRITEOUTPUTTAPENTOUT,2040
000028      NRC=1
000029      RI=1
000030      RIP=0
000031      RRP=0
000032      160  READIAPUTTAPENTIN,170,NR,NP,TH
000033      170  FORMAT(2I5,E10.5)
000034      WRITEOUTPUTTAPENTOUT,2050,NR,TH
000035      DT=TH/(FLOAT (NP)-0.5)
000036      ROP=DT/2.
000037      NCE=0
000038      IF((N-1)175,220,175)
000039      175  CALL  STOP(250)
000040      200  READIAPUTTAPENTIN,170,NR,NP,TH
000041      WRITEOUTPUTTAPENTOUT,2050,NR,TH
000042      DT=TH/(FLOAT (NP))
000043      NCE=0
000044      NRC=NRC+1

```

B-31

BNWL-516

000045		IF (RC-RI)175,210,175	GEOMR04
000046	216	RNP=RIP+0.5*DT	GEOMR04
000047		ROP=RIP+DT	GEOMR04
000048	220	VX=1.19159*(ROP*ROP-RIP*RIP)	GEOMR04
000049		RI(1)=RNP	GEOMR04
000050		RI(2)=RIP	GEOMR04
000051		RO(1)=ROP	GEOMR04
000052		RAL(1)=RNP	GEOMR04
000053		ROL(1)=VA	GEOMR05
000054		WRITE(OUTPUT,PENTOUT,2060,N,VX,RNP,RIP	GEOMR05
000055		RIP=RNP	GEOMR05
000056		NO=R0+1	GEOMR05
000057		N=N+1	GEOMR05
000058		IF (-R0)230,230,240	GEOMR05
000059	230	IF (C-RF)210,200,200	GEOMR05
000060	240	DO250 I=1,NX	GEOMR05
000061		DO260 J=1,NX	GEOMR05
000062		DO270 K=1,1X	GEOMR05
000063	250	T(1,I,J,K)=0.	GEOMR06
000064		DR=1.0	GEOMR06
000065		CA=1.0	GEOMR06
000066		X=0.	GEOMR06
000067		DO280 L=1,100	GEOMR06
000068		X=X+DR	GEOMR06
000069		Z=.101250550193+X*(.2031025486+X*(4.557857070+X*(24.02730460	GEOMR06
000070		+X*(37.64615114+X*(15.80553871+X*(1.965032641))))))	GEOMR06
000071		B=.001354582282+X*(.2045502171+X*(4.77189521+X*(28.64849162	GEOMR06
000072		+X*(30.30777370+X*(47.40853418+X*(15.03011027+X*(1.488832521))))	GEOMR06
000073		2)))	GEOMR07
000074		CE=30.47*(1.+X)*EXP(-X)*A/D	GEOMR07
000075		F00(L)=(CE-CA)/DH	GEOMR07
000076		F01(L)=CA-F00(L)*(X-DH)	GEOMR07
000077	260	CA=CB	GEOMR07
000078		CA=1.5707963	GEOMR07
000079		A=0.	GEOMR07
000080		DO 262 L=1,100	GEOMR07
000081		X=X+DR	GEOMR07
000082		A=.240709709E-07+X*(.1467508796E-03+X*(.05736867829+X*(	GEOMR07
000083		12.001301403+X*(24.26269113+X*(41.44135900+X*(12.14837747))))))	GEOMR08
000084		B=.1502008395E-07+X*(.9383589972E-04+X*(.03696900541+X*(	GEOMR08
000085		11.940193072+X*(19.71226041+X*(52.67424655+X*(43.95298186+X*(	GEOMR08
000086		22.693354952))))))	GEOMR08
000087		COMPUTY(1.+X)*EXP(-X)*A/E	GEOMR08
000088		F01(L)=(CE-CB)/DH	GEOMR08
000089		F01(L)=CA-F01(L)*(X-DH)	GEOMR08
000090	262	CA=CB	GEOMR08
000091		CE1A(1)=0.	GEOMR08
000092		CE1A(2)=3.1415926	GEOMR08
000093		CE1A(3)=.15707963	GEOMR09

000094		D0270L=4,21	GEOMR09
000095	270	BETA(L)=BETA(L-1)+BETA(3)	GEOMR09
000096		D0200L=1,21	GEOMR09
000097		D0200L=1,NX	GEOMR09
000098	500	RCA=RN(K)*SIN(BETA(L))	
000099		RCAS=RCA*RCA	GEOMR09
000100		RAI=1	GEOMR09
000101		A=0.	GEOMR09
000102		D0000N=1,NX	GEOMR09
000103		IF(R0(N)-RCA)520,520,530	GEOMR10
000104	520	RAI,=RAI+1	GEOMR10
000105		DX(N)=1.	GEOMR10
000106		GO TO 600	GEOMR10
000107	530	B=SQRT(R0(N)*R0(N)-RCAS)	
000108		DX(N)=B-A	GEOMR10
000109		A=B	GEOMR10
000110	600	CONTINUE	GEOMR10
000111		D0760I=1,IX	GEOMR10
000112		D0620N=NXIN,NX	GEOMR10
000113	620	DL(I)=XTM(N,I)*DX(I)	GEOMR11
000114		IF(RN(K))635,630,635	GEOMR11
000115	630	X=DL(K)	GEOMR11
000116		RH02=DX(K)	GEOMR11
000117		GO TO 636	GEOMR11
000118	635	IF(L-2)625,624,621	GEOMR11
000119	625	RH02=RO(K)-RH(K)	GEOMR11
000120		GO TO 639	GEOMR11
000121	624	RH02=RN(K)-RI(K)	GEOMR11
000122		GO TO 639	GEOMR11
000123	621	IF(L-12)623,622,632	GEOMR12
000124	623	IF(RI(K)-RCA)627,627,626	GEOMR12
000125	626	RH02=DX(K)-SQRT(RN(K)**2-RCAS)+SQRT(RI(K)**2-RCAS)	
000126		GO TO 639	GEOMR12
000127	627	RH02=DX(K)-SQRT(RN(K)**2-RCAS)	
000128		GO TO 639	GEOMR12
000129	622	RH02=DX(K)	GEOMR12
000130		GO TO 639	GEOMR12
000131	632	IF(RCA-RI(K))634,633,633	GEOMR12
000132	633	RH02=SQRT(RN(K)**2-RCAS)	
000133		GO TO 639	GEOMR13
000134	634	RH02=SQRT(RN(K)**2-RCAS)-SQRT(RI(K)**2-RCAS)	
000135	639	X=RH02*XTM(K,I)	GEOMR13
000136	636	LP=1.+X/DH	GEOMR13
000137		IF(LP-100)638,638,637	GEOMR13
000138	637	CA=0.	GEOMR13
000139		GO TO 604	GEOMR13
000140	638	CA=FNA(LP)+X*FNB(LP)	GEOMR13
000141		IF(1.-CA-1.E-6)602,602,604	GEOMR13
000142	604	T(K,K,I)=T(K,K,I)+(1.-CA)/XTM(K,I)	GEOMR13

000143	GO TO 603	GEOMR14
000144	602 T(K,R,I)=T(K,R,I)+1.5707963*RH02	GEOMR14
000145	603 IF(CLT(L)-1.5707963)640,640,660	GEOMR14
000146	640 IF(X=0)650,660,660	GEOMR14
000147	650 R=R+1	GEOMR14
000148	GO TO 700	GEOMR14
000149	660 IF(X=0)690,690,670	GEOMR14
000150	670 R=R-1	GEOMR14
000151	GO TO 700	GEOMR14
000152	680 R=R	GEOMR14
000153	GO TO 700	GEOMR15
000154	690 IF(X=1)650,650,695	GEOMR15
000155	695 R=R+1	GEOMR15
000156	GO TO 700	GEOMR15
000157	700 X=X+L(L)	GEOMR15
000158	IF(X=0)705,705,702	GEOMR15
000159	702 T(L,R,I)=T(L,R,I)+CA/XTM(R,I)	GEOMR15
000160	GO TO 700	GEOMR15
000161	705 LP=L.+X/L	GEOMR15
000162	CG=FNA(LP)+X*FNB(LP)	GEOMR15
000163	IF(CG-C0-1.E-6)703,703,705	GEOMR16
000164	703 T(L,R,I)=T(L,R,I)+(CA-C0)/XTM(L,I)	GEOMR16
000165	CG=C0	GEOMR16
000166	GO TO 704	GEOMR16
000167	704 X1=X-L(L)	GEOMR16
000168	LP=L.+X1/L	GEOMR16
000169	T(L,R,I)=T(L,R,I)+(FNA1(LP)+X1*FNB1(LP))*OY(N)	GEOMR16
000170	CG=C0	GEOMR16
000171	704 IF(L=0)711,720,720	GEOMR16
000172	710 R=R+1	GEOMR16
000173	GO TO 700	GEOMR17
000174	720 IF(L=0)730,730,760	GEOMR17
000175	730 X=X+L(L)	GEOMR17
000176	IF(X=0)735,735,732	GEOMR17
000177	732 T(L,R,I)=T(L,R,I)+CA/XTM(R,I)	GEOMR17
000178	GO TO 700	GEOMR17
000179	735 LP=L.+X/L	GEOMR17
000180	CG=FNA(LP)+X*FNB(LP)	GEOMR17
000181	IF(CG-C0-1.E-6)736,736,738	GEOMR17
000182	738 T(L,R,I)=T(L,R,I)+(CA-C0)/XTM(L,I)	GEOMR17
000183	CG=C0	GEOMR18
000184	GO TO 737	GEOMR18
000185	736 X1=X-L(L)	GEOMR18
000186	LP=L.+X1/L	GEOMR18
000187	T(L,R,I)=T(L,R,I)+(FNA1(LP)+X1*FNB1(LP))*DX(N)	GEOMR18
000188	CG=C0	GEOMR18
000189	737 IF(L=0)740,700,740	GEOMR18
000190	740 R=R-1	GEOMR18
000191	GO TO 700	GEOMR18

000192	760	CONTINUE	GEOMR18
000193		IF(L-2)790,770,790	GEOMR19
000194	770	D0780N=1,NX	GEOMR19
000195		D0780I=1,IX	GEOMR19
000196	780	T(N,K,I)=0.5*T(N,K,I)	GEOMR19
000197	790	CONTINUE	GEOMR19
000198	800	CONTINUE	GEOMR19
000199		D0820I=1,IX	GEOMR19
000200		D0820K=1,NX	GEOMR19
000201		D0820N=K,NX	GEOMR19
000202		T(N,K,I)=T(N,K,I)*0.05	GEOMR19
000203		T(K,N,I)=T(N,K,I)	GEOMR20
000204	820	T(N,K,I)=T(N,K,I)*VOL(K)/VOL(N)	GEOMR20
000205		D0860I=1,IX	GEOMR20
000206		D0860K=1,NX	GEOMR20
000207		G(K,I)=0.	GEOMR20
000208		D0840I=1,NX	GEOMR20
000209	840	G(K,I)=G(K,I)+VOL(N)*XTM(N,I)*T(N,K,I)	GEOMR20
000210	860	G(K,I)=G(K,I)/VOL(K)	GEOMR20
000211		IF(LEAKT)830,830,870	GEOMR20
000212	830	D0880I=1,NX	GEOMR20
000213	850	T(N,K,I)=T(N,K,I)/G(K,I)	GEOMR21
000214	870	NPAGE=NPAGE+1	GEOMR21
000215		WRITEOUTPUTTAPENTOUT,2000,IDENT,NPAGE	GEOMR21
000216		WRITEOUTPUTTAPENTOUT,865,((K,I,G(K,I),K=1,NX),I=1,IX)	GEOMR21
000217	865	FORMAT(11HOK,I,G(K,I)/(7(2I3,F9.5)))	GEOMR21
000218	2000	FORMAT(17HITHERMOS CASE NO.15,6H PAGEI3)	GEOMR21
000219	2010	FORMAT(34HOCYLINDRICAL GEOMETRY - NO LEAKAGE)	GEOMR21
000220	2020	FORMAT(34HOCYLINDRICAL GEOMETRY - LEAKAGE)	GEOMR21
000221	2030	FORMAT(64HOREGION THICKNESS POINT VOLUME R(CENTER)	GEOMR21
000222		1R(10HOK))	GEOMR21
000223	2040	FORMAT(66H -----	GEOMR22
000224		1-----)	GEOMR22
000225	2050	FORMAT(14,1PE18.5)	
000226	2060	FORMAT(125,1PE15.5,1P2E15.5)	
000227		RETURN	GEOMR22
000228		END	GEOMR22

13. LIST GEOR1

EL) GEOR1,1,651009, 41620

```

000001      SUBROUTINE GEOR1
000002      DIMENSION F(30,30),R(30,30),P(30,30,6),VOL(30)      *NEW
000003      1,RAQ(30),BV(30),V(30),MTBL(30),Q(30,30),XTM(30,30),XAM(30,30),IXPT      *NEW
000004      2(S),MTBL(30),ISTBA(30),ISTBE(30),ISTBG(30),CONCTA(30,6)      *NEW
000005      3,CONCTE(30),XAT(30,30),XST(30,30),XATE(30,30),S(30,30),      *NEW
000006      4RI(30),RO(30),RIN(30)      *NEW
000007      COMMON /T/ F, R, P, VOL      ***5
000008      COMMON /KAD/ BV, V, MTBL, Q, XTM
000009      COMMON /XAP/ IXPT, MTBL, ISTBA, ISTBE, ISTBG
000010      COMMON /ISTG/ CONCTA, CONCTE, XAT, XST, XATE
000011      COMMON /S/ IX, IX, IX, IXPCN, ISOX, ISOXE
000012      COMMON /LEAKT/ NPAGE, IDENT, NX, NTIN, NTOUT
000013      COMMON /MTLIS/ NTPUN, NTEMP, IDY, DRX, DELTAU
000014      COMMON /LIFUSE/ ISOXT, HOLID(3,30), KERINT(30), AMAS(30), RI, RO
000015      DIMENSION V1(30),V2(30),V3(30),V4(30),V5(30),CN(30),CN2(30),CP(30)      *NEW
000016      1,CH2(30),U(31)      *NEW
000017      DIMENSION ROUT(30),RIN(30)      *NEW
000018      EQUIVALENCE (ROUT,RO),(RIN,RI)      ***5
000019      DIMENSION REFL(30)
000020      NPAGE=NPAGE+1
000021      WRITE (NTOUT,2000) IDENT, NPAGE
000022      WRITE (NTOUT,5)
000023      5 FORMAT(30H)CYLINDRICAL GEOMETRY, COSINE CURRENTS)
000024      WRITE (NTOUT,2030)
000025      2000 FORMAT(6H)REGION THICKNESS POINT VOLUME R(CENTER)
000026      1R(1,1R))
000027      WRITE (NTOUT,2040)
000028      2040 FORMAT(6H) -----
000029      1-----)
000030      PRCH1
000031      RE1
000032      R1PE0
000033      R1PE0
000034      READ (RTIN,171)NR,RP,TH
000035      171 FORMAT(215,E10.5)
000036      WRITE (NTOUT,2050)NR,TH
000037      2050 FORMAT(14,I16.5)
000038      DT=TH/(FLOAT(RP)-0.5)
000039      RUP=0.1/2.
000040      RC=0
000041      IF (NR-1)175,220,175
000042      175 CALLSTOP(250)
000043      200 READ (RTIN,171)NR,RP,TH
000044      WRITE (NTOUT,2050)NR,TH

```

GEOR0530
GEOR0540

B-36

BNWL-516

000045	DT=10/FLOAT(NP)	
000046	NC=0	
000047	NR=NR0+1	
000048	IF(NR-NR)175,210,175	
000049	210 ROP=RIP+0.5*DT	
000050	ROP=RIP+DT	
000051	220 VX=3.14159*(ROP*ROP-RIP*RIP)	
000052	RN(N)=RNP	
000053	RI(N)=RIP	
000054	RO(N)=ROP	
000055	RAD(N)=RNP	
000056	VOL(N)=VX	
000057	WRITE (NOUT,2060)N,VX,RNP,RIP	
000058	2060 FORMAT(125,1P2E15.5,1P2E13.5)	
000059	RIP=ROP	
000060	NC=NC+1	
000061	N=N+1	
000062	IF(N-NX)230,230,240	
000063	230 IF(NC-NP)210,200,200	
000064	240 IF(LEAKT.EQ.2) GO TO 250	
000065	DO 241 I=1,IX	
000066	241 REFL(I)=FLOAT(LEAKT)	
000067	GO TO 260	
000068	250 REAL(5,251)(REFL(I),I=1,IX)	
000069	251 FORMAT(7E10,5)	
000070	260 CONTINUE	
000071	NX=NX	GEOR0560
000072	DO 400 I=1,IX	GEOR0570
000073	AX=XTM(1,I)*ROUT(1)	GEOR0580
000074	CALL ESCAP(0,AX,PA1,PI)	
000075	DO 100 N=2,IX	GEOR0600
000076	AX=XTM(N,I)*(ROUT(N)-RIN(N))	GEOR0610
000077	A2=RIN(N)/ROUT(N)	GEOR0620
000078	CALL ESCAP(A2,AX,PA,PI)	
000079	AX=0.63662*VOL(N)*XTM(N,I)/RIN(N)	GEOR0640
000080	V1(N)=PI	GEOR0650
000081	V5(N)=1.-AX*PI	GEOR0660
000082	V2(N)=A2*V5(N)	GEOR0670
000083	V3(N)=PA	GEOR0680
000084	100 V4(N)=1.-A2*(1.+AX*(PA-PI))	GEOR0690
000085	CN1=1.-0.63662*VOL(1)*XTM(1,I)*PA1/ROUT(1)	GEOR0700
000086	NN1=NX-1	GEOR0710
000087	NP1=NX+1	GEOR0720
000088	DO 110 N=1,NP1	GEOR0730
000089	110 U(N)=0.0	GEOR0740
000090	DO 300 NG=1,NX	GEOR0750
000091	U(NG)=0.0	GEOR0760
000092	U(NG+1)=VOL(NG)	GEOR0770
000093	CN2(NX)=0.0	GEOR0780

000094	DO 120 K=1,NM1	GEOR0790
000095	L=IX-K	GEOR0800
000096	120 CN2(L)=V1(L+1)*U(L+2)+V2(L+1)*CN2(L+1)	GEOR0810
000097	CP2(1)=PA1*U(2)+CN1*CN2(1)	GEOR0820
000098	DO 130 K=2,IX	GEOR0830
000099	130 CP2(K)=V3(K)*U(N+1)+V4(K)*CN2(K)+V5(K)*CP2(N-1)	GEOR0840
000100	CH(IX)=1.0	GEOR0850
000101	DO 140 K=1,NM1	GEOR0860
000102	L=IX-K	GEOR0870
000103	140 CH(L)=V2(L+1)*CH(L+1)	GEOR0880
000104	CP(1)=CP1*CH(1)	GEOR0890
000105	DO 150 K=2,IX	GEOR0900
000106	150 CP(K)=V4(K)*CH(N)+V5(N)*CP(N-1)	GEOR0910
000107	CP(IX)=CP2(IX)/(1.-REFL(I)*CP(IX))	
000108	CH(IX)=REFL(I)*CP(IX)	
000109	DO 160 K=1,NM1	GEOR0940
000110	CP(K)=CP2(K)+CH(IX)*CP(N)	GEOR0950
000111	160 CH(K)=CN2(K)+CH(IX)*CH(N)	GEOR0960
000112	T(I,K,I)=(U(K)+CH(1)-CP(1))/VOL(1)/XTM(I,I)	GEOR0970
000113	DO 170 K=2,IX	GEOR0980
000114	170 T(I,K,I)=(U(K+1)+CH(N)-CP(N)+CP(N-1)-CH(N-1))/VOL(N)/XTM(I,I)	GEOR0990
000115	300 CONTINUE	GEOR1000
000116	400 CONTINUE	GEOR1010
000117	DO 101 K=1,IX	
000118	DO 102 K=1,IX	
000119	Q(K,I)=0.	
000120	DO 103 K=1,IX	
000121	100 Q(K,I)=Q(K,I)+VOL(N)*XTM(N,I)*T(I,K,I)	
000122	100 Q(K,I)=Q(K,I)/VOL(K)	
000123	100 NPAGE=NPAGE+1	
000124	WRITE(OUTPOTIAPENTOUT,2000,I=1,1) NPAGE	
000125	WRITE(OUTPOTIAPENTOUT,865,((K,I,Q(K,I),K=1,IX),I=1,IX)	
000126	865 FORMAT(21H0K,I,Q(K,I)/(7(2I3,F9.5)))	
000127	2000 FORMAT(17H1THERMOS CASE NO.15,6H PAGE13)	
000128	RETURN	GEOR1020
000129	END	GEOR1030

14. LIST ESCAP

W ELT ESCAP,1,660711, 57624

```

000001      SUBROUTINE ESCAP(VKP,XP,PA,PI)
000002      X=XP
000003      VK=VKP
000004      IF(X)7,2,7
000005      2 G1X=1.0
000006      G0X=.63662
000007      S0X=1.
000008      S1X=G1X
000009      GO TO 21
000010      7 IF(X-1.0)8,8,13
000011      8 XLOG=ALOG(X)
000012      G1X=1.+5*X*(XLOG-.9228)-.1660*X**2+.0177*X**3
000013      G0X=.63662-0.5*X+.10610*X**2*(1.94926-XLOG)+.00265*X**4*(1.89926-
000014      1 XLOG)
000015      S0X=1.-1.33333*X-X**2*((.03243*X**2+.49872)*XLOG-.05505*X**2-.685
000016      142)
000017      S1X=G1X
000018      GO TO 21
000019      13 X3=X+3.0
000020      X4=4.0*X+13.0
000021      G1X=(.5-EXP(-X))*((1.+3.08/X3**2)/X3)/X
000022      G0X=(.5-EXP(-X))*SQRT(2.54647/X4)*(1.+18.75/X4**2))/X
000023      T=1.0/X**2
000024      S0X=(((-.12032*T+.26569)*T-.13533)*T-.19625)*T+1.0)/(X*2.)
000025      S1X=G1X
000026      21 IF(VK)24,22,24
000027      22 BLAM=0.0
000028      GO TO 29
000029      24 IF(VK-1.0)27,25,27
000030      25 BLAM=1.0
000031      GO TO 29
000032      27 ROOT=SQRT(1.0-VK**2)
000033      BLA=((ROOT+ATAN(VK/ROOT)/VK-1.5708*VK)/(1.0-VK))-2.0)*.87567
000034      29 VKNL=3.8+.3/((1.01-VK)*(1.+4.*X))
000035      ALPHA=VK*(VK-BLAM)*EXP(-VKNL*X)
000036      G=(1.0-ALPHA)*G0X+ALPHA*G1X
000037      SAK=1.0-VK
000038      BIGL=PI*BAK*((5.0*X-3.0)/(2.0*X+1.0))
000039      S=((BAK-BIGL)*S0X+VK*S1X)/(1.0-BIGL)
000040      PI=SAK/(1.0+VK)
000041      PA=S-PI
000042      RETURN
000043      END

```

ESCA0030
 ESCA0040
 ESCA0050
 ESCA0060
 ESCA0070
 ESCA0080
 ESCA0090
 ESCA0100
 ESCA0110
 ESCA0120
 ESCA0130
 ESCA0140
 ESCA0150
 ESCA0160
 ESCA0170
 ESCA0180
 ESCA0190
 ESCA0200
 ESCA0210
 ESCA0220
 ESCA0230
 ESCA0240
 ESCA0250
 ESCA0260
 ESCA0270
 ESCA0280
 ESCA0290
 ESCA0300
 ESCA0310
 ESCA0320
 ESCA0330
 ESCA0340
 ESCA0350
 ESCA0360
 ESCA0370
 ESCA0380
 ESCA0390
 ESCA0400
 ESCA0410
 ESCA0420
 ESCA0430
 ESCA0440

15. LIST GEOX1

B-39

BNWL-516

0 EL7 GE0X1,1,661009, 41611

```

000001      SUBROUTINE GE0X1
000002      DIMENSIONT(30,30,30),F(30,30),H(30,30),R(30,30),P(30,30,6),VOL(30)      *NEW
000003      1,XAL(30),DV(30),V(30),MTBL(30),G(30,30),XTM(30,30),XAM(30,30),IXPT      *NEW
000004      2(6),MTBL(30),ISTBA(30),ISTBB(30),ISTBE(30),ISTBG(30),CONCTA(30,6)      *NEW
000005      3,CONCTE(30),XAT(30,30),XST(30,30),XATE(30,30),S(30,30),      *NEW
000006      4RI(30),RO(30)      ***-5
000007      COMMON T      , F      , H      , R      , P      , VOL
000008      COMMON RAD      , DV      , V      , MTBL      , G      , XTM
000009      COMMON XAM      , IXPT      , MTBL      , ISTBA      , ISTBB      , ISTBE
000010      COMMON ISTB      , CONCTA      , CONCTE      , XAT      , XST      , XATE
000011      COMMON S      , IX      , IX      , IXPCM      , ISOX      , ISOXE
000012      COMMON LEANT      , NPAGE      , IDENT      , MX      , NTIN      , NTOUT
000013      COMMON NTIN      , NTFUN      , NTEMP,IBY,NRX,DELTAU
000014      COMMON/LIFUSE/ISOX1,HOLID(3,30),XKERN(30),AVAS(30),RI,RO
000015      DIMENSION V1(30),V2(30),U(31),CH2(30),CP2(30),CN(30),CP(30)      *NEW
000016      DIMENSION REFL(30)      ***-3
000017      25      NPAGE=NPAGE+1
000018      WRITE(OUTPUTTAPENTOUT,30,10ELT,NPAGE
000019      30      FORMAT(17H1)PERF40S CASE NO.15,6N PAGE13)
000020      WRITE (10OUT,5)
000021      5      FORMAT(30H      SLAB GEOMETRY, COSINE CURRENTS)
000022      65      N=1
000023      WRITE(OUTPUTTAPENTOUT,2000
000024      2000      FORMAT(51HREGION THICKNESS POINT VOLUME POSITION)
000025      WRITE(OUTPUTTAPENTOUT,2010
000026      2010      FOR AT(53H -----)
000027      X=0.
000028      DO74M=1,NXA
000029      READ INPUTTAPENTIN,67,NRXA,NP,TH
000030      67      FOR AT(215,210,5)
000031      IF (NRXA=NR)55,69,68
000032      66      CALL STOP(200)
000033      69      WRITE(OUTPUTTAPENTOUT,2020,NRXA,TH
000034      2020      FOR AT(14,1,216,5)
000035      NC=0
000036      GR=TH/FLD(1(NP)
000037      X=X+0.5*NXA
000038      70      VOL(N)=LXA
000039      XAL(N)=X
000040      RO(N)=X+.5*NXA
000041      RI(N)=X-.5*NXA
000042      WRITE(OUTPUTTAPENTOUT,2030,N,DXA,X
000043      2030      FOR AT(125,19E15,5,19E15,5)
000044      IF (N=NX)71,75,75

```

GE0X0530
GE0X0540

B-40

BNWL-516

000045	71	N=N+1	
000046		NC=NC+1	
000047		IF(NC-PP)72,73,73	
000048	72	X=X+CAA	
000049		GO TO 75	
000050	73	X=X+0.5*DXA	
000051	74	CONTINUE	
000052	75	IF(LEART.EQ.2) GO TO 90	
000053		DO 76 I=1,IX	
000054	76	REFL(I)=FLOAT(LEART)	
000055		GO TO 95	
000056	90	READ(5,91)(REFL(I),I=1,IX)	
000057	91	FORMAT(7E10.5)	
000058	95	CONTINUE	
000059		NX=N	
000060		DO 400 I=1,IX	
000061		DO 100 N=1,NX	
000062		Z=ATN(0.1)*VOL(N)	
000063		IF(Z-1.0)1,1,2	
000064	1	V1(N)=0.5+0.25*Z*(ALOG(Z)-0.9228)-0.083*Z*Z+0.00685*Z*Z*Z	
000065		GO TO 100	
000066	2	V1(N)=(0.25-EXP(-Z))*(0.5+1.54/(Z+3.))**2/(Z+3.))/Z	
000067	100	V2(N)=1.-4.*V1(N)*Z	
000068		PA1=V1(1)*(1.+V2(1))	
000069		CN1=V2(1)**2	
000070		NM1=NX-1	
000071		NP1=NX+1	
000072		DO 110 N=1,NP1	
000073	110	U(N)=0.0	
000074		DO 300 NX=1,NX	
000075		U(NX)=0.0	
000076		U(NX+1)=VOL(NX)	
000077		CN2(NX)=0.0	
000078		DO 120 N=1,NM1	
000079		L=NX-N	
000080	120	CN2(L)=V1(L+1)*U(L+2)+V2(L+1)*CN2(L+1)	
000081		CP2(1)=PA1*U(2)+CN1*CN2(1)	
000082		DO 130 N=2,NX	
000083	130	CP2(N)=V1(N)*U(N+1)+V2(N)*CP2(N-1)	
000084		CN(NX)=1.0	
000085		DO 140 N=1,NM1	
000086		L=NX-N	
000087	140	CN(L)=V2(L+1)*CN(L+1)	
000088		CP(1)=CN1*CN(1)	
000089		DO 150 N=2,NX	
000090	150	CP(N)=V2(N)*CP(N-1)	
000091		CP(NX)=CP2(NX)/(1.-REFL(I)*CP(NX))	
000092		CN(NX)=REFL(I)*CP(NX)	
000093		DO 160 N=1,NM1	
			GE0X0560
			GE0X0570
			GE0X0580
			GE0X0590
			GE0X0600
			GE0X0610
			GE0X0620
			GE0X0630
			GE0X0640
			GE0X0650
			GE0X0660
			GE0X0670
			GE0X0680
			GE0X0690
			GE0X0700
			GE0X0710
			GE0X0720
			GE0X0730
			GE0X0740
			GE0X0750
			GE0X0760
			GE0X0770
			GE0X0780
			GE0X0790
			GE0X0800
			GE0X0810
			GE0X0820
			GE0X0830
			GE0X0840
			GE0X0850
			GE0X0860
			GE0X0870
			GE0X0900

000094	CN(I)=CN2(I)+CN(IX)*CP(I)	GEOX0910
000095	180 CN(N)=CN2(N)+CN(IX)*CN(N)	GEOX0920
000096	T(1,N,I)=(C(2)+CN(1)-CP(1))/VOL(1)/XTM(1,I)	GEOX0930
000097	DO 170 J=2,N	GEOX0940
000098	170 T(N,J,I)=(C(N+1)+CN(N)-CP(N)+CP(N-1)-CN(N-1))/VOL(N)/XTM(I,J)	GEOX0950
000099	300 CONTINUE	GEOX0960
000100	400 CONTINUE	GEOX0970
000101	DO110K=1,IX	
000102	DO110J=1,N	
000103	F(J,K)=0.	
000104	DO100I=1,NX	
000105	100 F(J,K)=F(J,K)+ATM(1,K)*VOL(1)*T(I,J,K)	
000106	110 F(J,K)=F(J,K)/VOL(J)	
000107	PPAGE=PPAGE+1	
000108	WRITE(7,POT)/PENTON1,20,IDENT,PPAGE	
000109	WRITE(7,POT)/PENTON1,1120,((J,K,F(J,K),J=1,NX),K=1,IX)	
000110	1120 FOR JI(1180,I,0(K,1)/(7(2I3,P0.5)))	
000111	RETURN	GEOX0980
000112	END	GEOX0990

16. LIST GEOX

ELT GEOX,1,661,09, 41644

Line	Code	Text	Label	Comments
000001		SUBROUTINE GEOX		
000002		DIMENSION ENX(3),DX(30),XT(31)		
000003	C	SLAB TRANSPORT KERNEL		
000004		-THERMOS- HONECK, BNL		
000005		DIMENSION(30,30,30),F(30,30),R(30,30),R(30,30),P(30,30,6),VOL(30)	GEOMX00	
000006		1,RAD(30),DV(30),V(30),MTBL(30),Q(30,30),XTM(30,30),XAM(30,30),IXPT		
000007		2(6),ARTBL(30),ISTBA(30),ISTBB(30),ISTBE(30),ISTBG(30),CONCTA(30,6)		
000008		3,CONCTE(30),XAT(30,30),XST(30,30),XATE(30,30),S(30,30),		
000009		*RI(30),RO(30)		
000010		COMMON T , F , H , R , P , VOL		
000011		COMMON RAD , DV , V , MTBL , Q , XTM		
000012		COMMON XAM , IXPT , ARTBL , ISTBA , ISTBB , ISTBE		
000013		COMMON ISTE6 , CONCTA , CONCTE , XAT , XST , XATE		
000014		COMMON S , IX , NX , IXPCM , ISOX , ISOXE		
000015		COMMON LEAKT , NPAGE , IDENT , NX , NTIN , NTOUT		
000016		COMMON NTLIP , NTPUK , NTEMP,IBY,NRX,DELTAU		
000017		COMMON/DIFUSE/ISOXT,HOLID(3,30),INKERT(30),AMAS(30),RI,RO		
000018		MAX=3	GEOMX01	
000019	15	LIST=LEAKT	GEOMX01	
000020	25	FORMAT(915)	GEOMX01	
000021		NPAGE=NPAGE+1	GEOMX01	
000022	30	WRITEOUTPUTTAPENTOUT,30,IDENT,NPAGE	GEOMX01	
000023		FORMAT(17H1THERMOS CASE NO.15,6H PAGE13)	GEOMX01	
000024	35	IF(LYST)35,45,55	GEOMX01	
000025	40	WRITEOUTPUTTAPENTOUT,40,NRX	GEOMX02	
000026		FORMAT(24H FULL SLAB, REGIONS=13)	GEOMX02	
000027		LEAKT=1	GEOMX02	
000028	45	GO1065	GEOMX02	
000029	50	WRITEOUTPUTTAPENTOUT,50,NRX	GEOMX02	
000030		FORMAT(20H HALF SLAB, REGIONS=13)	GEOMX02	
000031		LEAKT=-1	GEOMX02	
000032	55	GO1065	GEOMX02	
000033	60	WRITEOUTPUTTAPENTOUT,60,NRX	GEOMX02	
000034		FORMAT(20H SLAB CELL, REGIONS=13)	GEOMX02	
000035	65	LEAKT=-1	GEOMX03	
000036		N=1	GEOMX03	
000037		WRITEOUTPUTTAPENTOUT,2000	GEOMX03	
000038		WRITEOUTPUTTAPENTOUT,2010	GEOMX03	
000039		X=0.	GEOMX03	
000040		DO74NR=1,NRX	GEOMX03	
000041	67	REAL INPUTTAPENTIN,67,NRXA,NF,TH	GEOMX03	
000042		FORMAT(215,E10,5)	GEOMX03	
000043	68	IF(NRXA=NR)68,69,68	GEOMX03	
000044	69	CALL STOP(200)		
000045		WRITEOUTPUTTAPENTOUT,2020,NRXA,TH	GEOMX04	

B-43

BNWL-516

000045		NC=0	GEOMX04
000046		DXA=1./FLOAT(NP)	
000047		X=X+0.5*DXA	GEOMX04
000048	70	VOL(I)=DXA	GEOMX04
000049		KAP(I)=X	GEOMX04
000050		KQ(I)=X+.5*DXA	
000051		K1(I)=X-.5*DXA	
000052		XRITEOUTPUTTAPENTOUT,2030,N,DXA,X	GEOMX04
000053		IF(X-X)71,75,75	GEOMX04
000054	71	K=K+1	GEOMX04
000055		KC=K+1	GEOMX04
000056		IF(KC-KF)72,73,73	GEOMX05
000057	72	X=X+DXA	GEOMX05
000058		GO1070	GEOMX05
000059	73	X=X+.5*DXA	GEOMX05
000060	74	CONTINUE	GEOMX05
000061	75	DO1000=1,IX	GEOMX05
000062		DO1000=1,IX	GEOMX05
000063		DO1001=1,IX	GEOMX05
000064	80	T(I,J,K)=0.	GEOMX05
000065		KF1=0	GEOMX05
000066		CALL SLACK(X,X,X,X,KF1)	GEOMX06
000067		KF1=1	GEOMX06
000068		DO1000=1,IX	GEOMX06
000069		DO1001=1,IX	GEOMX06
000070	100	DX(I)=VOL(I)*XTM(I,K)	GEOMX06
000071		XT(I)=0.	GEOMX06
000072		DO1001=1,IX	GEOMX06
000073	110	XT(I+1)=XT(I)+DX(I)	GEOMX06
000074		KLA=2.*XT(I,X+1)	GEOMX06
000075		DO2001=1,IX	GEOMX06
000076		DO2000=1,IX	GEOMX07
000077		DI=X(I)	GEOMX07
000078		DO=X(I)	GEOMX07
000079		DELTA=VOL(I)	GEOMX07
000080		X=XT(I)-XT(I)	GEOMX07
000081		IF(I-J)120,130,120	GEOMX07
000082	120	CALL SLACK(X,DI,DO,A,NFT)	GEOMX07
000083		T(I,J,K)=T(I,J,K)+A	GEOMX07
000084	130	IF(LIST)260,150,140	GEOMX07
000085	140	X=X+ALAN	GEOMX07
000086		IF(X-0.)120,150,150	GEOMX08
000087	150	X=XT(I)+XT(I+1)	GEOMX08
000088	160	CALL SLACK(X,DI,DO,A,NFT)	GEOMX08
000089		T(I,J,K)=T(I,J,K)+A	GEOMX08
000090	170	IF(LIST)250,250,180	GEOMX08
000091	180	X=X+ALAN	GEOMX08
000092		IF(X-0.)180,190,190	GEOMX08
000093	190	X=ALAN-XT(J+1)+XT(I+1)	GEOMX08

000094	200	CALL SLABK(X,BI,DJ,A,NFT)	GEOMX08
000095		T(I,J,K)=T(I,J,K)+A	GEOMX08
000096	210	X=X+ALAM	GEOMX09
000097		IF(X-B.)200,220,220	GEOMX09
000098	220	X=ALAM-XT(J+1)-XT(I)	GEOMX09
000099	230	CALL SLABK(X,BI,DJ,A,NFT)	GEOMX09
000100		T(I,J,K)=T(I,J,K)+A	GEOMX09
000101	240	X=X+ALAM	GEOMX09
000102		IF(X-B.)230,250,250	GEOMX09
000103	250	CONTINUE	GEOMX09
000104	260	CONTINUE	GEOMX09
000105		MAX=3	GEOMX09
000106		DO270I=1,NX	GEOMX10
000107		X=DX(I)	GEOMX10
000108	270	CALLEI(X,MAX,ENX)	GEOMX10
000109		IF(X)277,278,277	GEOMX10
000110	277	T(I,I,K)=T(I,I,K)+VOL(I)*(X-0.5+ENX(3))/(X*X)	GEOMX10
000111		GO TO 270	GEOMX10
000112	278	T(I,I,K)=T(I,I,K)+VOL(I)*ENX(1)/2.	GEOMX10
000113	270	CONTINUE	GEOMX10
000114		DO300 I=1,NX	GEOMX10
000115		DO300 J=1,NX	GEOMX10
000116	300	T(J,I,K)=T(I,J,K)*VOL(I)/VOL(J)	GEOMX11
000117	1000	CONTINUE	GEOMX11
000118		DO1100K=1,IX	GEOMX11
000119		DO1100J=1,NX	GEOMX11
000120		F(J,K)=0.	GEOMX11
000121		DO1100I=1,NX	GEOMX11
000122	1100	F(J,K)=F(J,K)+XTX(I,K)*VOL(I)*T(I,J,K)	GEOMX11
000123	1110	F(J,K)=F(J,K)/VOL(J)	GEOMX11
000124		NPAGE=NPAGE+1	GEOMX11
000125		WRITEOUTPUTTAPENTOUT,30,IDENT,NPAGE	GEOMX11
000126		WRITEOUTPUTTAPENTOUT,1120,((J,K,F(J,K),J=1,NX),K=1,IX)	GEOMX12
000127	1120	FORMAT(11HOK,I,Q(K,I)/(7(2I3,F9.5)))	GEOMX12
000128		IF(LEAKT)1010,1010,1160	GEOMX12
000129	1010	DO1150K=1,IX	GEOMX12
000130		DO1150J=1,NX	GEOMX12
000131		DO1150I=1,NX	GEOMX12
000132	1150	T(I,J,K)=T(I,J,K)/F(J,K)	GEOMX12
000133	1160	CONTINUE	GEOMX12
000134		RETURN	GEOMX12
000135	2000	FORMAT(51HOREGION THICKNESS POINT VOLUME POSITION)	GEOMX12
000136	2010	FORMAT(53H -----)	GEOMX13
000137	2020	FORMAT(14,1PE16.5)	GEOMX13
000138	2030	FORMAT(I25,1PE15.5,1PE13.5)	GEOMX13
000139		END	GEOMX13

17. LIST EI

B-45

BNWL-516

3 EL1 EI,1,660711, 57602

000001		SUBROUTINE EI(X,FX,FX)	EI	00
000002		PI=3.141592653589793	EI	00
000003	5	IF(X)6,6,10	EI	00
000004	6	FX=1	EI	00
000005	10	IF(X)30,30,50	EI	00
000006	30	FX(1)=1.02+30	EI	00
000007		IF(X-1)45,150,35	EI	00
000008	35	FX(1)=2,FX	EI	00
000009		A=FX(1)		
000010	40	FX(1)=1/(A-1.)	EI	00
000011		GO TO 150	EI	01
000012	50	IF(X-75)80,60,60	EI	01
000013	60	FX(1)=1,10	EI	01
000014	70	FX(1)=0.	EI	01
000015		GO TO 150	EI	01
000016	80	A=EXP(-X)		
000017		IF(X-1,0)90,120,120	EI	01
000018	90	B=ALOG(X)		
000019		IF(X-1,001)100,100,110	EI	01
000020	100	FX(1)=X-B-0.577215665	EI	01
000021		GO TO 150	EI	02
000022	110	FX(1)=-.577215665-B+X*(1.+X*(-.25+X*(.055555555+X*(-.010416666+X*E	EI	02
000023		1(.255555555-2+X*(-.23143147E-3+X*(.25344666E-4+X*(-.31001951E-5+X*E	EI	02
000024		2(.3051924E-6)))	EI	02
000025		GO TO 150	EI	02
000026	120	C=.2372905+X*(4.53079235+X*(5.1266902+X))	EI	02
000027		D=2.4716531+X*(8.6660126+X*(6.1265272+X))	EI	02
000028		FX(1)=((A/X)*C)/D	EI	02
000029	130	IF(X-1)150,150,135	EI	02
000030	135	FX(1)=2,FX	EI	02
000031		B=FX(1)-1.		
000032	140	FX(1)=(A-X*FX(1-1))/B	EI	03
000033	150	CONTINUE	EI	03
000034		RETURN	EI	03
000035		END	EI	03

10. LIST SLAPK

B-46

BNWL-516

ELT SLABK,1,676118, 31051

000001		SUBROUTINE SLABK(X,DI,DJ,E,NFT)	SLABK00
000002		DIMENSION T(30,30,30),F(30,30),H(30,30),R(30,30),P(30,30,6),VOL(30)	
000003		1,RAD(30),DV(30),V(30),MTBL(30),Q(30,30),XTM(30,30),XAM(30,30),IXPT	
000004		2(6),NRTBL(30),ISTBA(30),ISTBB(30),ISTBE(30),ISTBG(30),CONCTA(30,6)	
000005		3,CONCTE(30),XAT(30,30),XST(30,30),XATE(30,30),S(30,30)	
000006		COMMON T , F , H , R , P , VOL	
000007		COMMON RAD , DV , V , MTBL , Q , XTM	
000008		COMMON XAM , IXPT , NRTBL , ISTBA , ISTBB , ISTBE	
000009		COMMON ISTBG , CONCTA , CONCTE , XAT , XST , XATE	
000010		COMMON S , IX , NX , IXPCM , ISOX , ISOXE	
000011		COMMON LEAKT , NPAGE , IDENT , MX , NTIN , NTOUT	
000012		COMMON NTLIB , NTPUN , NTEMP,IBY,NRX,DELTAJ	
000013		DIMENSION CA(500),CB(500),CC(500),CD(500),ENX(10)	SLABK00
000014	10	IF(NFT)100,20,100	SLABK01 **-1
000015	20	MAX=3	SLABK01
000016		H=0.01	SLABK01
000017		TH=0.02	SLABK01
000018		THS=2.E-4	SLABK01
000019		XA=0.	SLABK01
000020		FA=0.5	SLABK01
000021		DO30N=1,300	SLABK01
000022		XB=XA+H	SLABK02
000023		XC=XA+TH	SLABK02
000024		CALLE1(XB,MAX,ENX)	SLABK02
000025		FB=ENX(3)	SLABK02
000026		CALLE1(XC,MAX,ENX)	SLABK02
000027		FC=ENX(3)	SLABK02
000028		CA(N)=FA	SLABK02
000029		CB(N)=(4.*(FB-FA)-FC+FA)/TH	SLABK02
000030		CC(N)=(FC+FA-FB-FB)/THS	SLABK02
000031		CD(N)=XA	SLABK02
000032		XA=XC	SLABK03
000033	30	FA=FC	SLABK03
000034		GO TO 250	SLABK03
000035	100	E=0.	SLABK03
000036		IF(DJ)101,102,101	SLABK03
000037	102	IF(DI)105,230,105	SLABK03
000038	105	XP=X-DI	SLABK03
000039		CALLE1(XP,MAX,ENX)	SLABK03
000040		E=ENX(2)	SLABK03
000041		CALLE1(X,MAX,ENX)	SLABK03
000042		E=DELTAJ*(E-ENX(2))/(2.*DI)	SLABK04
000043		GO TO 250	SLABK04
000044	101	IF(DI)103,104,103	SLABK04

B-47

BNWL-516

000045	104	CALLEI(X,MAX,ENX)	SLABK04
000046		E=ENX(2)	SLABK04
000047		XP=X+DJ	SLABK04
000048		CALLEI(XP,MAX,ENX)	SLABK04
000049		E=DELTAJ*(E-ENX(2))/(2.*DJ)	SLABK04
000050		GO TO 250	SLABK04
000051	103	XP=X-DI	SLABK04
000052		N=1.+50.*XP	SLABK05
000053		IF(N)120,120,130	SLABK05
000054	120	N=1	SLABK05
000055	130	IF(N-300)140,140,250	SLABK05
000056	140	E=CA(N)+(XP-CD(N))*(CB(N)+(XP-CD(N))*CC(N))	SLABK05
000057	150	XP=X+DJ	SLABK05
000058		N=1.+50.*XP	SLABK05
000059		IF(N-300)160,160,165	SLABK05
000060	160	E=E+CA(N)+(XP-CD(N))*(CB(N)+(XP-CD(N))*CC(N))	SLABK05
000061		GO TO 170	SLABK05
000062	165	CALLEI(XP,MAX,ENX)	SLABK06
000063		E=E+ENX(3)	SLABK06
000064	170	XP=XP-DI	SLABK06
000065		N=1.+50.*XP	SLABK06
000066		IF(N-300)180,180,185	SLABK06
000067	180	E=E-CA(N)-(XP-CD(N))*(CB(N)+(XP-CD(N))*CC(N))	SLABK06
000068		GO TO 190	SLABK06
000069	185	CALLEI(XP,MAX,ENX)	SLABK06
000070		E=E-ENX(3)	SLABK06
000071	190	N=1.+50.*X	SLABK06
000072		IF(N-300)200,200,210	SLABK07
000073	200	E=E-CA(N)-(X-CD(N))*(CB(N)+(X-CD(N))*CC(N))	SLABK07
000074		GO TO 220	SLABK07
000075	210	CALLEI(X,MAX,ENX)	SLABK07
000076		E=E-ENX(3)	SLABK07
000077	220	IF(L-1.L-6)230,230,240	SLABK07
000078	230	XP=X+0.5*(DJ-DI)	SLABK07
000079		CALLEI(XP,MAX,ENX)	SLABK07
000080		E=ENX(1)*DELTAJ/2.	SLABK07
000081		GO TO 250	SLABK07
000082	240	E=E*DELTAJ/(2.*DI*DJ)	SLABK08
000083	250	RETURN	SLABK08
000084		END	SLABK08

END CUR

APPENDIX C
THE LIBRARY UPDATE
PROGRAM⁽²⁾

APPENDIX C

THE LIBRARY UPDATE PROGRAM⁽²⁾LIBRARY FOR THERMAL ENERGY CALCULATIONS

This section describes the code LITHE (Library for Thermal Energies) used to prepare a cross section library tape for THERMOS calculations in the HAMMER system. The program accepts absorption and fission cross sections as constant, $1/v$, or tabulated. Scattering cross sections and kernels may be either input on binary decks or computed from the Brown-St. John form of the free gas kernel. In this model the cross section is described by

$$\sigma_s(v_r) = \sum_{n=1}^{NTERM} A_n e^{-\kappa_n v_r^2}$$

where v_r is the relative velocity, and A_n , κ_n , and M_n (the mass) are input parameters.

The units used are:

cross sections - barns
velocity - 2200 m/sec
temperature - °K

Structure of the Binary Tape LIB1

The first record on tape LIB1 contains

IX, HOL, V, DV

where IX is the number of velocity groups,

HOL is an 18-character (3 word) tape identification,

V are the velocity points (30 words), and

DV are the velocity increments (30 words).

The second record contains

WA, WB, HOLB, NKERN, VNU, XA, XS, XF, S

where WA is the isotope identification number,
 WB is the temperature and model index,
 HOLB is an 18-character (3 word) isotope identification,
 NKERN is the number of Legendre components of the scattering kernel included (≤ 4),
 VNU is the value of ν (neutrons/fission),
 XA are the absorption cross sections at each velocity (30 words),
 XS are the scattering cross sections at each velocity (30 words),
 XF are the fission cross sections at each velocity (30 words), and
 S are the slowing down sources into each group (30 words).

The next few records contain the Legendre components of the scattering kernel in the form

$$P_{nij} = 4\pi(0.0253)v_i v_j \Delta v_j \int_{-1}^1 d\mu p_n(\mu) \frac{d\sigma(E_i \leftarrow E_j, \mu)}{d\Omega d\epsilon}$$

where $p_n(\mu)$ is the Legendre polynomial.

If NKERN = 0, no kernels are used and no records written.

If NKERN = 1, the isotropic (P_0) component is used and one record written.

If NKERN = 2, the isotropic (P_0) components and P_1 component are used and two records written, etc.

The pattern is repeated from the second record for each isotope. The last record is similar to the second record but $WA \leq 0$ and signals the end of the tape.

LITHE Input Data

<u>Item</u>	<u>Columns</u>	<u>Format</u>	<u>Symbol</u>	<u>Description</u>
1	1-18	3A6	HOL	18-character description of tape
2	1-5	I5	ITAG	=0 make up a new tape ≠0 update existing tape
	6-10	I5	IX	number of velocity groups (≤ 30)
	11-15	I5	NISD	number of isotopes to be deleted from existing tape (≤ 100)
3	---	7E10.5	V(I), I=1,IX	The velocity points in increasing order. Omit if ITAG ≠ 0
4	---	7E10.5	DV(I), I=1,IX	Velocity increments. Omit if ITAG ≠ 0
5	1-10 11-20	E10.0 E10.0	(WAP(L), WBP(L), L=1, NISD)	Identification number and temperature/model index for isotopes to be deleted. One card/isotope. Omit if NISD = 0
6	1-18	3A6	HOLB	18-character description of isotope
	21-30	F10.0	WA	Isotope identification number
	31-40	F10.0	WB	Temperature/model index
	41-45	I5	LXA	=0 $\sigma_a(v) = VXA$ (see item 7) =1 $\sigma_a(v) = VXA/v$ (see item 7) =2 $\sigma_a(v)$ tabulated
	46-50	I5	LXS	=0 $\sigma_s(v) = VXS$ (see item 7) =1 $\sigma_s(v)$ computed from gas model

<u>Item</u>	<u>Columns</u>	<u>Format</u>	<u>Symbol</u>	<u>Description</u>
6				=2 $\sigma_s(v)$ computed from input kernel
	51-55	I5	LXF	=0 $\sigma_f(v) = VXF$ (see item 7) =1 $\sigma_f(v) = VXF/v$ (see item 7) =2 $\sigma_f(v)$ tabulated
	56-60	I5	NKERN	Number of kernels to be put on tape
	61-65	I5	NTERM	Number of terms in BSJ formula
7	1-10	E10.5	VXA	Value of σ_a
	11-20	E10.5	VXS	Value of σ_s
	21-30	E10.5	VXF	Value of σ_f
	31-40	E10.5	VNU	Value of v
	41-50	E10.5	AM	Mass used in source calcu- lation (amu)
	51-60	E10.5	HXS	Cross section used in source calculation (barns)
	61-70	E10.5	TP	Temperature used in source calculation ($^{\circ}K$)
8	---	7E10.5	(XA(I), I=1,IX)	Tabulated values of σ_a (v_i). Omit if LXA $\neq$ 2
9	---	7E10.5	(XF(I), I=1,IX)	Tabulated values of σ_f (v_i). Omit if LXF $\neq$ 2
10	---	7E10.5	T,	Temperature ($^{\circ}K$) used in the kernel calculation
			(ZAMT(N), M_n)	used in the BSJ formula (amu)
			ZAT(N), A_n	used in the BSJ formula (barns)
			ZAKT(N), K_n	used in the BSJ formula N=1, NTERM) Omit if LXS $\neq$ 1

<u>Item</u>	<u>Columns</u>	<u>Format</u>	<u>Symbol</u>	<u>Description</u>
11	---	---		The NKERN binary kernel decks in order P_0 , P_1 , . . . Omit if $LXS \neq 2$
12	---	---		Repeat items 6-11 for each isotope to be added to the library. Follow last isotope with a blank card to signal end of input data.

THERMOS/BATTELLE LIBRARY CONTENTS
 TAPE: HT AUGUST 8,1966

GROUP BOUNDARY DATA

GROUP INDEX =====	BOUNDARY ENERGIES =====	MID-POINT ENERGIES =====	MID-POINT VELOCITIES =====	DELTA VELOCITIES =====
1	5.7000-04	1.4250-04	7.5049-02	1.5009-01
2	1.5800-03	1.0120-03	2.0000-01	9.9800-02
3	3.0999-03	2.2765-03	2.9997-01	1.0014-01
4	5.1199-03	4.0469-03	3.9995-01	9.9815-02
5	7.6500-03	6.3217-03	4.9987-01	1.0003-01
6	1.0690-02	9.1065-03	5.9995-01	1.0014-01
7	1.4230-02	1.2396-02	6.9999-01	9.9939-02
8	1.8280-02	1.6192-02	7.9999-01	1.0005-01
9	2.2830-02	2.0492-02	8.9997-01	9.9909-02
10	2.8000-02	2.5349-02	1.0010-00	1.0208-01
11	3.3460-02	3.0669-02	1.1010-00	9.8006-02
12	3.8530-02	3.5950-02	1.1920-00	8.4055-02
13	4.6110-02	4.2235-02	1.2920-00	1.1594-01
14	5.3189-02	4.9586-02	1.4000-00	9.9939-02
15	6.0780-02	5.6921-02	1.4999-00	1.0000-01
16	6.9720-02	6.5173-02	1.6050-00	1.1008-01
17	8.0160-02	7.4849-02	1.7200-00	1.1995-01
18	9.2299-02	8.6122-02	1.8450-00	1.3003-01
19	1.0632-01	9.9186-02	1.9800-00	1.3994-01
20	1.2190-01	1.1397-01	2.1225-00	1.4506-01
21	1.4091-01	1.3123-01	2.2775-00	1.6495-01
22	1.6451-01	1.5248-01	2.4550-00	1.8998-01
23	1.9412-01	1.7901-01	2.6599-00	2.2003-01
24	2.3151-01	2.1241-01	2.8975-00	2.5499-01
25	2.7887-01	2.5464-01	3.1725-00	2.9503-01
26	3.3891-01	3.0816-01	3.4900-00	3.3998-01
27	4.1498-01	3.7598-01	3.8550-00	3.8998-01
28	5.1118-01	4.6182-01	4.2725-00	4.4498-01
29	6.3250-01	5.7022-01	4.7474-00	5.0502-01
30	7.8493-01	7.0666-01	5.2850-00	5.7000-01

C-6

BNWL-516

THERMOS/BATTELLE LIBRARY CONTENTS
TAPE: HT AUGUST 8, 1966

I	S	F	I	S	I	T	X	A	M	S	2	S	2	H	S	K	N	E	I	S	F	N	L	
O	I	D	E	D	Y	-	T	A	I	2	I	2	G	A	E	C	U	R	N	O	F	N	A	B
T	R	E	C	E	P	S	O	S	G	O	G	O	H	T	R	O	M	N	F	U	O	O	T	R
O	S	N	O	N	E	E	M	S	.	O	.	O	E	E	E	E	F	L	.	C	T	E	E	A
P	T	T	N	I	C	I							E	E	E	E	F	L	.	C	T	E	E	A
E	.		U	.	.	C	A	M	F	M	N	R	L	R	S	E								Y
===	===	===	===	===	===	===	===	===	===	===	===	===	===	===	===	===	===	===	===	===	===	===	===	===
H	1	1001	1029	1/V	1.		0.332	0.		20.4	GAKER	4	BNL325										08/03/66	
D	2	1002	1029	1/V	2.		5.-4	0.		3.35	GAKER	4	BNL325										08/03/66	
LI	6	3006	1029	TAB	6.		944.0	0.		1.4	BSJ	1	BNWLIR										08/03/66	
LI	7	3007	1029	TAB	7.		0.033	0.		1.4	BSJ	1	BNWLIR										08/03/66	
BE	9	4009	1029	TAB	9.		1.-3	0.		6.	BSJ	1	BNWLIR										08/03/66	
B	10	5010	1029	TAB	10.		4.02+3	0.		4.	BSJ	1	BNWLIR										08/03/66	
B	NAI	5111	1029	1/V	10.81		755.	0.		4.	BSJ	1	BNL325										08/03/66	
C	12	6012	1029	1/V	12.		3.4-3	0.		4.8	PARKS	1	BNL325										08/03/66	
N	14	7014	1029	1/V	14.		1.85	0.		10.5	BSJ	1	BNL325										08/03/66	
O	16	8000	1029	1/V	16.		1.8-4	0.		3.76	BSJ	1	BNL325										08/03/66	
AL	27	13000	1029	1/V	27.0		0.235	0.		1.4	BSJ	1	BNL325										08/03/66	
CR		24000	1029	TAB	52.		3.1	0.		4.	BSJ	1	BNWLIR										08/03/66	
SS	304	304	1029	1/V	55.4		2.87	0.		11.2	BSJ	1	THERMO										08/03/66	
FE	56	26000	1029	TAB	56.		2.7	0.		11.2	BSJ	1	BNWLIR										08/03/66	
NI		28000	1029	TAB	58.71		4.25	0.		17.2	BSJ	1	BNWLIR										08/03/66	
CU	63	29063	1029	TAB	0.		4.5	0.		0.		0	BNWLIR										08/03/66	
CU	65	29065	1029	TAB	0.		3.67	0.		0.		0	BNWLIR										08/03/66	
ZR		40000	1029	TAB	91.22		0.18	0.		6.1	BSJ	1	BNWLIR										08/03/66	
CD		48000	1029	TAB	112.4		2512.0	0.		6.9	BSJ	1	BNWLIR										08/03/66	
IN	115	49115	1029	TAB	0.		190.8	0.		0.		0	BNWLIR										08/03/66	
XE	135	54135	1029	TAB	0.		2.5+6	0.		0.		0	BNWLIR										08/03/66	
SM	149	62149	1029	TAB	0.		4.08+4	0.		0.		0	BNWLIR										08/03/66	
EU		63000	1029	TAB	0.		4500.	0.		0.		0	BNL325										08/03/66	
GU		64000	1029	TAB	0.		4.6+3	0.		0.		0	BNL325										08/03/66	
UY	164	66164	1029	TAB	0.		2.8+3	0.		0.		0	BNWLIR										08/03/66	
LU	175	71175	1029	TAB	0.		12.4	0.		0.		0	BNWLIR										08/03/66	
LU	176	71176	1029	TAB	0.		2077.0	0.		0.		0	BNWLIR										08/03/66	
HF		72000	1029	TAB	0.		105.0	0.		0.		0	GA										08/03/66	
AU		79000	1029	TAB	0.		98.7	0.		0.		0	BNWLIR										08/03/66	
TH	232	90232	1029	TAB	232.		759.3	0.		12.0	BSJ	1	BNWLIR										08/03/66	
PA	233	91233	1029	TAB	233.		43.9	0.		12.5	BSJ	1	BNWLIR										08/03/66	

THERMOS/BATTELLE LIBRARY CONTENTS
TAPE: HT AUGUST 8, 1966

I	S	F I	S I	T X	A M	S 2	S 2	H S	K	K	I S	L
O	I D	E D	Y -	T A	I 2	I 2	G A	E C	U R	N O	F N	A B
T	R E	C E	P S	O S	G 0	G 0	H T	R O	M N	F U	O O	T R
U	S N	O N	E E	M S	. 0	. 0	T	N D	R E	O R	O T	E A
P	T I	N T	C I				E E	E E	E L	. C	T E	R
E	.	D .	.	C	A M	F M	N R	L	R S	E		Y
===	===	===	===	===	===	===	===	===	===	===	===	===
U 235	92233	11029	TAB	233.	575.0	526.0	12.4	BSJ	1	BNWLIP *	08/03/66	
U 235	92233	21029	TAB	233.	576.1	527.5	12.4	BSJ	1	BNWLIP **	08/03/66	
U 235	92233	41029	TAB	233.	573.1	524.5	12.4	BSJ	1	BNWLIP ***	08/03/66	
U 235	92233	31029	TAB	233.	576.3	527.7	12.4	BSJ	1	BNWLIP ****	08/03/66	
U 234	92234	11029	TAB	234.	95.0	0.	7.3	BSJ	1	BNWLIP *	08/03/66	
U 235	92235	11029	TAB	235.	678.0	579.0		BSJ	1	BNWLIP *	08/03/66	
U 235	92235	21029	TAB	235.	682.0	582.2	7.3	BSJ	1	BNWLIP **	08/03/66	
U 235	92235	41029	TAB	235.	678.2	577.1	7.3	BSJ	1	BNWLIP ***	08/03/66	
U 235	92235	31029	TAB	235.	679.9	579.5	7.3	BSJ	1	BNWLIP ****	08/03/66	
U 236	92236	11029	TAB	236.	6.0	0.	7.3	BSJ	1	BNWLIP *	08/03/66	
U 236	92236	11029	TAB	238.	2.72	0.	7.3	BSJ	1	BNWLIP *	08/03/66	
PU239	94239	11029	TAB	239.	1008.0	754.0	7.3	BSJ	1	BNWLIP *	08/03/66	
PU239	94239	21029	TAB	239.	1030.1	748.2	7.3	BSJ	1	BNWLIP **	08/03/66	
PU239	94239	41029	TAB	239.	1014.5	740.6	7.3	BSJ	1	BNWLIP ***	08/03/66	
PU239	94239	31029	TAB	239.	1008.0	742.0	7.3	BSJ	1	BNWLIP ****	08/03/66	
PU240	94240	11029	TAB	240.	282.0	0.048	7.3	BSJ	1	BNWLIP *	08/03/66	
PU241	94241	11029	TAB	241.	1370.0	1030.	7.3	BSJ	1	BNWLIP *	08/03/66	
PU241	94241	31029	TAB	241.	1391.0	1009.	7.3	BSJ	1	BNWLIP ****	08/03/66	
PU242	94242	11029	TAB	242.	19.2	0.2	7.3	BSJ	1	BNWLIP *	08/03/66	
UNIT 1	1	1029	1/V	0.	1.	0.	0.		0	HAMMER	08/03/66	
UNIT 2	2	1029	1/V	0.	0.	0.	1.	BSJ	1	HAMMER	08/03/66	
UNIT 3	3	1029	1/V	0.	70.	0.	0.		0	HAMMER	08/03/66	
UNIT 4	4	1029	CON	0.	1.	0.	0.		0	HAMMER	08/03/66	

----- FOOTNOTE -----
* LEONARD DATA
** SHER DATA
*** SHER 65 DATA
**** WESCOTT DATA

DISTRIBUTIONNumber
of Copies

1	<u>AEC Division of Technical Information Extension</u>
3	<u>AEC Library, Washington</u> Reactor Physics Branch, DRDT I. F. Zartman (2) Water Reactor Products D. Erb
3	<u>AEC, RDT Site Representative - PNL</u> W. E. Fry P. G. Holsted (2)
5	<u>AEC Richland Operations Office</u> H. A. House C. R. Qualheim C. L. Robinson R. K. Sharp Technical Information Library
7	<u>Douglas United Nuclear</u> E. E. Mills W. S. Nechodom G. F. Owsley Hans Toffer F. Bouse (3)
1	<u>Isochem</u> R. D. Carter
1	<u>University of Washington</u> Department of Nuclear Engineering A. L. Babb

Number
of Copies

99

Battelle-Northwest

S. J. Altschuler	W. W. Little, Jr.
J. L. Baker	R. C. Lloyd
C. L. Bennett	L. L. Maas
R. A. Bennett	C. A. Mansius
S. R. Bierman	D. R. Marr
C. L. Brown	R. P. Matsen
W. L. Bunch	D. D. Matsumoto
G. J. Busselman	E. T. Merrill
J. L. Carter	D. F. Newman
D. E. Christensen	T. J. Oakes
R. G. Clark	L. J. Page (10)
E. D. Clayton	W. W. Porath
G. M. Dalen	W. L. Purcell
E. C. Davis, Jr.	W. C. Roberts
F. G. Dawson	R. E. Schenter
D. E. Deonigi	L. C. Schmid
B. H. Duane	J. R. Sheff
S. L. Engstrom	D. R. Skeen (10)
D. G. Foster	R. I. Smith
H. A. Fowler	W. P. Stinson
H. C. Fox	D. H. Thomsen
A. G. Gibbs	V. O. Uotinen
D. W. Glasgow	A. D. Vaughn
C. E. Haines	A. E. Waltar
L. E. Hansen	L. D. Williams
G. E. Hanson	J. R. Worden
R. W. Hardie	W. R. Young
O. K. Harling	H. S. Zwibel
R. A. Harris	Technical Information
C. M. Heeb	Files (5)
R. E. Heineman	Technical Publications (2)
H. L. Henry	
G. M. Hess III	
N. A. Hill	
P. L. Hofmann	
R. H. Holeman	
J. G. Holt	
U. P. Jenquin	
G. J. Konzek	
D. A. Kottwitz	
J. W. Kutcher	
D. D. Lanning	
J. H. Lauby	
R. C. Liikala	
D. L. Lessor	
C. W. Lindenmeier	